— INCORPORATING —
"SOUND AND CINE"

tape recorder

JULY 1964 Vol. 6 No. 6 Price 2 /-

■ 147 WAYS OF RECORDING SHEEP ■ ORGAN RECORDING
■ STUDIO MIXER ■ SOUND ANALYSIS ■ PRINT-THROUGH

WORLD RECORD CLUB OFFERS YOU THE CHOICE OF

ANY 3 PRE-RECORDED TAPES

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

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

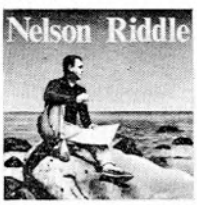
59 The silken voice of Nat King Cole in Walkin', Because You're Mine, You'll Never Grow Old, Baby Won't You Say You Love Me and 8 more.

30 Ian Carmichael, Joyce Blair, star cast and orchestra. As Long As He Needs Me, Consider Yourself, all the hit numbers from Lionel Bart's great show.
Also in stereo.

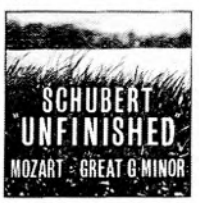
49 Beethoven Fidelio Overture, Brahms St. Anthony variations, Mendelssohn Hebrides Overture, Wagner Siegfried Idyll. Superb interpretations.
Also in stereo.

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

61 The world's 3 greatest sonatas — Beethoven's Moonlight, Pathetique and Appassionata—superbly played by famous TV pianist Joseph Cooper.



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



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

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

48 Deep in My Heart, Drinking Song, Serenade - all the old favourites fresher than ever with Marion Grimaldi, Linden Singers and Orchestra.
Also in stereo.

53 Bizet's thrilling music magnificently performed by Sinfonia of London under Muir Mathieson. **Also in stereo.**

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

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

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

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

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

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

40 Bruna Rizzoli and Giuseppe Savio with the chorus of the Teatro Nuovo di Milano and orchestra conducted by Napoleone Annovazzi.

52 Gracie Fields sings her favourite songs for you, including In My Little Bottom Drawer, Sally, Song of the Mountain and ten others.

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

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

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

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

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

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

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

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

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

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

FOR ONLY 30/-

THE GREATEST BREAKTHROUGH SINCE TAPE RECORDING!

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

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

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

WORLD RECORD CLUB 7-POINT PLAN MEANS BETTER LISTENING FOR YOU!

1. AN UNPARALLELED INTRODUCTORY OFFER.

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

2. THE OPPORTUNITY TO BUILD A UNIQUE TAPE COLLECTION.

The WRC plan offers you an exciting and varied annual repertoire of more than 70 selected tape releases, covering classics, jazz, shows, ballet music, light music and 'pops'. Every one is a superlatively recorded 3¾ ips mono tape (or 12" LP—mono *and* stereo). Tapes are offered to you at the privilege club price of 29/- (plus a small charge for post and packing)—much less than you would pay elsewhere for recordings of anything like this quality.

Your only obligation, as a Club member, is to agree to buy four more tapes (or 12" LPs) during your year of membership. Beyond this, there is no subscription or membership fee.

3. A PLANNED PROGRAMME.

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

4. NEW CLUB MAGAZINE.

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

5. SPECIAL CONCERT PRICE CONCESSIONS.

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

6. FREE BONUS TAPES.

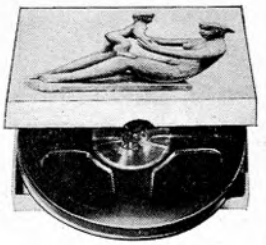
The more you buy, the more you save! After fulfilling the minimum membership obligations, you earn *another* tape of your own choice free for every extra three you buy!

7. EXCLUSIVE EXTRA RELEASES.

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

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

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



. . . AND IF YOU OWN A STEREO TAPE RECORDER

hear the fantastic reproduction of

STEREO 21

THE NEWEST, TRUEST SOUND ON TAPE TODAY!

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

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

7-DAY FREE TRIAL OFFER—*POST TODAY!* STEREO 21 *FREE BROCHURE*

To:
THE WORLD RECORD CLUB Ltd. (Dept. TRR4)
Box 11 PARKBRIDGE HOUSE, RICHMOND, SURREY.

SEND NO MONEY NOW

3¾ ips pre-recorded tapes		12" LPs	

Tick what you want

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

Signed.....

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

MY 3-SELECTION 'PACKAGE' COMPRISES

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

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

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

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

ADDRESS.....

.....

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To:
THE WORLD RECORD CLUB Ltd. (Dept. TRR4)
Box 11 PARKBRIDGE HOUSE, RICHMOND, SURREY.

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

NAME.....
(BLOCK CAPITALS PLEASE)

ADDRESS.....

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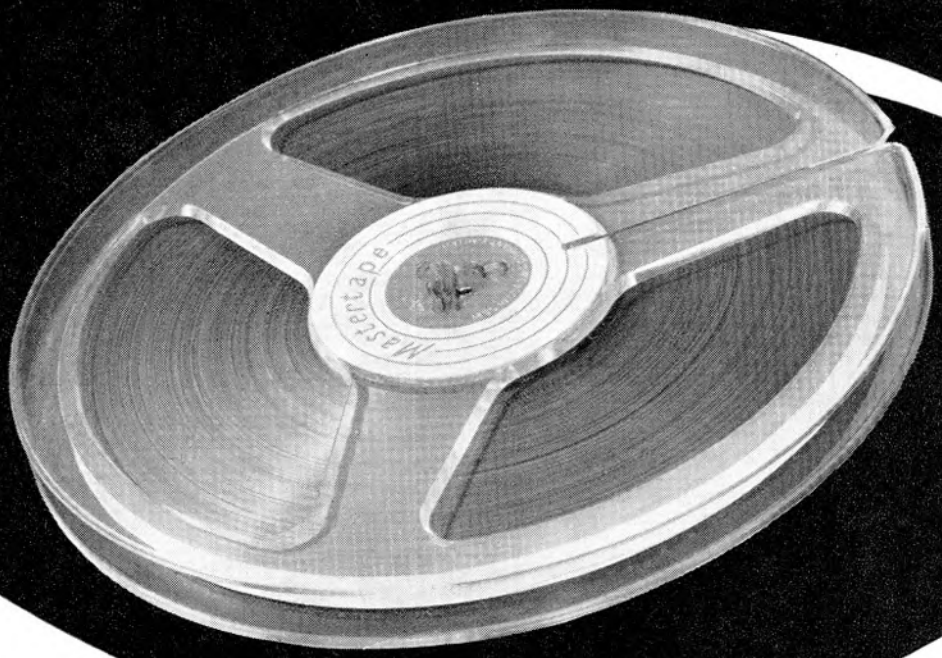
*** Elizabethan, Fidelity, Wyndsor and other famous makers fit MASTERTAPE!**



MASTERTAPE

Nationally distributed by Vidor and available now at your local radio shop.

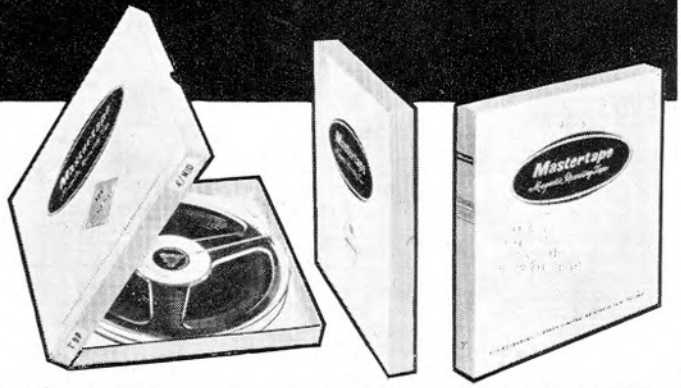
. . . . there is a Mastertape to suit your requirements. Just compare these prices for the most popular sizes: 5¾" 900 ft. Standard Play (P.V.C.) 20/-; 5¾" 1200 ft. Long Play (P.V.C.) 25/-; 7" 2400 ft. Double Play (Polyester) 55/- and our 10 minute Mini-Voice Letter at 2/8d. — the best quality and value in high grade recording tape!

** Always have a spare reel for that unexpected recording session!*

Manufactured in England by

M.S.S. RECORDING CO. LTD. Colnbrook, Slough, Bucks.

Tel: Colnbrook 2431 (8 lines)



tape recorder

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JULY 1964 · VOLUME 6 · NUMBER 6

CONTENTS

EDITORIAL

VARIOUS estimates have been made during the last few years of the number of tape recorders sold in this country, and the figure is usually between one and two million. Even if we allow for the many thousands of models which have broken down beyond repair, or have been put in the loft and forgotten, dropped in the garden pond by well-meaning children, or used as spin-driers, the total either in use or capable of being used must be very large.

Accordingly, the types of people who own recorders must be very diverse, ranging from the knowledgeable technical enthusiast to the man who dares to perform the simplest of operations only after reading the instruction manual a dozen times, and from the music lover who records the local operatic society in stereo to the unassuming type who places the microphone on the dining room table at a children's party. Differences of wealth must also play a big part, as one can easily spend below £20 or over £200 on domestic equipment, and manufacturers report sales at both ends of the scale.

Inevitably, a large proportion of recorder owners never get seriously engrossed in tape recording as a hobby—which is a great pity because, as readers of this magazine know, it can be a fascinating and rewarding business. However, judging by our postbag, those who *do* become involved still tend to be fairly representative of the wide range of types we have mentioned. This being so, it should be possible to get a much higher percentage of the one or two million actively interested in the hobby by doing a little propaganda work at all levels of activity.

If every reader of the *Tape Recorder* could find a friend or acquaintance who owns—but does not use—a recorder, and could persuade him by example and enthusiasm to join the fray (and perhaps become a *Tape Recorder* reader !), and if each convert in turn did likewise, we could start a snowball rolling which would set those one or two million machines on the move—lofts might be opened and ponds drained.

Tape recording, though built on a technical base, is essentially a *creative* activity, and recently we were delighted to hear the efforts of two keen young lads, still at school, who had recorded a number of satirical 'shows' for the amusement of their family and friends. Each tape comprised a series of short sketches based on topical news items, some spoken, some sung with a piano thumping away in the background. In one episode we were supposedly transported (by radio commentator) to some remote spot in the Pacific where a new spacecraft was about to be launched ; the recorded voice had exactly that distorted, fading and dimly understood quality which sometimes occurs on the short-waves during international news coverage.

Fascinated by the realism, we enquired as to the technique employed. "Oh, it's quite simple," said one of the boys, "you simply take a cheap transistorised Japanese recorder, grossly overload it by shouting at the microphone with full volume, then replay it with the lid closed—turning the volume up and down for the fading effect".

These two lads had no special technical knowledge, just intelligence and a good sense of fun. The results were uproariously funny and provided a worthwhile evening's entertainment. In many homes this is the sort of thing that tape recording could mean—creating fun, interest or pleasure with simple materials or just plain voices.

The technical enthusiasts must not be forgotten, of course, for they provide the fundamental advances on which our hobby depends. We have always made a special effort in this magazine to cater for these readers, and we shall continue to do so, but although some say we are too technical and others that we are not technical enough, we try to cover both wings (and the middle) as fully as space permits.

As the months go by we hope to give a little more space to the creative side of tape recording while keeping our technical base secure, so readers with ideas please let us hear what you are doing in letters and articles to help us make *our* contribution to the expansion of tape recording into the major national hobby which it deserves to be. In this issue we have four articles which could be classified as technical, two as semi-technical, one of general interest (on organ recording), and one humorous piece ; in addition there are tape record reviews and other regular features. The omission of an equipment review does not indicate any change of policy—it comes about as a result of a slight piece of mis-timing in connection with our changed publishing arrangements—Mr. Tutchings will be back in action next month.

SUBSCRIPTION RATES

Annual subscription rate to the *Tape Recorder* and *Hi-Fi News* is 30s. in the U.K. and 32s. 6d. overseas (U.S.A. $4.50) from Link House Publications Ltd., Dingwall Avenue, Croydon, Surrey. This includes a free copy of the annual index.

COVER PICTURE

WE do not know which of the two characters shown on this month's cover is asking the questions, but the recorder being used is an *EL*3300, latest transistorised battery-operated addition to the Philips range. Details of the new machine are given on page 247.

N.B. Observant readers will have noticed that the Grundig machine on last month's cover was a TK46, not a TK6 as stated—it is rather difficult to record in stereo on a mono battery portable ! Apologies to Grundig and misled readers.

Here's something really NEW in tape recording:

CARTRIDGE LOADING

—exclusive feature of the brilliant new

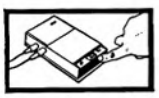
PHILIPS BATTERY POCKET TAPE RECORDER

EL3300

Just check these revolutionary features:

The easiest tape system in the world—cartridge loading.

Forget about troublesome spools and tape threading—simply clip in the one-piece cartridge for instant use—get 30 minutes recording per side.



The simplest operation—controlled by one push-button.

Single control gives playback, record (with interlocking safety button), fast wind and fast re-wind. No drain on batteries except when recorder is actually operating.

The most versatile microphone—use it any one of three ways.

Sensitive, omni-directional "stick" type microphone can be held in hand, clipped in pocket or stood on plastic stand.

The most useful extra control—remote stop-start.

Remote control switch on microphone starts and stops recorder—detaches from microphone for separate use.

Battery operation for instant use—anywhere, any time.

Five small batteries last about 20 hours. Indicator needle shows recording modulation level and battery strength.

Real Leather carrying case—always ready for action.

Carrying case gives easy access to recorder controls. Tape is visible through special window. Case has space for accessory stowage.

The first really new tape recorder for years

25 gns COMPLETE

ANOTHER BRILLIANT DEVELOPMENT BY PHILIPS – the friend of the family

(PTR001 4B)

WORLD OF TAPE

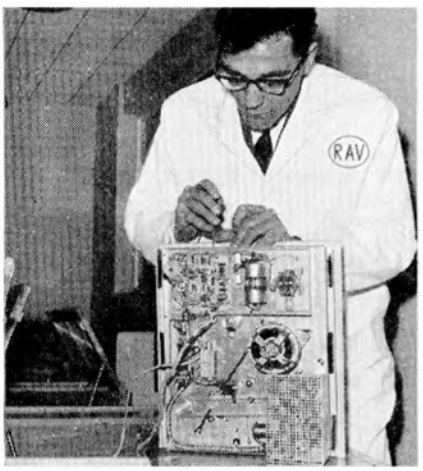
Vidor to Distribute MSS Tape

RETAIL distribution of MSS Tape is now to be handled by Vidor Ltd., of Erith, Kent. Deliveries will take place on a weekly basis using a nation-wide network of vans. The new arrangement is said to have many advantages over normal delivery methods which are unsuited to the supplying of certain products, including recording equipment.

* * *

Two More Laboratories

CAPABLE of seating twelve students, a *Rank Audio Visual* Language Laboratory has been supplied to the RAF Higher Education Centre at Butzweilerhof, West Germany. Installation was completed in May, at a total cost of nearly £2,000.



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A Truvox tape deck, back-bone of the Rank laboratory, in preparation for installing into a student booth.

*

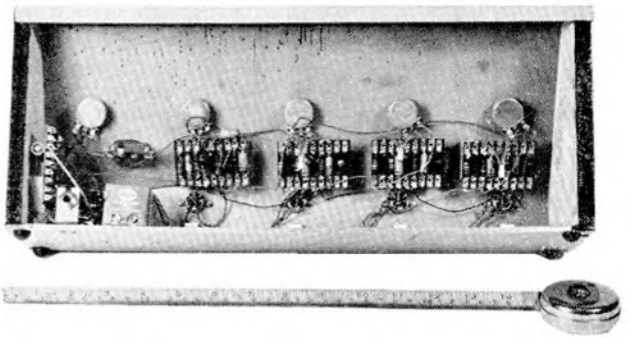
The first Rank laboratory to be installed in this country was recently completed for the City of Westminster College of Commerce, Francis Street, London, S.W.1. **Manufacturer : Rank Audio Visual, Woodger Road, Shepherds Bush, London, W.12.**

* * *

The Maidstone Mixer

LIKE most tape recording organisations, the Maidstone Society forgather fortnightly throughout the year. When it came to using several recorders and microphones in a concerted effort they felt considerably handicapped where many recording activities were involved. The cause of their inhibition seemed to be the lack of mixing facilities. A technical member acted as guide in a project that led to the construction of a five-channel transistorised mixer for microphone and high level signals. Using unit construction, the mixer was put together by different members and finally assembled in a cabinet.

Equipped with three low level medium impedance and two high impedance (high and low level) inputs, the pre-amplifiers were designed around MAT 120 transistors. The three low impedance channels were fed into a common-emitter amplifier stage having a small percentage of negative-feedback and passing on to a variable-resistor. The controls for each input were connected in parallel and fed to the output amplifier stage. This stage employed a common-emitter amplifier with negative-feedback from a small resistor in the emitter lead. The high impedance channel (low level) comprised two directly coupled transistors in a 'bootstrap' arrangement giving 3 Meg. input impedance. For the high impedance high level (1V) channel a simple gain control and series blocking resistor in the slider lead feed a suitable input current to the output stage. An input of 1V in this channel gives a maximum of 1.2V out from the final amplifier. The three low impedance channels have a sensitivity of approximately 2.5mV for a 1V output and overloading occurs when the output reaches 2V, but this is not likely to happen in normal use.



The cabinet is of *Stelvetite*, a plastic-faced steel, with wooden ends. 1¼in. knobs with dials numbered from 0 to 10 are used on the gain controls. Input and output connections are through standard jack and DIN sockets.

The club plan to write-up the technical and constructional specifications of their mixer, giving complete details of materials and parts required. These particulars, complete with photographs, will be available from the **Hon. Secretary, Maidstone Tape Recording Society, 504 Loose Road, Maidstone, Kent.**

* * *

Larger Reels for Electronic World

IN order to promote the latest addition to their range of tape, free sample lengths of triple play are being offered by the distributors of Electronic World. The offer is valid until the end of August.

All Electronic World tapes can now be purchased on 8½ and 10½ reels. The latter size provides double the capacity of a 7in. spool. **Distributor : De-Villiers (Electronic World) Ltd., 16/20 Strutton Ground, London, S.W.1.**

* * *

Tape at the Brentford Institute

BEGINNING on September 23rd, a series of weekly lectures is to be given by K. Short (Recording Devices Ltd.). Enrolment can be made by post to the Head of Evening Institutes, Education Department, Town Hall, Chiswick, London, W.4, or by personal application between 14 to 17 September. Classes take place on Wednesday evenings from 7 to 9 p.m. The fee is £1.

* * *

WE wish to point out an error in the price given for the Global Products tape record "Sound Effects No. 2". This was stated, in its announcement (January 1964) and review (May 1964), as £1 2s. 8d. The correct price is £1 12s. 8d.

NEXT MONTH

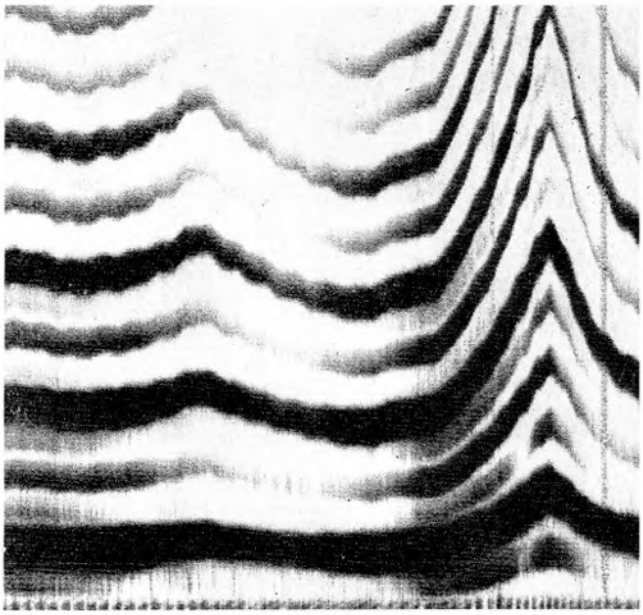
THE August issue of the *Tape Recorder* will be on sale Friday, July 31st, and will carry the first of a short series of articles by S. Welldon giving details of fully transistorised record and replay circuits for use with several popular decks. The third instalment of the Robinson Studio Mixer and Part 5 of Gordon King's "Better Taping" will be featured, together with all the regular items.

SOUND analysis

By C. N. G. MATTHEWS

ANY characteristic sound is a single fundamental frequency upon which are superimposed the harmonics that give the sound its character. That is a simple enough statement, but suppose we want to study the frequency make-up of a few simple words or a bar of music. That is not so easy. A single sustained note or chord could be analysed by any one of a dozen means, but speech or music do not usually occur in this form. A photograph, taken at the right moment, of an oscilloscope trace produces an interesting pattern, but it is difficult to interpret. Of course, adaptations of film sound-track apparatus give perfect results, but the process is complicated and expensive. Yet the quick and convenient analysis of a sound is one of the most useful things in the world. For instance, what better dynamic test of a tape recorder than to compare, with absolute accuracy, its sound output with that produced by a standard tape on a standard machine? Equipment to do this in a few minutes could save hours of testing time in a factory, to say nothing of its usefulness in speech and similar studies.

The Americans have gone a long way towards solving this problem by inventing the *Sonagraph*. This machine, which is really a tape recorder with a difference, is so simple that even I can use it. **Fig. 1** (below), produced in just five minutes, is an analysis of me saying "A sonograph". The range is from 85 c/s to 8 Kc/s, the lower frequency being at the bottom of the paper and the darkness of the marking being an indication of sound energy. The figure below shows



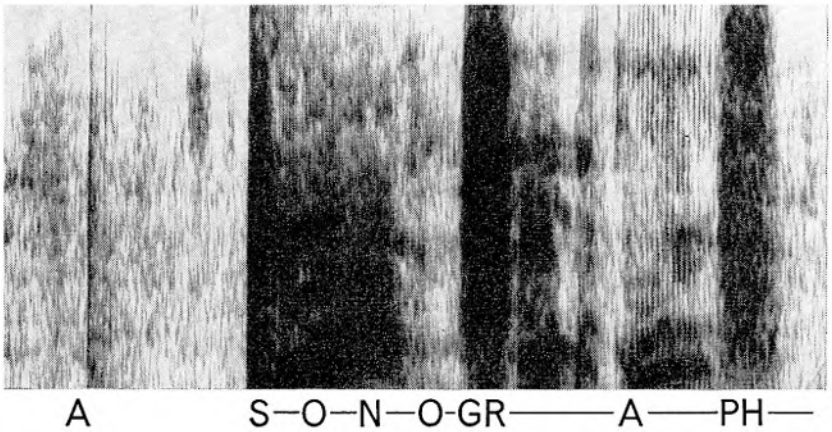
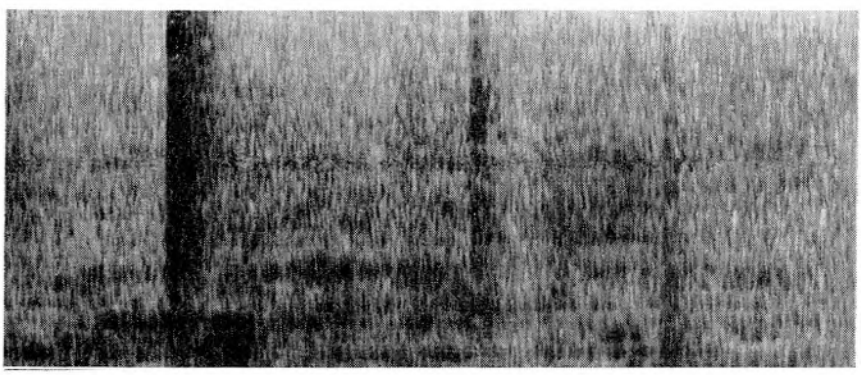
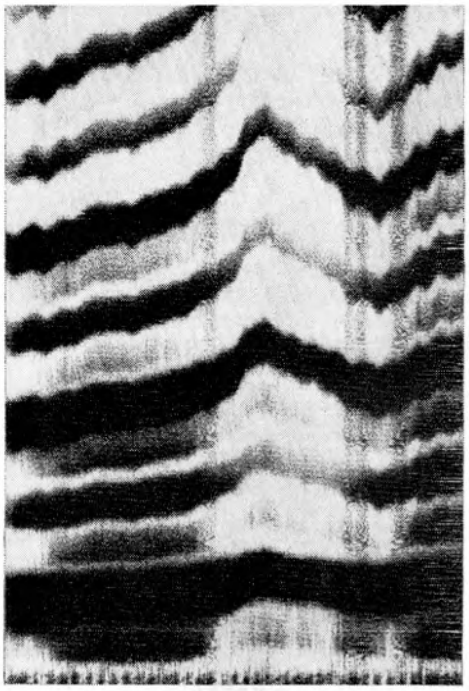


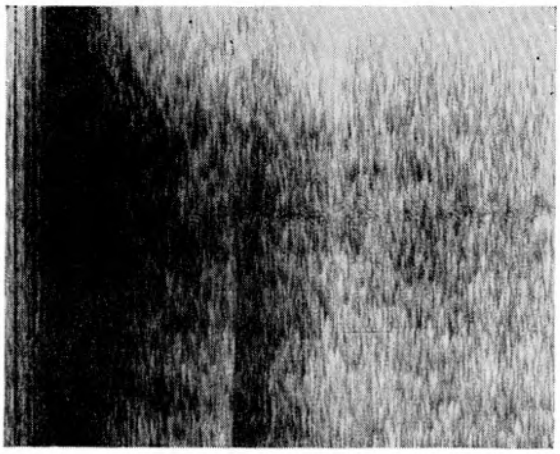
Fig. 5 *(to the right of the title) shows a sustained orchestral chord, while here* **(fig. 6)** *we have you-know-who singing three famous words.*



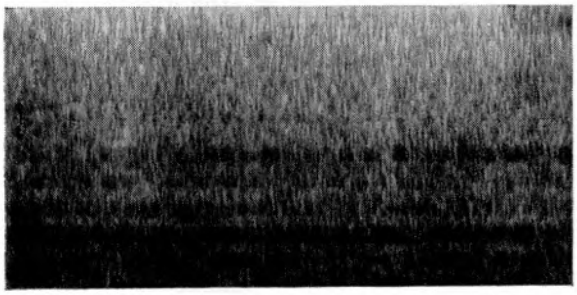
that the **A** has a low energy content and not very much of the higher harmonics. Then, just before the **S** I seem to have made a false start indicated by the dark marking. **S** is obviously a very powerful letter; the depth of mark is intense, with a clear-cut start, and the harmonics of the sibilant extend well beyond the range of the equipment. The high energy level, still very rich in harmonics extends over the first syllable, ending fairly sharply with **N**. **O** has not much energy and few harmonics, but the gutteral **G** brings another steep-fronted, harmonic-rich burst of power which the rolling of the **R** seems to carry in ripples through the long vowel sound till the final **PH**. This last sound has not so high an energy content as the **S**, particularly at the lower frequencies, but its proportion of higher harmonics is even greater. For a true reproduction of the words each of the countless variations displayed by the sonagram must be present in correct position and level. In this particular example, all the changes took place in one second.

The instrument itself, so far as reproducing and recording is concerned, is a straightforward tape recorder. The tape, however, is a short length carried on the outside of a steel turntable. Sound output is recorded and erased continuously until the sonagraph is switched to reproduce, when the last two seconds of recording are played back over and over again. This output is put through what amounts to a





The big picture (**fig. 3**) *illustrates a faulty tape recorder, while* **fig. 4** *immediately to the left of this caption shows a striking match.*



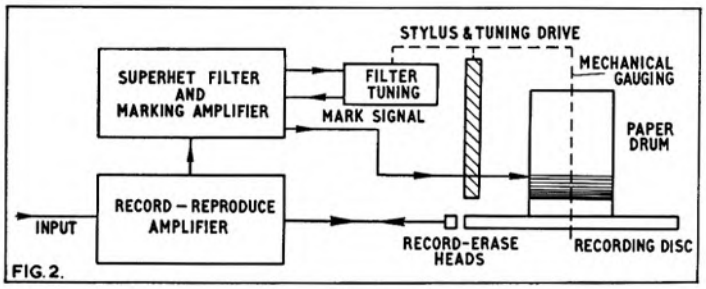


FIG. 2.

super-heterodyne receiver which acts as a variable filter.

Mounted on the same axis as the recording disc is a drum carrying a sheet of prepared paper on which rests a metal stylus. The stylus, which is driven by a worm gear, moves slowly upwards as the drum and disc rotate. The tuning of the superheterodyne receiver/filter is controlled by the same gearing and the considerably amplified output is applied to the stylus. Thus when the stylus is at the bottom of the paper, any 85 c/s signal present in the recording at any time will produce a high voltage between stylus and paper at the appropriate horizontal position. Thus causes an arc which produces a burn of intensity proportional to the level of the signal. As the stylus moves upwards, the frequency of the filter moves upwards, so that a higher frequency signal is needed to produce a burn. In this way a complete analysis of frequency against time is made, and permanent records are produced while the test is under way. The block diagram of **fig. 2** gives an idea of the process.

Fig. 3 is the record of a test made on a faulty tape recorder. The recorder was fed with a pure sine-wave at a frequency of 1 Kc/s. This should have produced an even line of unvarying intensity fairly close to the bottom of the sonagram, leaving the rest of the paper clear. Instead of this, the analysis was an intriguing example of modern art that at once indicated three separate faults. Firstly, as the input signal was at a fixed frequency, the frequency variation indicated by the large waves in the lines could have been caused only by wow, or speed variations of the tape. This was eliminated by paying attention to the drive which was alternately binding and slipping. Next, the small ripples which produce no aural effect after the wow had been removed, showed that a certain amount of flutter was present. To eliminate this the motor had to be changed.

A further sonagram made at this stage showed that both wow and flutter had been removed, but that all the extra, unwanted frequencies were still present. This could mean only one thing; at some stage the recorder amplifier was being so badly overloaded that the sine-wave was being clipped into practically a square wave. The extra lines were of course, the harmonics that are characteristic of this waveform. A little delving revealed a bias fault that caused a valve to work on its top bend. After this trouble had been removed the recorder was perfect.

This, of course, is an extreme example, but very small amounts of wow and flutter are clearly indicated by this test and harmonic distortion is shown up at once. Faults in frequency response can be detected by feeding the recorder with a sine-wave wobbulated over the range. This produces a sine-wave sonagram. Any variation in the intensity of this indicates a variation in frequency response. This test is particularly useful for tone correction experiments.

Fig. 4 is an analysis of the sound produced by striking a match. The complex, fine-grained pattern may explain why it is so difficult to make a convincing reproduction of this type of sound. An interesting feature is the secondary burst of energy, apparently caused by the wood beginning to kindle.

Figs. 5 and **6** are two musical examples. The first is the sustained final chord of a full orchestra in an improvised concert hall. The poor acoustics of the building won the battle at this point. The last example was recorded in a coffee bar while teenagers were listening to a group of Liverpudlian young gentlemen enthusiastically defending, with a triple affirmative, the amorous integrity of an un-named female —"Yeah, yeah, yeah !"

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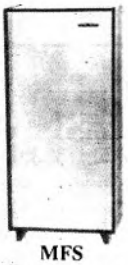

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RSW-1

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TAPE RECORDER SERVICE No. 31

By H. W. Hellyer

THE SONY RANGE

VISITORS to this year's Audio Fair may have gained the impression that the whole range of Japanese tape recorders is based on the gleaming austerity of the professional models. To be sure, Messrs. Tellux Ltd. had not neglected the average enthusiast. Room 311 had more to offer than the impressive *TC777A ;* there was even a stereophonic tape deck and amplifier unit suitable for the constructor, and the Sony *TC*200 was undoubtedly a prize packet—two of everything, all the way through, for a modest 79 guineas. But before we take off on the flapping wings of the 521 style, or kid ourselves that the Sony 600 is within our budget, even without main amplifier and loudspeakers, let us take a look at some of the 'popular' machines that this energetic company has marketed in the last few years.

Starting numerically there are the 101, the 103 (both 3¾ and 1⅞ i/s), and the 111 (7½ and 3¾ i/s), two-track machines with the first two mentioned able to take up to 7in. spools by dint of a cleverly arranged overlap and a compact transport system. They have a number of similar features. But whereas the 101 and 103 are wooden-cased jobs, the 111 has a more streamlined plastic case, and employs belt drive instead of the familiar Sony sprung-idler system. The 103 differs also in that it incorporates a three-transistor, built-in radio with ferrite aerial rod.

There are several other Sony machines with an integral radio tuner, which we shall look at in greater detail later. For the present, a brief review of the principal adjustments and servicing problems will take all the space that is available. Much could be said about radio tuners : the Copyright Act, the uselessness of MW reception, and so forth, but this is not the place. From the servicing point of view, the radio section of most tape recorders which have this facility can be regarded as a quite separate section.

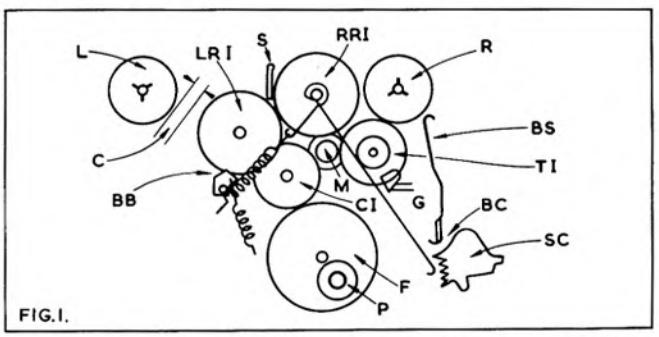

FIG.I.

Model 101. This is a machine with a four-transistor pre-amplifier circuit driving a 6AR5 valve output, doubling as HF oscillator for recording purposes, with a 5MK9 valve rectifier. The spool and flywheel drive is via four separate idlers, with a single function selector lever and spring return action throughout. **Fig. 1** gives some indication of the mechanical system and notes the clearances to be obtained from the following adjustments.

To dismantle, first take off the pinch roller, volume control and speed-change knobs (push-fit) and the record lever cap, then the selector knob and the fast forward control just beneath it. The head guard can be removed by pulling straight up, after which, the three securing screws can be taken out and the top cover taken off. Next, remove the screws of the four rubber feet and take off the base. After releasing the screws that secure the carrying handle, invert the machine, take out the two screws at the back and lift the cabinet clear.

We are now ready for action : check that the functions operate, and switch to Play. Note that take-up action is provided by idler **TI** engaging both the motor pulley **M** and the right-hand spool carrier (lower section) **R.** There is an idler guide, **G,** which can be adjusted for correct clearance between idler and motor pulley, and again idler and clutch drum, in the Stop position. Take a little trouble to get this right and many other adjustments will fall into place. Next, switch to Fast Forward and adjust for adequate take-up, both with full and empty supply spool.

The setting of the idlers **LRI** and **RRI** is very important. These two idlers engage for fast winding, but *must* disengage cleanly when not functioning. The primary selection is by the long rod from the cam **SC,** and spring tension is applied as indicated. The important point is the routing of this control rod, which must not touch the motor pulley. It may have to be bent slightly, and the clearance of both idlers should then be checked to ensure that correct clearance is obtained when the 101 is switched to Stop. Clearance between **RRI** and **R** and between **LRI** and **L** should be about a millimetre on Fast Forward to Stop and Fast Rewind and Stop, respectively. The stopper **S** may be adjusted for this clearance.

The brakes are simple. With the function switch at Stop, the clearance of the lower end of **BC,** the rod bearing the brake **BS,** to the cam **SC** should be more than a half-millimetre. There should be no inward movement, and the pressure should be adjusted by bending the top end of the brake support.

A subsidiary brake is applied to the left-hand idler, as shown at **BB.** There is a tension spring with this brake block, allowing adjustment. Note the clearance **C** (shown exaggerated in **fig 1.**).

The pinch pressure can now be adjusted. First check that the arm is correctly operated, so that the roller at its right-hand end comes within a half-millimetre of the Fast Forward cam, which is concentric with the cam **SC** of **fig. 1.** The machine is switched to Fast Forward for this test and adjustment is by moving the whole head mounting plate (three screw fixing). It may be necessary to adjust the tape shifter, i.e., the arm on the lever which comes between the two heads. Finally, see that the pinch lever allows the Fast Forward lever to return to its normal position. If necessary, apply a little judicious pressure with the long-nosed pliers. Note that the capstan and pinch rollers with *red* markings are used on 50 c/s, and the 60 c/s components have a white upper circle. In addition, the voltage selector and motor connection panel have to be altered.

The Record lever has a stopper at each limit of its travel, and these are adjusted by first unhooking the tension spring from the record lever and loosening the fixing screws of the two stoppers. Then, the lever is moved to its extremes of travel and the locking screws tightened. Always check under operating conditions.

Azimuth and head position are adjusted by the setting of the three screws that secure the main plate, the tape shifter previously mentioned, and the head shield. The only other mechanical factor that need bother us is the speed changing device, which is a simple lifter, depending on the position of the motor pulley relative to the idlers. When switched to 7½ i/s, the bottom side of the capstan idler should clear the motor pulley, and on 3¾ i/s, the top side should clear the pulley, which can be adjusted for this setting.

Electrically, there are additional adjustments. Machines earlier than serial number 30,000 had two neons for signal level indication. One acted as a pilot light and DC stabiliser for the other, which was connected to the secondary winding of the inter-stage transformer when the machine was switched to Record. The stabiliser strikes at 160V and the signal indicator at 55V to 60V, the latter setting being determined to some extent by a 500K pre-set. Correct adjustment is to turn the pre-set until the neon strikes just when the recording current produces distortion, thus giving an overload indication.

This is not a very satisfactory state of affairs for the enthusiast, and later machines were fitted with a Vu-meter. More care is needed with

(continued overleaf)

the setting of signal level to obtain the best results. The meter is connected to a tap on the interstage transformer secondary winding via a copper oxide rectifier, and the adjustment is made for a reading of 130μA, which should bring the pointer to the end of the black region of the scale (for the benefit of experimenters, the meter resistance is 290 ohms). The above meter indication is for 8 dB below tape saturation. Now, if the signal level is adjusted by setting the volume control, for the meter deflection to reach the end of the black region on peak recording, all should be in order when played back. If an alteration is necessary, switch to Record, shunt the grid of the oscillator with a resistor of about 50K, feed in a 1 Kc/s signal at 55 dB below saturation level to the high level input socket, then adjust the volume control until a reading of 5.8V is obtained (using a valve-voltmeter or high impedance meter) across the secondary winding of the interstage transformer. Under these conditions, the preset can be adjusted for correct deflection.

The model 103 has a radio tuner, which consists of a three-transistor superhet with ferrite rod aerial. The coverage is MW only (535 to 1,605 Kc/s) and the IF is 455 Kc/s. In other words, a normal radio unit feeding the tape recording unit. The two points that are most often queried are (a) the tuner switch connections, and (b) the ferrite aerial rod coil connections. These are shown in detail in **fig. 2.** Identification is as in the manufacturer's circuit.

The tuner printed circuit board is mounted above the deck-plate and the switch is operated by a push-button to its right. The tuning capacitor is adjacent, and care must be taken when uncasing and re-assembling not to bend the vanes of this ganged capacitor. It is always good practice to turn the gang (tuning control) until the vanes are fully

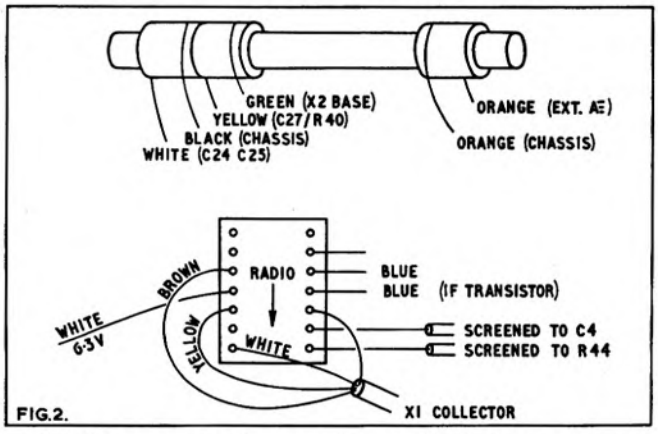

FIG.2.

meshed before commencing operations, and again before assembly. Another switch that needs careful treatment is the monitor switch at the front of the deck. This is a simple slide switch used to cut the speaker in or out for monitoring. The ferrite rod depicted in **fig. 2** is mounted diagonally beside the motor, beneath the deck. Care should be taken with its mounting: but, contrary to popular opinion, it is not the end of the world if the rod breaks. The broken ends can be fitted together and bonded with a good contact adhesive. It is advantageous to fit a splint and sleeve across the break if it occurs on a plain portion of the rod, and not beneath a coil. The reason for this type of remedy being successful is simply that the rod is a *magnetic* circuit, not an electrical conductor, and if the broken ends are brought close enough together, despite the intervening layer of adhesive, a magnetic circuit is remade.

The Sony 111 is a quite different machine. With its very neat two-tone plastic cabinet and lightweight (ten pounds) construction, it has the appearance of a streamlined portable, but is, in fact, a fully comprehensive mains machine. An efficient 6 x 3in. loudspeaker gives 2W power output from the three-valve circuit (a selenium rectifier is used for the HT supply). Recording is half-track with a 5in. maximum spool capacity. Speeds are 3¾ and 1⅞ i/s and the frequency response at 7½ i/s—70 c/s to 8 Kc/s.

Dismantling this machine needs attention; the knobs pull off, but the head cover must be pushed toward the rear before it can be lifted away. The Phillips-headed screws are next removed from beside the volume control spindle, inside the capstan container, beside the Record lever opening and from the rear of the machine. There are

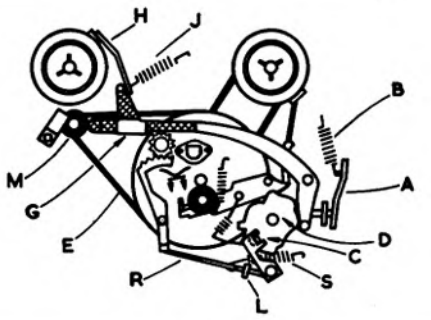

FIG. 3.

two in this last position. After removing these, the cabinet top can be lifted off. To get the base off, turn the four rubber feet anti-clockwise.

Azimuth adjustment is normal two-screw, with the left screw spring-loaded and the right one used for fine adjustment of the gap relative to the tape. The erase head is a permanent magnet which is brought into action by the movement of a toothed segment lever (see **fig. 3**). The fine adjustment is provided by a locknut **L** on the rod **R** which limits the travel of the crescent-shaped lever, and a spring **S** provides return tension. This is a positive movement, but it is initiated by the Record selector, and there is a quite critical setting required for the Record Stopper, if this has been damaged or maladjusted. When the Record Lever **A** is pulled toward the front, against the tension of spring **B**, and then the Forward position selected (as for Play), the locking fork **C** holds the selector in place. Beneath the deck there is a sector cam with a locknut, which limits the action of the switch itself, and this should be adjusted for positive Record and Play selection when the Record lever is in the appropriate position. The securing screw at the bridge part of the Record lever should also be checked for freedom of swivel action. Binding at this point can give the same effect as a weak return spring.

The stepped cam **D** makes all the selection positions as the single

(*continued on page* 243)

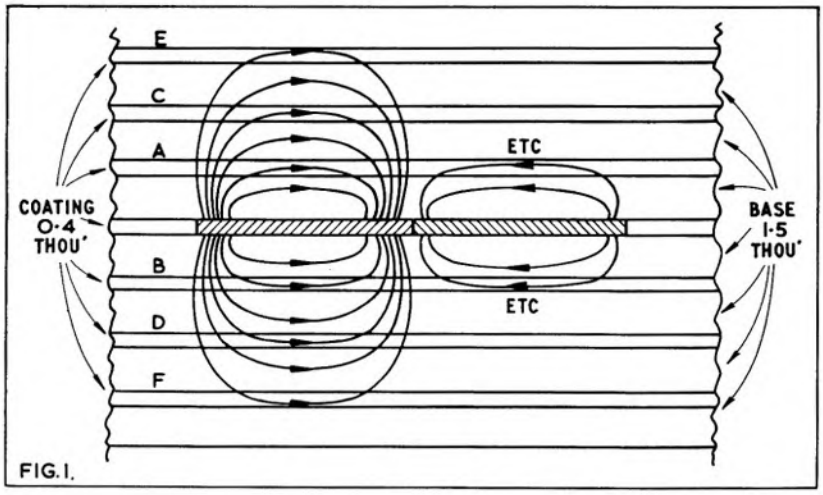

FIG. 1.

This shows adjacent layers of tape on a spool with two half-wavelengths of master signal (recorded 500 c/s at 7½ i/s) to scale, and flux lines passing through other layers, not necessarily to scale.

print through

A RARE TAPE MALADY

BY GRAHAM BALMAIN

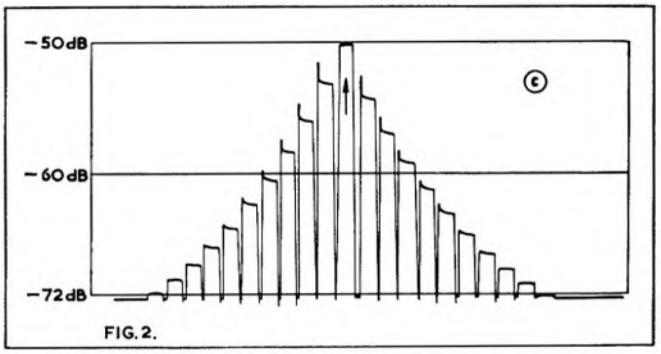

FIG. 2.

THE first and most important thing to say about print-through is this : the average domestic tape-user will probably never experience its effects directly. That is, he may hear it sometimes in recorded programmes on FM radio and perhaps even on gramophone records (though even then it is more likely to be a similar effect to over-modulation of the nitrate master disc than to print on the original master tape), but he is not likely to hear any on his own recordings unless they are stored badly.

Why discuss it at all, then ? The best reason is the unholy fear of print-through which many users have, for no very good cause except the scares occasionally started by various experts who have had bad experiences. Another good reason is to help readers avoid the combinations of circumstances which *could* cause trouble. And my own reason (as if you hadn't guessed by now) is that print-through is an interesting subject, apart from being of great importance to professional recordists.

Print-through is simply the transfer of the magnetic impressions recorded on any part of the tape to the layers adjacent to it in the reel, by the process illustrated in **fig. 1.** The shaded part of the coating represents the extent of two half-wavelengths of recorded signal—the magnet elements beloved of beginners' booklets and advertisements—and its external flux passes through adjacent coating layers much as shown, becoming weaker in the normal way as the distance from the recorded element increases. Since the magnetic oxide powder in the tape coating contains a small proportion of particles having a very low coercive force (say about 0:1 oersted against the 250-300 oersteds of the bulk of the particles) some small impression will be left on adjacent layers of coating. The process is probably helped by what is thought to be a continuous vibration of the magnetic vectors associated with the particles, which increases with temperature.

We can see from **fig. 1** that a number of layers on either side of the 'master' layer are likely to be affected in different degrees. Because of the disposition of the flux in the master layer and of the adjacent layers, the strongest print appears in layer **A** immediately outside the master on the spool. This 'first preprint' precedes the master signal when the reel is played, of course, and it is this print which is usually heard in the silence just before the beginning of a loud sound. The first after-print **B** is the next strongest, but is less often heard because a loud signal is very rarely followed immediately by enough silence (so to speak) to prevent its being masked. The prints decrease in level in the order **A, B, C, D** and so on, each pre-print being slightly louder than the corresponding after-print.

With the usual print-measuring equipment, including a 1Kc/s band-pass filter and a sensitive voltmeter, several pre- and after-prints can be detected easily (see **figs. 2** and **4**). Note the relatively small difference in the level of the first pre-prints on the three kinds of tape, and the noticeably smaller differences in level between successive prints on the thinner ones. These tapes were deliberately printed at a high temperature to show the general effects clearly ; more of that in a moment. To forestall the obvious question, the equipment also contains a 'strangler' which reduces the level of the master signal by 50dB *almost* instantaneously (but not quite—hence the name). This

(*continued on page* 231)

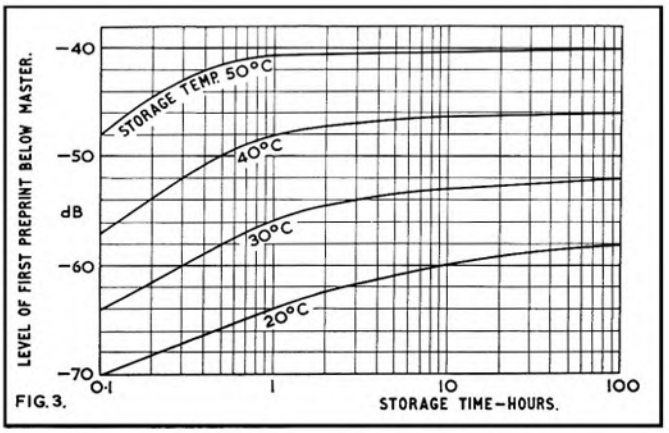

FIG. 3.

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BELSONA TRQ 399. Price 35 gns.

Tape	3 inch recording tape (85 mm diameter)
Tape Speeds	3¾ inch/sec (9.5 cm/sec) 1⅞ inch/sec (4.75 cm/sec)
Motor	6V, 0.6W, with electric governor
Recording Time	34 min. both ways at 3¾ speed. 68 min. both ways at 1⅞ speed
Output	500 mW
Speaker	4 inch x 2¾ inch (10 x 7 cm) P.M. speaker
Amplifier	6-transistor amplifier, 1-transistor high frequency generator
Recording System	AC bias system
Erasing System	DC electromagnetic system
Track	Double track
Rewinding Time	Less than 4 min.
Fast Forward Winding Time	Less than 4 min.
Frequency Characteristics	150-7,000 cycles (3¾ speed) 150-4,000 cycles (1⅞ speed)
Power Source	Four flashlight cells (used for both amplifier and motor)
Dimensions	Width 8 13/16" (224 mm), Height 3⅜" (85 mm), Depth 6⅛" (155 mm)
Weight	4.4 lbs. (2 kg) including batteries

Compact Belsona portables offer many features previously found only in standard models. 'Hitachi Ring Base Transistors' for full tone and volume. Level Meter recording guide and battery life indicator. Transistors eliminate warm-up, permit immediate recording and playback. Hitachi also offer finest quality mains operated models, like the TRA 500.

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Tokyo Japan

device is a great saver of meter pointers, loudspeaker coils and my nerves. The pen recorder is too slow to show the initial few milliseconds at full level. The spikes on the print records are due to the pen overshooting.

Since the first pre-print is the most important one in practice, it will hereafter be referred to as 'the print'.

The main characteristics of print-through are these : the relative strength of the print depends on the wavelength of the originating signal, the time for which the reel is stored and the temperature during that time. The most unfavourable range of wavelengths is in the region of 10-20 thousandths of an inch, which corresponds to about 500 c/s to 15 Kc/s at 15 i/s, 250-750 c/s at 7½ i/s, and so on. Since our hearing is most sensitive in the 1 to 5 Kc/s range, especially to low-level signals of the kind we are considering, the worst effects obviously occur in recordings made at 15 and 30 i/s. This is one reason why you may hear print-through in recorded radio programmes but not from your own recorder, which probably runs at 7½ i/s or less.

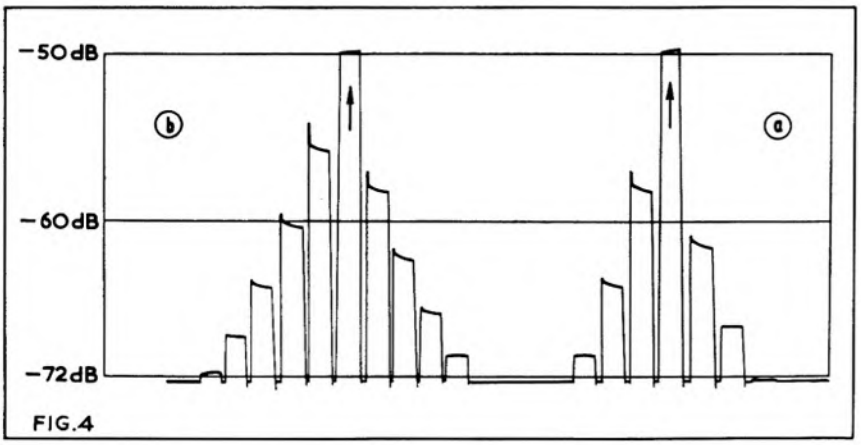

FIG.4

This and fig. 2 *shows a print series on* (a) *Standard Play tape,* (b) *Long Play, and* (c) *Double Play. Preprints are to left of master-signal* (*marked with an arrow*).

The time and temperature of storage are to some extent interdependent. The print level increases with time according to an exponential law, rapidly at first and then flattening off to a gradual rise which theoretically continues for ever. In practice, the level comes within a dB or so of a practical maximum value in quite a short time, depending on the storage temperature.

A typical tape stored at 'room temperature' (21° C or 70° F) will have a print from a 15 thou. wavelength signal (500 c/s at 7½ i/s) of some 60 dB below that signal within two days, and perhaps 58 dB after two weeks. At 15° C (60° F) it might reach 64 dB in three days, at 40°C (104° F) it could reach as much as 46 dB in three hours. This would annoy almost anyone. And, once printed at any temperature, the impression cannot be reduced by lowering the temperature. **Fig. 3** shows the kind of behaviour to be expected. The moral need hardly be pointed ; you cannot avoid the time factor, but you can keep the tape cool. Not in the fridge—there's too much moisture about for comfort there—but away from heaters and out of the sunlight. Play it cool, too, if you can. Some domestic machines get surprisingly hot around the spool carriers after an hour or two.

What else increases print-through ? Magnetic fields are the only other important cause. Printing is normally an unbiased recording, and any stray field helps the process along by tending to bias the coating in a more or less effective way. Don't store tapes near loudspeakers, transformers, motors, power leads or anything else having an appreciable magnetic field. Print levels can be raised by some 20-30 dB thereby before the recording itself suffers appreciably, although a high and probably irregular background noise will also appear and betray the cause. Done under controlled conditions, this is one method of duplicating tapes.

A less obvious way of 'biasing' the tape accidentally for printing is by having a real or effective DC component in the erase or record head during recording. A DC sufficient to cause coating saturation will raise print levels by some 10 dB, and *pro rata* below that. The rough modulation noise produced by the DC will identify this one, and its cause will be either a leaky coupling capacitor, a grossly asymmetrical bias or erase current waveform, or a magnetised head.

All this is of little comfort to the reader who has precious recordings suffering from appreciable prints. Take heart !—there are two things you can do which may help. One is to wind the tape on to another spool, wrong end out, and keep it there for a few hours before playing. True enough, you will get another set of prints, but the first and more annoying should largely disappear. Even the second set will themselves be reduced when you rewind the tape just before playing it, and they won't have got much hold anyway. Some broadcasting organisations store tapes the wrong way round for this reason, rewinding them an hour or two before use.

The second expedient is somewhat risky, needing care and a little experimenting beforehand. Since only very-low-coercivity particles are involved, prints can be erased much more readily than can the wanted recording, so applying a very weak erasing field will reduce prints acceptably without affecting the recording overmuch—but some HF loss may have to be accepted. Some method of adjusting the bias or erase supply from zero upwards is the first essential ; the second is a length of tape with an unwanted recording, both tape and recording being of the same kind as that needing treatment.

The procedure is first to experiment with the unwanted recording, subjecting it to various amounts of bias or erase field until you find the point where the loss of HF content is acceptable. During these experiments the tape should be somehow spaced well away from the head not being used, or led round its back if that is mechanically possible. If the unwanted recording also has prints, it is worth checking the reduction achieved at lower fields ; two treatments at half-strength may produce the same or a greater reduction with less effect on the HF content of the recording.

(*continued overleaf*)

PRINT THROUGH — CONTINUED

The final stage is to run through the tape to be treated under whatever conditions you find best, and keep your fingers crossed ! Results should be even better if the tape has first been given the other rewinding treatment, of course, and it may help to do preliminary experiments on these lines, too.

Before anyone writes to ask for figures of fields required, reductions achieved and so on, I must very regretfully say that I shall refuse to give any. What is needed depends entirely on the type of heads, the type of tape, the kind of recording, the tape speed and a host of other things (including your own ideas of whether a print is audible and how much HF loss is tolerable) which cannot be predicted on the spot, let alone by remote control. I've ruined more of my colleague's recordings that way . . .

It All Depends

Come to that, the whole behaviour of prints depends on the type of tape, the type of head, and all the rest. Some kinds of tape are better than the average ; others are much worse, especially those from one particular country (no names, no pack-drill—you'll know soon enough if you get one). But the average print level is low enough to be missed under normal domestic conditions, if only because it is masked by the generally higher background noise of the tape or, more usually, the machine, or even the listening environment itself. Prints start to be appreciable when the listening level is high and the noise level is comparable with or less than the print level, in the 50 to 70 dB region ; and a change of only 3 or 4 dB in noise level can then mean the difference between inaudibility and annoyance. I always remember the customer who ordered an expensive special batch of tape with 6 dB less noise than usual, got it, and then refused to accept it because the print level—although the same as usual—was then clearly audible. You can't win ! But then, as I said, the problem is of real importance to professionals. It is still an unlikely one for the domestic user, and I have yet to hear of a genuine case of print-through on a tape made, stored and heard in reasonable domestic conditions. Any offers ?

TOWARDS BETTER TAPING

BY GORDON KING **PART 4**

PAST articles in this series have considered mains isolation, signal inputs and extension speakers. In this article it is proposed to investigate that vital component, the microphone.

Most domestic tape recorders are supplied complete with a microphone of some kind or other. But while this serves admirably to transfer sound waves to magnetic tape waveforms, via the medium of the recorder, and allows the successful recording of domestic noises, it is generally possessed of various limitations. This means that for better quality recordings the use of a microphone different from that supplied with the machine may well be desirable, supposing, of course, that the recorder is capable of responding reasonably well to both the high and low audio frequencies.

A microphone is a *transducer*. That means that it exhibits the property of changing the sound waves it picks up into very small electric currents. A microphone, then, can be considered as a generator of electricity, the sound being the mechanical energy and the audio output the electricity.

Some microphones work on exactly the same principle as the electric generator. That is, a coil of wire is caused to pass through a magnetic field. As many of us will know, when a magnetic field is so cut an EMF (electro-motive force) is developed across the terminals of the coil of a strength depending upon (i) the number of turns in the coil, (ii) the rate at which the field is cut, and (iii) the strength of the magnetic field.

The *dynamic* (or moving-coil) microphone is of this nature. Here the coil is caused to move to and fro in the field, as the result of a coupled diaphragm vibrating in sympathy with the sound waves. When the coil cuts the field in one direction small electric currents flow in a specific direction through the coil and when it cuts the field in the opposite direction the current flow is also reversed. A microphone thus produces *alternating* current of a waveform matching that of the sound waves themselves. This type of microphone is robust, of reasonable quality and unaffected by temperature and humidity conditions.

Other microphones using the electromagnetic principle are the ribbon (or *velocity*) microphone and the *variable-reluctance* microphone. In the ribbon microphone, a metallic foil ribbon is suspended in the magnetic field, and the ribbon is used instead of a diaphragm, this being caused to vibrate by the sound waves. The ribbon, in fact, is the 'moving-coil' or conductor. This type of microphone is more delicate than the dynamic microphone, but is renowned for its high quality output and is often used for studio and general-purpose applications.

Some variable-reluctance microphones have a fixed coil and a moving magnet assembly, this being mechanically coupled to a diaphragm.

Many of the popular type of tape recorders furnish a crystal microphone. This differs in principle of operation from the electro-magnetic type. Instead of a coil of wire (or conductor) and magnet, a crystal of rochelle salt, ammonium dihydrogen phosphate or barium titanate is used.

Such crystals have the property of producing an EMF across them when subjected to stress or strain (that is, bending or twisting). This is known as the *piezoelectric effect*. Thus, the crystal used generates an EMF of a waveform equal to that of the sound waves when it is stressed physically by the acoustic input, the crystal being mechanically coupled to the diaphragm.

The crystal microphone is relatively rugged and provides a good output voltage. It is, however, susceptible to changes in temperature and humidity. Nevertheless, it offers the best quality/cost ratio. The use of barium titanate crystal enhances the frequency response (signal output constant at the high and low frequencies as well as at the middle frequencies) at the cost of an overall smaller output voltage.

The modern trend is towards the use of the *ceramic* microphone. This works on the piezoelectric principle, like the crystal pickup, but instead of the crystal materials mentioned above, it employs a man-

(*continued on page* 235)

Microphones come in various forms. The one on the left is a small crystal unit for fixing to the lapel. Manufactured by Acos, it is designated Mic 55.

Next comes the Model LD/66 hand microphone, incorporating a built-in table-stand and moving-coil assembly. It is designed for general purpose applications by Lustraphone.

At right-centre is a studio ribbon microphone by Reslosound. The ribbon is set vertically within the field of a permanent magnet and a built-in transformer is used to step up the ribbon impedance.

The AKG D11N (far right) has a cardioid response which enables natural echo-free recordings to be made even in acoustically unsuitable locations. Frequency range is from 80 c/s to 12 Kc/s.

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made ceramic crystal which has been processed in a certain way during its manufacture so as to behave like a natural crystal.

The ceramic microphone is gradually replacing the crystal microphone first used with the popular type of tape recorder. It is far less temperature and humidity sensitive, but it generally has a smaller output than the crystal microphone, thereby calling for greater gain in the microphone channel of the recorder.

Another microphone, though somewhat more expensive than the microphones so far considered, works on the *condenser* principle. Some recorders, in fact, are supplied with a condenser microphone. It is composed essentially of two plates very close together, one being the actual diaphragm. As the sound waves cause the diaphragm to vibrate, so the capacitance between the two plates varies. The microphone is arranged in conjunction with a polarising voltage (**fig. 1**) so that the changing capacitance works in conjunction with a fixed charge to produce a small audio voltage across a *load* resistor.

Although rarely used for tape recording, the *carbon* microphone more or less completes the microphone family. This type is based on the use of tiny carbon granules which change their position (and thus their overall resistivity) as a coupled diaphragm vibrates in sympathy with the sound waves. The changing resistance is translated into an electrical voltage by virtue of an energising current and a transformer. The carbon microphone is used in almost all telephone handsets and was at one time popular for communications and public address applications. Its main advantages are ruggedness and high output voltage.

With such a display of microphones, it is not surprising that the tape newcomer is a little confused when faced with the prospect of trying out new microphones with a recorder which was supplied with one specific type of microphone.

Electrically, there are two main factors to consider. One is the *impedance* of the microphone input channel of the recorder (e.g., the impedance of the microphone originally supplied with the instrument) and the other is the signal *output voltage*. Let us take impedance first.

To be technical, impedance is the apparent resistance of an electrical circuit which is comprised of both true resistance and reactance. Let us not panic about this, for so far as we are concerned as tape recordists we need only to know the value of impedance in "ohms". We know that true (ohmic) resistance is that property given by ordinary conductors and resistors. Reactance, on the other hand, is an apparent resistance as 'seen' by alternating and signal currents. Both capacitance and inductance (coils, chokes and etc.) have a reactance value to AC, depending upon the value of the component and the frequency of the AC. Reactance and resistance together form impedance and this is expressed in *ohms* by the recorder manufacturer for his microphone input channel and by the microphone manufacturer for his microphones.

The secret here is that the impedance of the microphone used must match that of the input channel of the tape recorder for optimum transfer of the microphone signal to the tape recorder. Incorrect matching at the microphone input could result in a severe lack of sensitivity. This would arise, for instance, if a 100,000-ohm (100K) microphone were connected across a 30-ohm microphone input circuit or a 30-ohm microphone connected across a 250K input circuit. Here, then, lies a reason why beginners often experience poor results from microphones not specifically designed for their tape recorders.

The impedance of a channel may not be given specifically in terms of ohms. For instance, engineers (and others) often classify broadly as 'high impedance', 'low impedance' and 'medium impedance'. So far as microphones and their input channels are concerned, high impedance usually indicates anything from megohms (millions of ohms) down to about 2,000 ohms (2K), medium impedance down to about 600 ohms and low impedance down to 2 or 3 ohms.

From first principles, therefore, one could reasonably expect a high impedance microphone to work into a high impedance microphone channel, and likewise with matching medium and low impedances. From the professional aspect, however, the actual value of impedance becomes important, since most professional and semi-professional items of equipment operate at medium or low impedance and differences between microphone and input channel impedance are much more critical at low and medium impedance than at high impedance. Moreover, professional requirements are generally far more exacting than those of the amateur recordist.

The next thing is output voltage. This is not really a very easy factor to define, for the output voltage depends—apart from type of microphone—upon the impedance values and the intensity of the sound impinging upon the diaphragm. Obviously, the louder the sound, the greater the expectation of voltage across the microphone terminals.

If we wanted to look into the output voltage aspect of microphones we should have to get really technical. There is no need for this, for a knowledge of the 'classification' of output voltage for a particular type and make of microphone is generally sufficient for the requirements of the amateur recordist.

Nevertheless, a brief glimpse of the method used to indicate output voltage would not be amiss. The output voltage is often quoted in terms of 'sensitivity', the expression being in decibels relative to a fixed reference level, such as 1V (to equal 0dB) with a sound pressure of 1 dyne per square centimetre. Thus, a microphone with a sensitivity of 0dB at 1 volt/dyne/cm² would produce 1V of signal when subjected to a sound pressure of 1 dyne/cm².

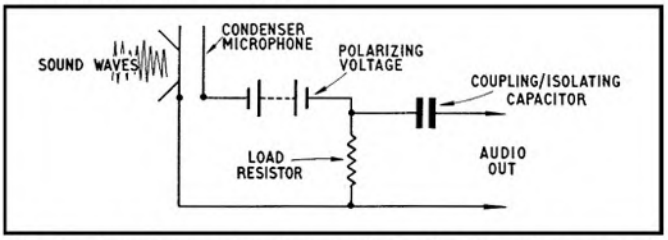


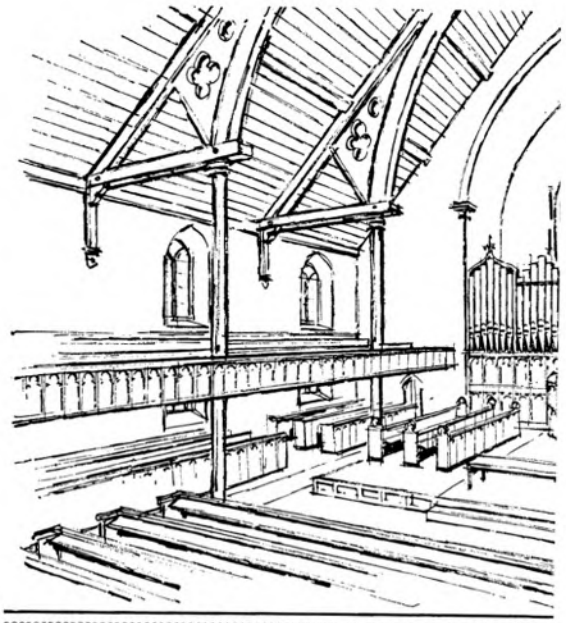
Fig. 1. *A condenser microphone needs a polarizing voltage so as to apply a charge across the plates. As the diaphragm plate is caused to vibrate by the sound waves, so the charge flows in and out of the capacitor and an audio voltage is developed across the load.*

Actually, there are very few microphones with such a great output voltage. The output is usually a fraction of a volt for a sound pressure of 1 dyne/cm², and the decibel (abbreviated dB) is the unit employed to introduce the fraction, or ratio. 40dB implies a voltage ratio of 100-to-1. Thus, a microphone with an output of 40dB *below* 1 volt/dyne/cm² would give a hundredth of a volt (or 10 mV) output at a sound pressure of 1 dyne/cm².

The *Lustraphone* miniature ribbon microphone, Type *VR*/70, for example, has a low impedance output of 90dB below 1 volt/dyne/cm² and a high impedance output of 56dB below 1 volt/dyne/cm². These can be translated into actual voltage by reference to a decibel table, but usually this is not necessary as the dB factor serves as the comparative reference.

If the microphone supplied with the recorder has an output of, say, "60dB below . . ." at a certain impedance, then provided we employ a microphone with similar characteristics we should be sure that our tape recorder would be fully loaded. A larger dB figure would mean that more 'record gain' would be needed to get full loading and that, basically, the microphone would be less sensitive than the original (note, though, that the quality and frequency response may be better than the original—this will be dealt with next month), while a smaller dB figure would mean that the microphone is more sensitive than the original, that it would pick up sounds of smaller intensity than the original microphone for a given 'record gain' setting.

Next month, we shall relate output voltage, impedance, frequency response and polar diagrams to the various microphones that we have looked at in this article.



"IN QUIRES AND PLACES WHERE THEY SING"

THE article on organ recording, (January *Tape Recorder*) seems to have aroused some interest, and a few lines may not be out of place to emphasise some points of detail. For the sake of the record I must correct two slips of the pen in the organ recording article. Firstly, the word "harmonics" referring to mixtures was wrong, it should have been "intervals", and secondly the 32 and 64 c/s quoted for the various C's should have been qualified as being approximate only.

The most important point is—once again and as with all recording —*balance*. It is no good placing the microphone so that the gentle choir organ flutes sound more powerful than the great organ diapasons, and the complicated siting and layout of some large instruments can lead one into this very trap. Next, if the balance between direct and reverberant sound is upset in favour of reverberation, the effect will lack "grip" and the music will sound mushy and ill-defined. In addition, whilst the level indicator may show a full level modulation, the lack of grip will reduce the apparent playback volume—a most unsatisfactory result.

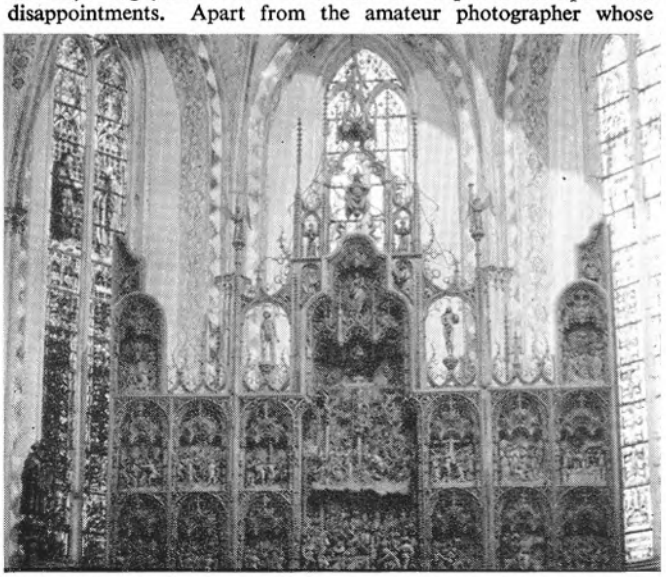
Monophonic (and indifferent quality stereophonic) playback systems treat direct and reverberant sound as one, and the eyes cannot assist the ears to discriminate between them, as in a live performance. Thus, generally, a more intimate recording effect is called for under these conditions, and if the organist suggests you record from the opposite end of the church, beam at him gratefully but make sure that at least some work is done close to the instrument.

Those lucky enough to have *good* stereo equipment can deliberately go out to record a building with a 'Cathedral acoustic' (i.e., a long reverberation period) ; some wonderful effects can be obtained, but nevertheless, don't overdo it !

Speaking of overdoing things, some of the flue stops in an organ are very "close toned" or in other words, produce an intense tone comparatively devoid of harmonics. These stops can overload recording equipment and cause distortion in the narrow band of frequencies recorded, even though sometimes the level indicator may not show it. The same effect can be experienced when recording test-tape notes ; I know an organ with a powerful Claribel Flute, the effect of which—on the level indicator—is equal to the full organ—pedal reeds and tuba included.

Finally, the microphones. Many of the lower price instruments sold with modest recorders have a steep bass-cut built in to minimise hum or motor noise pick-up and to help voice recording effects. It is no use expecting such a unit to produce a good recording of a 16ft. Violone. Rob the organ of its bass effect and half the grandeur is gone—so choose the right microphone.

Having attained medals for organ recording, it is natural to turn to fresh fields, and what more natural fields than the choir ? Be warned, though, that these fields are full of sharp rocks and potential disappointments. Apart from the amateur photographer whose



pictures "never come out" there is no more wretched figure than the budding recordist who descends on a church with cable, equipment, headphones, the lot, and proceeds to waste the time of perhaps forty people, producing at the end a raspy ill-balanced load of hummy mush (I know—I've done it !). People who sing generally have a good ear for music and can be quite ruthless in demolishing a poor effort, be the volume never so high !

Due to the artificial conditions experienced during playback, compared with the live performance, the ear notices vocal effects in a recording far more than in the more sympathetic atmosphere of actual buildings, and with repetition each little recorded defect becomes engraved in the mind. So be on your watch for the groaners and shriekers, especially for the passe sopranos, and baritones helping out as tenors. A quiet word beforehand with the conductor is advised, and if you can (discreetly) gain his assistance in placing the offenders at a good distance, or "forgetting" to advise them of the recording session, you can take top marks for man-management.

Balance is a complicated business, especially if the choir is accompanied by an awkwardly placed organ. Quite apart from the four main sections of the choir (bass, tenor, alto and soprano) there can be vocal soloists, instrumental soloists, and small semi-solo groups formed from people who otherwise spend most of their time singing in the chorus, whilst some of the greater works (the Bach *St. Matthew Passion* for example) have supplementary "Ripieno" choirs who join in on occasions. All these items need careful discussion beforehand with the conductor, preferably in the actual building, and it is also a good thing to attend a rehearsal, with the singers relatively static ; the best result which can be expected is compromise, unless you use a number of machines and operators and produce an edited tape of the best results.

However, back from the stage to the church. It is my opinion that the average amateur has quite enough to do without the trouble of operating a multi-channel mixer and several microphones. I feel that the complication of recording always increases as the cube of the number of microphones to be controlled, and with a sensibly disposed choir in a well laid-out building, one omni-directional microphone set in front of, and above, the choir, is a good standard arrangement. This ideal setting is shown as **fig. 1,** and note the similarity of this to many typical buildings erected for the Low Churches during the last century. A typical 'Church of England'

Fig. 1: *This type of church is seen in practically every town. Provided the roof timbers and projecting galleries don't result in a too-short reverberation period, this layout gives excellent balance and blend.*

"IN QUIRES AND PLACES WHERE THEY SING"

some further notes on organ recording by M. F. Woodward

Speaking of acoustics brings to mind one of the great experiences of this life—recording Plainsong in a reverberant church. Here is one of those moments where primary sound is of less importance, acting purely as a catalyst in a setting of acoustic grandeur. If to the aural effect is added the visual effect of a Winter's evening with the building lit only by dim lights over the music desks, then I defy anyone to remain unmoved.

I mentioned earlier—light heartedly—the question of man-management, and this is most important when handling choirs. Make a nuisance of yourself, and incur their collective displeasure, and the effect will be noted in the performance. For this reason, choose your men carefully before suggesting that they change their time-honoured position and sing in a side aisle ! Gain their co-operation and much will be accomplished, lose it and you might just as well stay at home. Avoid an artificial atmosphere, yards of cable, insecure microphones and equipment all over the place. Get there early and do your setting-up and testing before the choir arrives ; above all get the confidence of the conductor that you wish, for the sake of *his* choir, to get a successful result.

Beware of the effect of rustling pages, especially at the end of a piece. Ask for silence during pauses and once again at the end so that the building reverberation can play its part in the recording. Conductors sometimes tap their feet or hum the music (quite unconsciously) and if the microphone is near them this can be the cause of much head scratching.

The question of recording level can be a problem. Whilst you can rely on a standard output of sound from an organ time and time again, the most unlikely overloading can occur without warning from a choir, despite careful prior trials. A counsel of despair is to set a standard level somewhat below the anticipated maximum, but once having set it, don't meddle with it, unless you want a definite effect produced during playback. In particular the clear flute-like quality of treble voices can cause serious distortion and 'blasting' in record/playback equipment.

Equipment has not been covered directly in this article ; for further remarks on the subject—also for notes about recording in churches generally—I refer you to the article on organ recording in the January *Tape Recorder*. I feel that, primarily, a good microphone is required —the trouble lurking in several innocent treble voices is remarkable !

layout, shown as **fig 2,** can be far more complicated, with the organ to one side, speaking out both to South and West sides. In this case, it is sometimes worthwhile setting the microphone over the altar rail, and getting the choir to face it. This unorthodox arrangement is obviously 'out' for public performance, and also the choir may object (the tradition of setting your arm in a convenient carved crocket whilst facing West dies hard !). It is worth trying though. If a second microphone is available, this can be set adjacent to the soloists for the more intimate effects, and a directional microphone can be quite useful for such a duty. Don't forget that organ pedal notes are very pervading and get round directional microphones, sometimes with disconcerting effects—try it out first.

Recording a solo voice without any associated choir is somewhat simpler, but there is still scope for exercise of skill. Don't accept necessarily the standard position of the soloist standing on the chancel steps facing West ; try a side chapel, against a solid wall or even in the pulpit (especially if it is against a solid wall and has a 'sounding board' over it). Remember the accompanist, and don't site the soloist so that the organist cannot hear his soloist clearly. It pays to have the soloist singing towards the organist, the microphone being discreetly placed to pick up a well balanced but nevertheless subordinate accompaniment. The characteristics of the ribbon microphone are well suited to bass and baritone soloists.

Building acoustics are of great importance ; due to the heavy timber roofs and projecting galleries, many churches of the type show in **fig. 1** have a short reverberation period, and this gives a harsh effect. Many traditional churches have a significant nave/chancel arch, and this can lock up sound in the chancel to a surprising degree—another reason for recording over the altar rail. Be imaginative in your choir placing ; if the usual position has an unsatisfactory effect, try them in one of the side aisles facing into the nave, the solid wall behind and low roof above them may blend and intensify the tone in a most satisfactory manner.

Fig. 2 : *A church such as the one shown here may suffer from an unbalanced organ effect, part of the instrument speaking out into the Chance but with important sections of it speaking out Westwards into the Nave.*

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BIAS IN TAPE RECORDING

BY K. R. WICKS **PART 5**

SUPERIMPOSING AND FADE-ERASING

THERE are two basic methods for superimposing additional material on to an existing recording. The first method is the most obvious and also the most expensive. Suppose that announcements have to be put on to a tape of continuous music. The tape is played and the music is combined—by means of a conventional mixer—with the output of a microphone. The announcements are made in the appropriate places and the mixer output is recorded on another machine.

The second method entails passing the original tape through the recorder and recording the speech directly on top of the original material. The first obvious step is to prevent the erase head from removing the original music. On many machines this can be done by simply lacing the tape behind the erase head (see **fig. 1.**)

If at this stage an attempt were made to record the additional speech the results would not be very successful because the bias current in the record head would partially erase the material on the tape causing a sudden drop in level at the point where the tape amplifier was switched to 'record'.

Consequently the next step is to provide a control to increase the bias level gradually from zero, or near zero, to the required level for recording. Last month, methods of controlling the bias level were discussed, but the object then was rather different, namely to vary the bias level according to the tape used. In the present case, a much wider variation of the bias level is required, and a separate control for this specific purpose is desirable.

A wirewound potentiometer is connected in series with the bias supply to the record head (**fig. 2**). In normal use this control should be set to zero resistance. The actual value of the potentiometer will depend on the type of record head used, and some experiment will

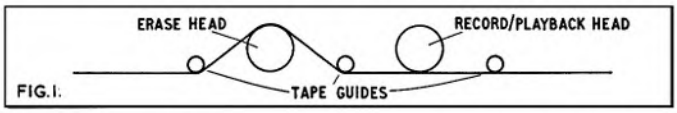

FIG.1.

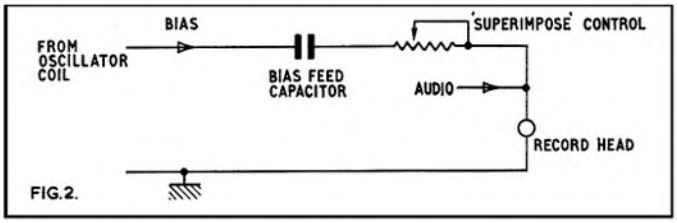

FIG.2.

be necessary before a suitable component is found. The main requirement is that when this control is set to *maximum* resistance, the bias current is so small that it does not cause any noticeable erasure of pre-recorded material.

A tape containing unwanted material should be passed through the recorder, the amplifier being switched to the 'record' condition.

The tape should be laced behind the erase head as explained. Several recordings are made with various resistances connected in series with the bias-feed capacitor, until the smallest value is found which leaves the original tape unaffected. A potentiometer of this resistance, or slightly higher, can then be permanently wired in place.

At this point, it would be well to point out that the bias supply to the record head should not be *suddenly* connected or broken away (when a tape amplifier is switched to the 'record' condition, the output from the oscillator grows from nothing to its full amplitude, and when the amplifier is switched back to the 'Play' condition, the oscillations are allowed to die away over a short period of time). If, during the tests to establish the optimum value for the potentiometer resistance, the bias circuit is broken, the sudden cessation of the bias current may cause slight permanent magnetisation of the record head. Similarly, the re-connecting of the bias circuit when the oscillator is operating can cause magnetisation of the head, because of the sudden surge of bias current. To guard against this, bias circuit alterations should not be made until the amplifier is switched to 'playback' (or, of course, switched off).

When a suitable control has been incorporated, the following procedure should be adopted to effect a superimposition :

(a) With the potentiometer set to maximum resistance, the tape amplifier is set to 'record'.
(b) the tape is started, and at the point where the announcement is required, the control is gradually rotated to its zero resistance setting.
(c) The speech is recorded in the normal way.
(d) The bias current is gradually reduced back to its minimum value (i.e. potentiometer at maximum resistance).

While this method can yield quite reasonable results, it should be realised that there is one main disadvantage.

High frequency signals on a tape are much more easy to erase than low frequency signals, as they are contained in the outermost parts of the tape coating. Because of this, when the bias current is gradually increased, the decrease in the volume of the music will be more prominent at the top end of the frequency range, giving a rather muffled quality. The listener's attention is, however, somewhat distracted from this effect by the speech, which will, of course, be recorded at normal quality.

If the degree of 'muffling' produced is not considered tolerable, some improvement may be gained by using a slightly reduced bias level for the recording of the announcement, by not rotating the control quite to its zero resistance position.

The result will be that the music volume will not be reduced to the same extent as before, and will sound rather clearer. The quality of the speech may sound a little harsh due to under-biasing, and a compromise will have to be found between having the music too

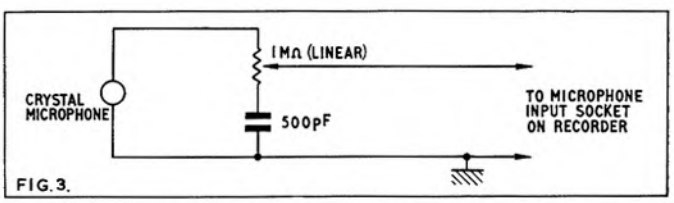

FIG.3.

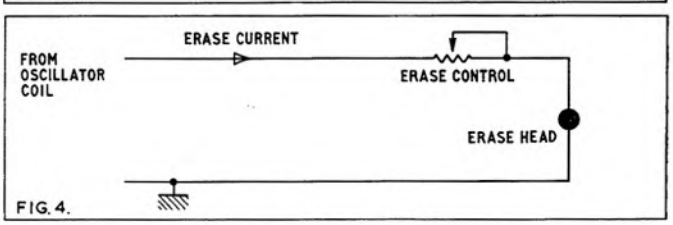

FIG.4.

woolly, and the speech too harsh. Some compensation for the harsh speech quality can, however, be taken. A simple top-cut circuit could be incorporated as shown in *fig.* 3, and adjusted by trial and error until the best setting is found.

Some practice is obviously necessary before the above method for superimposing material on to an existing tape can be used with confidence, but once the knack has been acquired, the facility can be quite useful.

Although 'fade-erasing' is not directly connected with 'Bias in Tape Recording', it is dealt with here as it follows naturally from the subject of superimposing. 'Fade-erasing' means gradually erasing a recording, so that when played back, the volume fades away to nothing.

All that is required for the fade-erase control is a wirewound potentiometer, of suitable value, in series with the erase head (see *fig.* 4).

The value used for this control is found in exactly the same way as for the superimposing potentiometer, and the same precautions should be taken to prevent accidental magnetisation of the *erase* head.

The fade-erase control is used in the following manner :—

(a) The superimpose control (if fitted), is set to maximum resistance, so that the bias current will be extremely small, and will

(continued overleaf)

have no appreciable erasing effect. If this control is not fitted, the tape should be laced behind the record head.

(b) The fade-erase control is also set to maximum resistance, and the tape passed through the machine, the amplifier being in the 'record' condition.

(c) At the place on the tape where the fade is required, the control is gradually rotated so that the erase current steadily increases to its maximum value.

The result will be that, on playing back the tape, the volume will be found to fade away, as required, but again there is the disadvantage that the high frequencies disappear before the low frequencies. Unfortunately there is no remedy for this.

This method of fade-erasing will be found useful on recordings where the tape has run out, before the end of the recorded material. A faded ending sounds very much better than an abrupt cut in the sound at the end of the tape.

One important point to be noted is that there will be some interaction between the two controls. Where both have been fitted, the tape need not be laced behind the erase head when superimposing is to be performed, since the erase head can, of course, be prevented from operating by setting the erase control to maximum resistance. This action will, however, cause an increase in the bias voltage due to the decreased load on the oscillator stage, so that when the superimpose control is rotated, it should be borne in mind that the optimum bias position will now be reached before the control is set to zero resistance.

On the tape recorders which have separate record and playback heads, the tape can be monitored while the superimposing or fading is being carried out, and good results are fairly easily obtained. On the majority of machines with a combined record-replay head, the tape will have to be played first, and then marked with chinagraph pencil in the appropriate places. Rather more skill is required when the tape cannot immediately be monitored, and it would be well to remember that a tape can easily be ruined by in-expert use of these controls.

247 ways of recording sheep

BY BILL RAWLE

CARTOONS BY ANSCOMB

FANTASTIC ! Incredible ! Amazing ! Terrific ! These are some of the adjectives, consonants and vowels used by people when confronted with the *Historian*. The imagination boggles all over the place at the thought of this truly remarkable recorder, which is due to be released to the British public about the same time as colour television, in the spring of 1983.

This machine is a little unusual due to its ability to pick up sounds from the past and transfer them to tape. As you know, sound waves travel through the air and you hear them when they strike the ear-drums. If someone shouts in your direction, dozens of shafts of sound are emanated, only a few of which are caught by the ears. The rest travel on past you. Where do they go ? On and on and on, say the experts ; indestructible and permanent, awaiting the time when they can be picked up and reproduced.

With the advent of the *Historian* that time has now come. Although the machine is not as yet available, I am acting as agent for some of the recordings that have been made on it, and the following are available from me at reduced price due to increased production and poor sales :

Tape 1 : Napoleon singing in his bathtub. 50ft. on 8¼in. spool, including 24ft. leader at each end. Price 5¾ gns.

Tape 2 : Nell Gwyn with the barrow wheel on her foot, yelling blue murder and "Oranges". 25ft. on 7in. spool. (Note—should you tire of this recording you can erase it and still be left with a perfectly good 7in. spool of tape.) Price 4⅜gns.

Tape 3 : "Doctor Livingstone, I presume." 4ft. double play tape on 10in. spool. Price 1⅜gns.

Tape 4 : "Kismet Hardy" (could be "Kiss me Hardy"—not very clear due to gun-fire in background). Price 3⅛ gns.

Tape 5 : Mr. Kruschev praises Stalin. "The great Leader." (Stop Press : All copies sold. Regret cannot reveal name of purchaser.)

Tape 6 : Economic Crisis Warnings. (Recordings available for each year right back to commencement of Parliament—state year/s required.) 4,800ft. hypo-thin tape on 3in. reels. Price 1s. 6d. each, or will exchange for transistorised mouth-organ.

Almost as exciting is the news of a tape recorder capable of translating foreign languages. The front of the machine is arranged with push-buttons, each button representing one of the principal languages of the world : Zulu, Welsh, Gaelic, etc.

Converting to Mono

Precisely! Precisely! Precisely!

First you record in English on Track 1. Then rewind to the start and press button marked with appropriate language. The recording will then be translated on Track 2. I have pledged my word not to provide technical details for very obvious reasons.

But think what this means ! No more language lessons. And what a spectacle ! Esperantists weeping on each others' shoulders, language professors and interpreters queueing for the dole, language records being moulded into ashtrays.

A *Single-Speak* model is to be called the *Corrector*. When a Cockney, Oxford, or other accent is recorded the machine replays the words in perfect English. It is rumoured that the BBC have already been inundated with applications for jobs as News Readers.

Rumour has it that the Army will use tape recorders for giving drill commands. Suitable amplification will be provided, allowing the Sergeant-Major time to nip off for a cup of tea while the troops are legging it up and down the parade ground. The tape machine is of uniform pattern, operated by means of brass buttons. The finish is pastel khaki.

Only the highest quality recorders may be used for such works, however. On one occasion, when a very cheap tape machine was used, the needle stuck and, since no order to halt was given, a squad of recruits at Catterick Camp in Yorkshire marched right off the parade ground and was eventually located approaching the outskirts of Nottingham.

Now that summer is upon us, it is time to get out and about with a battery portable, and I have exciting news of an exciting competition with exciting prizes to be won.

(continued on page 243)

Regret cannot reveal name of purchaser

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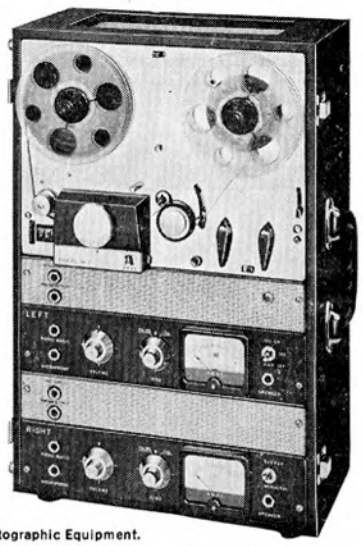

AKAI Model 345. 4 track, 2 speed, full stereo or monaural, fully automatic operation, protected circuit, automatic re-play device, total output 20 watts, V.U. meters, remote control. Basic price **£208.19.0.** Remote control **£6.10.0**

AKAI Model 707. 2 track, 2 speed monaural, V.U. Meter, single touch speed control, automatic shut-off device. Total output 6 watts, Complete with microphone, recording tape, empty reel, reel caps, service cables, and full instructions. **£88.4.0**

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247 WAYS OF RECORDING SHEEP — CONTINUED

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2nd Prize : (Original Family Favourites record of Fingals Cave). For the best recording of snowflakes (no background music please).

3rd Prize : (Sound-cancelling microphone). For the first received tape, publically announcing the abolition of taxation. (Remember, only the *first* tape to arrive qualifies for the prize.)

Just at the moment I am very busy preparing the first of twenty-four articles. The subject ? 'How to Convert to Mono.' These articles will be for the benefit of those of us who have reached an advanced stage in stereo sound reproduction, and having reached the 'peak', cannot make anything sound better than it is already. They have nothing left to fiddle-faddle with. Their ears are constantly straining for a 'new experience in sound'. Wait till the Ad writers get to work on them :

". . . the startling neo-realism of monophonic single-channel sound will leap at you dazzlingly from a single loudspeaker, and dazzle you with its brilliance . . ."

". . . hear the amazing effect of a railway train approaching from the corner of the room and disappearing into the same corner . . ."

". . . listen to the startling sound of a brass band as it marches backwards in a tight circle . . ."

Diagrams will be given, clearly illustrating the parts to be removed and the precise height from which they should be dropped into the dustbin. Later on you can sell the invalid chair you used for manoeuvring between the stereo speakers—or convert it into a microphone boom.

Passing Thought : What a pleasant sight it was at Xmas to admire some dealers' windows displaying tape recorders covered in artificial snow. Soon we may expect to see a sign in the same windows : 'Snow Plough Optional Extra'.

TAPE RECORDER SERVICE — CONTINUED

control is turned. Its action is quite obvious on inspection, and there is little to go wrong except when springs become weak or levers bind. The pressure roller arm is pulled into engagement by springs—there are three of these giving the necessary directional moment—and is held off by the cam pushing forward its outer end. The end of the pressure arm beyond the roller is used to engage the tape pads and push the riding plate inwards. The pads are mounted on a leaf spring, which can be bent slightly to adjust pressure.

Drive is by belt **E** from the motor pulley **M** to the flywheel. This is a flat belt. The clutch of the right-hand spool carrier is driven by another belt, of round section. A large felt pad is fitted between the belt pulley and a stepped spindle is spring-loaded, and has its bearing in the lower section of the deck-plate. Freedom to rotate is important, as is cleanliness of the felt pad. There is a small felt pad and helical spring beneath the feed spool carrier. A roller at the outer end of the main lever **G** engages the main belt with the feed spool drum for fast rewinding.

Correct braking is vital on this machine, and the brake system, as shown in **fig. 3,** is set not only for correct stop action, but for minimum spillage at full and empty spool positions. The brake **H** contacts the feed spool drum, and the action of the main lever is again determined by the position of cam **D.** Spring **J** is important, as is the correct lateral position of the lever. As this item is padded at the ends, it is necessary to check the last point by repeating the tests after adjustment, with the top plate in place. The brake spring can be bent for final adjustment—remembering to check with a near-full and also a near-empty spool loaded.

The take-up spool has a separate brake, attached to a spring blade at the outer end of the pressure arm. A refinement to the action of this assembly is a muting switch which is actuated on the full clearance of the brake. This should be an early check if intermittent playback is noted.

The electrical adjustments are simple, and the two main presets are shown in **fig. 4,** with the principal parts below the deck-plate, including the Record lever, cam and switch previously mentioned. The 500K preset **K** is used to balance out hum, and should be adjusted with the volume control at maximum. The head shield can also be adjusted to reduce hum, and the reading taken with a valve-voltmeter across an 8-ohm dummy load at the Extension Speaker sockets should not exceed 6mV.

The other preset **M** is used to set the signal level, or modulation indication. One peculiarity of this machine is the fact that the heater of the indicator is powered from the cathode of the oscillator valve. This means that it is not possible to 'kill' the bias in the normal way,

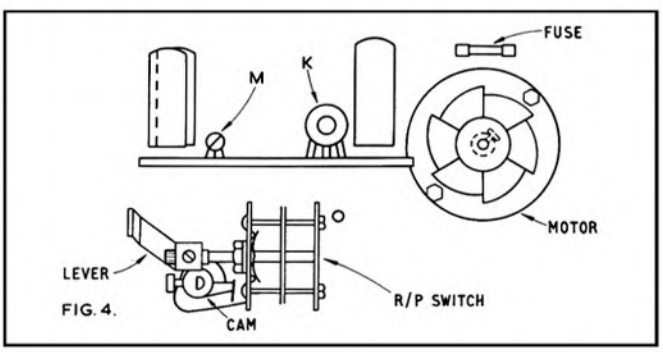


FIG. 4.

as is desirable when setting the level indicator. An RF filter is recommended, consisting of a 60mH coil in series with a 0.0005 μF capacitor across the bias feed circuit, that is across the Record/Play head at the input end of the equaliser network. If a high level signal is now applied, at 1 Kc/s, 10 dB down on maximum signal level, with the volume control adjusted for a valve-voltmeter reading of 7½V, the preset **M** can be adjusted until the green light just disappears. Remember that on this type of indicator, the light beam decreases as the negative voltage to the grid increases.

The foregoing notes are applicable to some extent to other machines in the Sony range, and in the next article it may be necessary to refer to one or more of these diagrams when dealing with other machines.

A STUDIO QUALITY MIXER

BY D. P. ROBINSON **PART 2**

'more mechanical details and the power supply'

LAST month the design and theory of the mixer were discussed at some length, ending with the major dimensions of the cabinet and metal-work so that a start could be made on the construction. This month's article will describe the manufacture of the quadrant fader assemblies which are the main contributors to the small size of the comprehensive mixer. The power supply for the unit will also be given, so that with this built and tested, it will be easy to test the remaining circuitry, which will be given fully in the following articles of this series. This power supply is also useful as a general-purpose bench unit, and can be designed to be variable over a range for use in other circumstances.

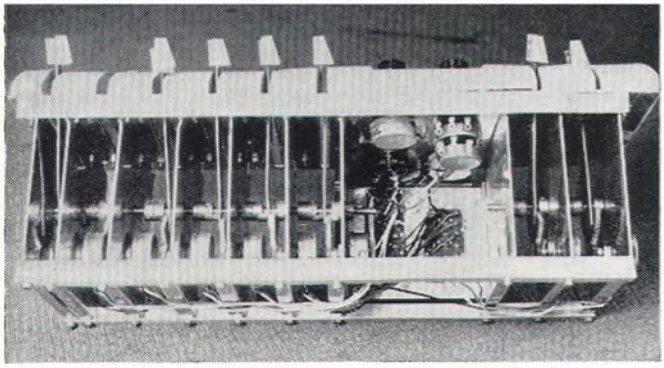


Fig. 2(a): *Complete assembly of potentiometers with control levers.*

The fader rack is a self-contained chassis, allowing the entire assembly to be removed from the mixer. This eases considerably the wiring, and any maintenance necessary is made much less difficult. All the electrical connections are made through a pair of multiway sockets on the rear of the chassis, which means that the removal of the unit is simple and quick.

A professional stud-fader operates with a sliding contact on the moving arm, making contact with a row of plated studs; resistors are connected between the studs to form a potential divider which is thus tapped by the moving contact. An extremely long life is achieved, but the studs need regular cleaning, and in practice it is found that there is little to choose, in terms of noise or life, between stud-faders and sealed moulded carbon potentiometers. The stud type is only preferable when extreme accuracy is required for a given rotation of the control, since this is determined by the accuracy of the resistors in the chain. A stud-fader is very expensive to make, and this design uses normal potentiometers with a pair of gear wheels to provide the quadrant action. Two wheels are required per fader, one large (120 teeth, brass) and the other small (32 teeth, steel). Both gears are 64 dp. and can be obtained from *S. H. Muffett Ltd.*, of Mount Ephraim Works, Tunbridge Wells, Kent, at a cost of 4s. 9d and 12s. 6d. respectively, together with the $\frac{3}{16}$ in. shaft and $\frac{1}{2}$ x $\frac{1}{4}$ in. brass collars also needed.

The operating arm is made from steel, for strength, and is shown in detail in **fig. 1.** The topmost part is shaped to suit the type of knob chosen; the prototype used, the *Painton EM* variety, but these are a little expensive at just under five shillings each, and it would be cheaper to adapt another type to suit, or possibly to try to make some from fibreglass. The feel of the EM knobs was so obviously correct that for the prototype they were the only choice. The wider end is drilled with a $\frac{1}{2}$ in. hole so that the arm is a snug fit over the boss in the larger gear wheel, and is fastened to the wheel by a 6 BA screw into a tapped hole in the gear. For economy the large gear wheel is cut in two, and to each side of each half is brazed one of the $\frac{1}{2}$ x $\frac{1}{4}$ in. brass collars. This gives the assembly a degree of freedom from moving along the axis of rotation, which from the operator's point of view is aggravated by the length of the lever. The assembly is shown in **fig. 2 (a)** and **(b)**, which also indicates that *Araldite* was used as the author did not have easy access to brazing facilities; in use this has proved to be entirely satisfactory, although there is no doubt the brazing method is to be preferred.

Figs. 3 and **4** together show the arrangement of the fader rack. The framework should be made first, commencing with ten identical side pieces. Detail (1) in **fig. 3.** If possible a simple jig should be made for these to ensure that, when bent as shown, the holes on the centre line are concentric, since these are the ones which carry the the shafts and potentiometers; the other hole is for a grommet and is used for the wiring. If it is not possible to make a suitable jig, the lower hole is best made slightly elliptical so that correct meshing of the gears can be achieved. The deck plate is made in 16 SWG aluminium, Detail (2), with eight slots cut; by itself this is now very flexible, so two pieces of $\frac{1}{2}$ x $\frac{1}{2}$ angle, $\frac{1}{2}$ in. shorter than the plate, are fastened one on each side, and this also forms a ledge for fixing the fader rack to the mixer box. The side pieces are then screwed to the plate, three at one end and seven at the other, as shown in the exploded diagram. The outermost plate in the group of seven is reversed relative to the others so that the deck plate projects clear of the assembly for mounting. A further two angle pieces are then added to the bottom of the rack.

Shaft Assembly

Two shafts are used to leave the centre section free for the multiway plugs for the electrical connections, and it is best if the short one is assembled first. The shaft is introduced from the outside end, and in order between the two sections are added a control arm assembly and a $\frac{1}{2}$ x $\frac{1}{4}$ in. brass collar. Finally, a collar is added on the outside of the shaft to prevent it sliding further into the rack. The arm assembly is then pushed hard against the right-hand plate, looking from the front, and the collar on its left brought up to the assembly and screwed down to the shaft. In this way the assembly cannot move along the shaft, but is free to rotate since it is not fixed to it. It would be possible to devise a system of locking the arm to the shaft for ganging potentiometers together, but it was thought that this would be an additional complication.

The centre hole in the steel 32-teeth gear wheel is then enlarged to $\frac{1}{4}$ in. diameter, if possible with a tapered reamer to ensure concentricity, and an 8 BA grub-screw fitted to the boss in a suitable place to hold the gear to a flat on the potentiometer spindle, which should be cut as short as possible. The potentiometer fits on the outside of the end plate, and the gear inside; all the controls are 5K with a log-law track. Meshing of the gears is important so that the control is neither too stiff or slips teeth when moved. When this is correct, and the position is such that the arm just does not hit the deck plate at either end of its travel, the potentiometer nut is tightened. The long shaft assembly is put together in the same way.

This completes the rack with the exception of the curved pieces which carry the cursor indications of the potentiometer settings. These proved to be difficult to make easily in metal, and the final technique adopted was to make the side pieces in Bakelite laminate cut to shape and then placed on either side of a wooden block which is about $\frac{1}{8}$in. undersized all round. Fibre-glass paste is then spread over the mould, and when dry the surface is sanded smooth. The former is then withdrawn for the next piece. The centre section is made in a similar way except that an aluminium plate is let into the fibreglass for strength. Four holes are made in this to let the shafts

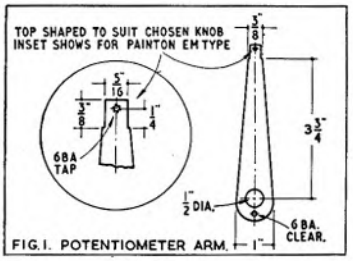


FIG. 1. POTENTIOMETER ARM.

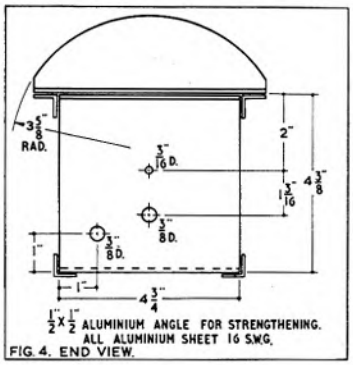


FIG. 4. END VIEW.

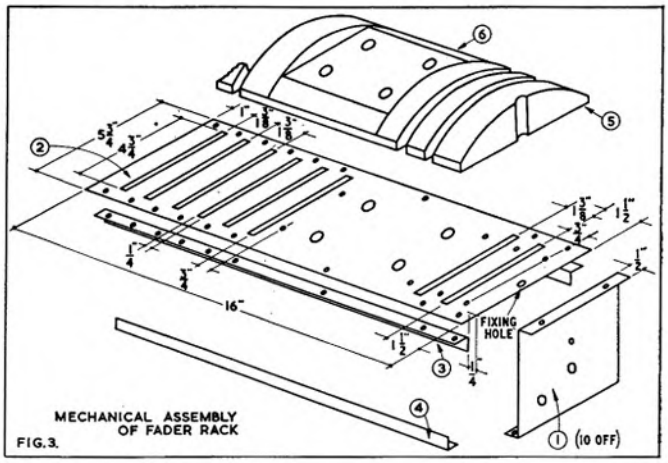


FIG. 3. MECHANICAL ASSEMBLY OF FADER RACK

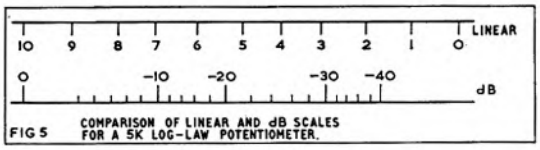


FIG 5 COMPARISON OF LINEAR AND dB SCALES FOR A 5K LOG-LAW POTENTIOMETER.

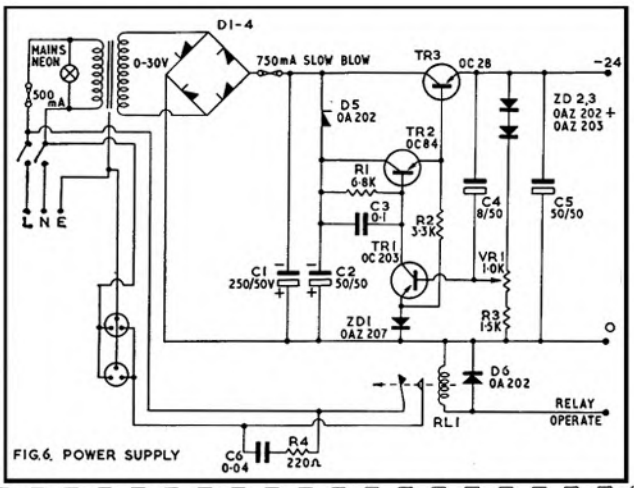


FIG. 6. POWER SUPPLY

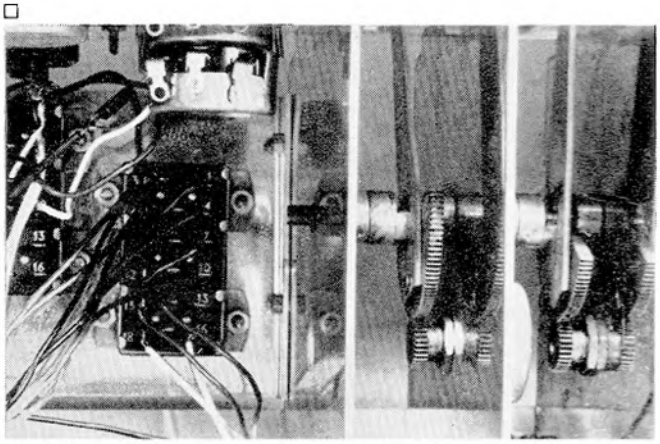


Fig. 2(b): *Close-up view of part of Fig. 2(a), showing connections to socket and the engagement of the toothed wheels.*

of four subsidiary potentiometers pass through. In the prototype these were two for panning control, one for earphone balance and the other for earphone volume.

These curved pieces are then fixed with *Araldite* to the deck plate, although the main centre section is bolted so that it can be removed should it become necessary to change any of the potentiometers immediately below. The assembly is then painted and lettered to suit with either *Lettraset* or *Panel Signs* transfers. An arbitrary scale of 1 to 10 was chosen ; if required a dB scale could be used instead, although the log-law track in most potentiometers will only give an *approximately* linear scale in decimals. For interest, the two scales in **fig. 5** were drawn up, the one merely by dividing the scale length into ten equal parts, and the other by accurate measurement of the output voltage. Apart from the very open scale at the top end, the dB side is very usable, and does have the advantage that if the meter shows a 3 dB overload, the control knob can be moved to exactly the correct position. The dB scale gives a more precise meaning to the position of the knob, although it is easy to become accustomed to either.

This finishes the mechanical work to the rack, and all that remains to complete it entirely is the electrical wiring of the potentiometers to the multiway sockets, which are held on a simple bracket between two side pieces in the centre section ; this can be seen in **fig. 2** at the bottom at the back. Any scheme can be adopted for the wiring ; the prototype used one plug for the inputs to the potentiometers, and the other for the outputs. For all the wiring, single conductor pvc-covered wire is suitable, since no screening of any of the leads is required ; this is another benefit of low impedance transistor circuitry which certainly makes construction much simpler. The earthy ends of the controls are looped together and taken to a single pin on the plug, and the metal frame of the rack is earthed to the main metal-work of the mixer via another pin.

The final topic to discuss in this article is the power supply for the mixer. It is possible to run the mixer from a battery, but with the indicator lamps some 200 mA is required. While this is not large, it means an accumulator is best used so that it can be recharged when necessary. On several occasions, however, the standard large flash-lamp batteries have been used in series, but if the instrument has a lot of use this will prove to be expensive. For nearly all occasions there is a nearby mains electricity supply, and it is easiest in these cases to use the power supply, which also makes a convenient bench unit to power experimental circuits and similar projects in the work-room.

(continued overleaf)

Since the load on the supply may vary from one situation to another, the unit is best designed to be stabilised, that is to adjust the output voltage automatically to the required value regardless of the current drain. This has the advantage that the output impedance is low (constant voltage source). If the mains transformer is not well screened there is a possibility that its field will cause hum pick-up in the microphone input transformers, and so the complete supply is built into a separate box on the end of a short length of lead.

Series Regulator

The circuit is shown in **fig. 6,** and follows a standard type of design known as the series regulator. The basic operation is as follows. The emitter of the transistor TR 1 is held at a fixed potential produced by a zener diode ; a fraction of the output voltage is applied to the base and the amplified difference is used to drive the double emitter-follower of TR 2 and 3 and provide the output voltage. Any change in this output is fed to the amplifier and is applied out-of-phase to the base of the output stage, thus tending to correct the original change. In the same box there is a 24V relay with a set of mains O.5A-p make-contacts, which is operated by a key on the front panel of the mixer, and feeds two utility sockets on the case of the power supply. Usually these are connected to green lights in the studio or recording toom to cue the action to be recorded. Across the contacts is connected C6 and R4 to suppress any mains clicks (caused by the operation of the relay) which may pass to any other equipment being used—although the power pack would not be affected as it has its own built-in smoothing for this. The diode D6 across the relay coil damps the inductive voltage produced as the relay is de-energised. Next month will see the description of the signal path from the microphone amplifiers through the mixers and to the output stages which will leave only the monitoring circuits and meter to be described, and this is hoped to be the subject of the fourth in this series.

TAPE, RECORDERS & ACCESSORIES

FIRST DETAILS OF NEW PRODUCTS

★ GRUNDIG TABLE RECORDER ★

DESCRIBED as a Table Console Recorder, the recently introduced *Grundig TS* 19 is housed in a walnut cabinet. The 21½ x 13 x 8¼in. recorder provides storage space for accessories and is fitted with a detachable lid. Claimed frequency range, at the single speed of 3¾ i/s, is 40 c/s to 14 Kc/s. The 2.5W output is fed into an 8⅛ x 4⅜in. elliptical speaker. Output sockets are provided for hi-fi amplifier, extension loudspeaker, and monitor headphones. Internal mixing of microphone (2mV at 3 Meg.), radio (4mV at 50K) and pickup (400mV at 1 Meg.) is allowed for.

Maximum playing time using LP tape on two tracks is two hours, and the rewind speed 3¾ minutes. Weighing 29lb., the TS 19 retails at £56 14s. **Manufacturer : Grundig (Great Britain) Ltd., 40 Newlands Park, Sydenham, London, S.E.26.**

★ NEW PHILIPS BATTERY PORTABLE ★

DOUBLE-track recording on tape $\frac{3}{20}$ in. wide gives the *EL*3300 a total playing time of one hour on a single cartridge. Weighing 4lb., the machine is acclaimed as a "logical outcome of miniaturisation". To this end an ingenious winding system has been used, based on the principle that when one hub is filled with tape the other is almost empty. The distance between the two hubs is little more than the radius of one full reel of tape. As one reel grows so the other diminishes in size until the take-up hub is finally filled with tape considerably overlapping its original position.

The tape runs in the standard left to right direction but is wound with the oxide layer facing outwards. The miniature erase and record playback heads come out to meet the tape, thus eliminating the need for pressure pads. Both heads are fed with AC bias to cut down background noise. Running at 1⅞ i/s, the tape is driven by a tiny capstan "the size of a small nail" which remains locked against its pinch-wheel when set at Pause.

Operation is almost foolproof as a single control governs all mechanical functions. The front panel houses this together with a record-interlock and combined gain/battery-life meter. Two rim-operated controls on the side of the recorder vary recording gain and playback volume.

Measuring 4 x 2½ x $\frac{7}{16}$in., the cartridges can be fitted with one hand and are visible through a Perspex window, for the purpose of calculating recording time. Each cartridge contains 300ft. triple play tape and retails at 19s. 6d. A mu-metal shield is also fitted in the cartridge to provide screening for the record/playback head.

Battery life, using five 1.5V cells for two hours per day, is 20 hours. The specification quotes wow and flutter as being 1% peak-to-peak.

*Loading a cartridge into the EL*3300 *is a foolproof operation. It is held in position by plastic clips.*

Frequency response : 120 c/s to 6 Kc/s ± 3 dB. Signal-to-noise : better than 40 dB. Rewind time : 70 seconds. Dimensions (in leather carrying case) : 8¼ x 6½ x 2½in. Cabinet Dimensions : 7¾ x 4½ x 2¼in.

Selling at £26 5s., the EL3300 is supplied complete with leather case and shoulderstrap, microphone and recording lead.

The microphone is thoughtfully provided with a 'tiepin' attachment with which it can be fitted to the operator's clothing or to a table—stand also supplied. An interesting feature is the remote-control switch which may be fitted to the microphone or worked from the pocket. Two DIN plugs connect the microphone and switch with the recorder. The remote switch simply interrupts the motor and amplifier current supply, thus giving Pause facilities as distinct from 'on-and-off'.

Music, as well as speech, is claimed to be faithfully recorded and reproduced through the recorder's 2½in. speaker. The transistor amplifier has an output of 250 mW and may be connected directly to other equipment via an external amplifier output giving 0.5V at 20K. A single input is provided for recording from the microphone and high level source. The latter is connected through a resistor inside the direct recording lead's plug to prevent overloading the 0.3V, 2K input.

Various accessories are obtainable including a battery eliminator and headphones. These can also be used on the *EL*3586 battery recorder which will remain in production and is not superseded by the EL3300.

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

* * *

Sound Effects and Electronic Music

ELECTRONIC music and *musique concrete* are the subject of Castle EFX-2, recently issued by Recorded Tuition. Four passages are featured under the titles of 'Delta F', 'Study in Sinetones,' 'Sound Object' and 'Montage'.

A second recording, of sound effects, is contained on BGX-1, comprising sea, wind, rain, thunder, factory, and traffic sounds. Both are available as 45 rpm discs and 3¾ i/s full-track tapes, price 8s. and 18s. 6d. respectively. **Manufacturer : Recorded Tuition Ltd., 174 Maybank Road, South Woodford, London, E.18.**

TAPE RECORDS REVIEWED

● *In response to requests from many readers we are now adopting a new approach to tape record reviews. Previously we have compiled a composite review of all the tapes mentioned each month, but from now on each tape will be covered separately by an individual critic. The initials appearing beneath this month's reviews are those of George Goodall (G.G.) who deals with classics, and Tony Farskey (T.F.) who handles jazz and folk music.*

PASTORAL SYMPHONY (No. 6 in Fmajor), Beethoven. Philharmonia Orchestra conducted by Otto Klemperer. **Columbia TA-33CX 1532,** 3¾ i/s mono twin-track, 35s.

BEETHOVEN, in writing his Pastoral Symphony, set out to give a musical impression of the joys of the countryside. In this performance it is with a gentle, steady pace that our "pleasant feelings on arriving in the country" are first awakened. Klemperer chooses a sensible tempo for the first movement and the orchestra plays with persuasive charm. In the second movement, too, our feelings are pleasant as the brook gently ripples by. I did feel, though, that the peasants' merrymaking in the third movement could have been sprightlier. Beethoven's marking here was "allegro" and in the first movement "allegro ma non troppo", so the pulse of the third movement should be a little quicker than that of the first. This difference I felt was not made obvious enough, as if our visit to the country was on a hot day and the peasants' gambols were inhibited thereby. However, the storm arrives with convincing vigour, and the shepherds' song is sweetly sung.

The recording could be described as adequate for domestic machines. On wide-range equipment the frequency range sounds restricted and there is a hard edge to the string tone in loud passages. The recording was first published in 1958, and standards have improved since then. **—G.G.**

JOSH WHITE — SINGER SUPREME. A dozen songs on **World Record Club TT 298,** 3¾ i/s mono twin-track, 29s.

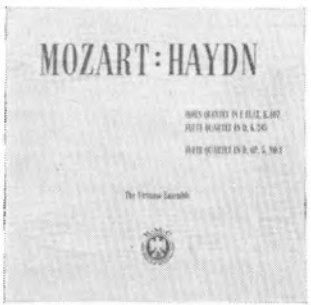
JOSH White, we are told, acquired his considerable instrumental and singing technique as a result of acting as a guide and accompanist to such great blues performers as Blind Lemon Jefferson. As a singer of spirituals and blues Josh has interpreted American folk and blues for a mass audience, paving the way for many great blues singers to be heard by millions all over the world by way of TV, records, radio, and the concert hall.

It is worth recalling that at the end of the Second World War, when the catalogues of the major British record companies were almost empty of folk and blues, Josh White was among the earliest artists to fill this gap with the first recording issued here of the protest song against lynching, *Strange Fruit*.

On this tape Josh White sings twelve songs ranging from the moving spiritual *Mumbling Word*, to a rocking treatment of the blues *Mean Mistreater*. Although his powerful inventive guitar playing is adequate enough by way of accompaniment, for a number of the songs a rhythm section is added. The addition of piano, drums and bass adds much to the performance of *Boll Wevill*, and to *Mean Mistreater*, which is my favourite from this tape.

During the early forties Josh White was singing songs of social significance in New York's Greenwich Village; *Hard Time Blues*, which is about the plight of the share croppers in the depressed South, dates from this period. My only regret concerning this tape is that it does not include a few more such numbers, so well suited to Josh White's Blues style.

The particular version of such songs as *Frankie and Johnny* or *Nobody Knows You* may not prove to be your favourite performance, but each and every item is given interesting treatment to make this a tape worth having, if you are at all interested in folk and blues of the sophisticated kind. The recording quality is superior throughout.—**T.F.**



MOZART, HAYDN CHAMBER MUSIC. Horn Quintet in E flat (K.407) and Flute Quartet in D (K.285) (Mozart). Flute Quartet in D, Op. 5 No. 1 (Haydn). Virtuoso Ensemble. **World Record Club TCM5,** 3¾ i/s mono twin-track, 29s.

THE kind of music we refer to as 'chamber music' was generally established in its form by Haydn and Mozart. Very often the composer joined with friends and associates in performing the music, and sometimes, when composing, would have a particular performer or group of performers in mind. Such is the case with Mozart's horn quintet played on this recording. Mozart wrote the horn part for his friend Leitgeb, a Salzburg cheese maker.

On this record, John Burden plays the horn part with dexterity. The light and lively first movement is followed by a calm tuneful second movement. The Finale is an irrepressible romp of a rondo.

The Mozart flute quartet is also very attractive music. In his published collection of letters, Mozart often displays a distaste for the flute; listening to this quartet one could be excused for not believing him. The work follows a similar pattern to the horn quintet, with its lively outer movements and central 'andante'. The flautist, Edward Walker, plays expressively throughout, particularly so in the second movement, a sustained melody on the flute with a background of pizzicato strings.

It is interesting to hear the Haydn flute quartet juxtaposed with one of Mozart's. This is one of the six flute quartets written by Haydn and it sounds—in direct comparison—a much simpler sort of music. Its four movements are all short and straightforward. Nevertheless the Virtuoso Ensemble give the impression of enjoying playing this music as much as I enjoyed listening to it.

Unfortunately the quality of the recording could be better. The balance between the instruments is good, but on the review copy

there was a slight, but definite, 'buzz' overriding the horn and flute tone at intervals throughout the whole tape. Doubtless this defect would be less noticeable on a tape recorder's internal loudspeaker. And must half of Track One be left blank? One feels that a little Haydn flute trio, or something of the kind, could have been nicely tucked in here.

It was a happy notion on somebody's part to make this issue. A pity that its potential is not completely realised.—**G.G.**

MEET ME IN CHICAGO. Jimmy McPartland (trumpet) and Art Hodes (piano), each with a supporting team. **World Record Club TT 297,** 3¾ i/s mono twin-track, 29s.

THE names of the jazzmen on this recording read like a directory of Chicago jazz: Jimmy McPartland, Art Hodes, Bud Freeman, Floyd Bean, George Wettling, George Brunies, Pee Wee Russell and Earl Murphy, all have contributed many pages to jazz history.

This assembly of talent was made possible by careful planning of the recording session to coincide with a Chicago concert date, to enable a number of visiting musicians to meet-up with some others who were resident in Chicago. Two groups were formed, one led by pianoman Art Hodes and the other by Jimmy McPartland on trumpet.

The routines are varied: both groups playing together, groups sharing alternate chorus, plus of course successions of breaks and solos. Both groups playing together is the least satisfactory part of this tape; it just doesn't sound properly integrated.

The solo honours must be awarded to tenor player **Bud Freeman,** his playing throughout is quite outstanding. McPartland, Hodes, Trottier, Dickenson and Russell also come through with some fine solos. An informative set of notes with the tape give very adequate details of who plays what and when.

The best numbers are: *You Gotta See Mama Ev'ry Night, Logan Square* and *Deed I Do*. The second track ends with a slow relaxed blues which alone makes this a worthwhile tape. The recording quality is good, but with a little drop-out here and there.—**T.F.**

THE WATER MUSIC. Handel (Ed. Boyling). Suite No. 1 in F Major, No. 2 in D major, No. 3 in G major. Bath Festival Orchestra directed by Yehudi Menuhin. **HMV TA - ALP 2028,** 3¾ i/s mono twin-track, 35s.

HANDEL'S *Water Music* is best known to many music lovers through Sir Hamilton Harty's arranged selection from the original. The Harty Suite selects six movements and scores them for larger orchestra, with the addition of flutes, clarinets and tympani. Handel's original was a more extended composition. Commissioned by George I, it was first performed in July 1717 and, of course, the orchestra of the period was smaller than the concert orchestra for which the Harty Suite is arranged.

The Bath Festival Orchestra here plays the complete *Water Music* with orchestral scoring closer to the original. The suites have a total of eighteen movements between them. It is all played with great relish and style—King George I would have loved it. How very pleasant the recorders sound, playing their parts in the second minuet of the G major suite and in the final allegro.

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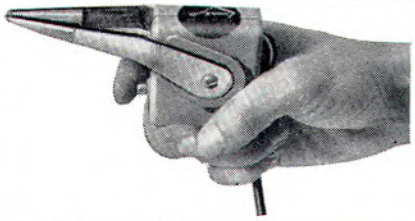

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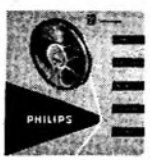

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