


AMATEUR TAPE RECORDING



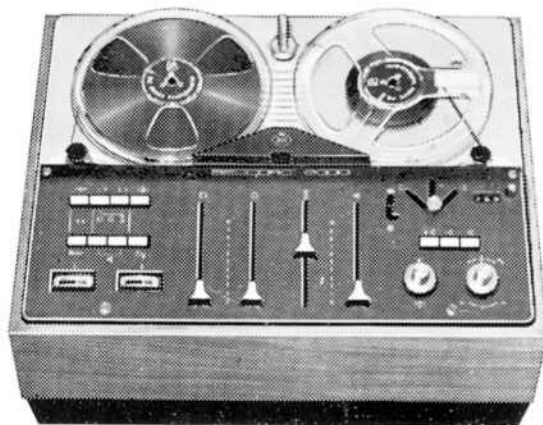
Audio Festival
Preview F.M.
Tuners: E. A. Rule
Loudspeakers:
D. J. Barnett/Video
Recording:
N. Rutherford
History of Stereo:
H. Burrell Hadden

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◀ **Beocord 2000 K**, prize-winner at the 1964 Hanover Fair, a Supreme example of B & O audio engineering. The first all-transistor hi-fi stereo tape recorder with a professional specification which has been acclaimed in international trade and tape-amateur circles for its carefully planned design, advanced features, and outstanding performance. The BEOCORD 2000 K is the ideal tape recorder for the enthusiast whose only interest is perfection. Available in a 2-track & a 4-track version. **112 gns.**



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◀ **The Beocord 1500**—the very latest tape recorder from Bang and Olufsen. Based on the design of the Beocord 2000 this new tape recorder is technically identical but does not have mixing facilities or an output replay amplifier and is intended for the enthusiast who already owns a high quality hi-fi system yet desires the inherent qualities of the famous B & O Beocord 2000. The Beocord 1500 is available in a choice of Teak or Brazilian Rosewood finish. Dimensions $8\frac{1}{8}$ " high, $17\frac{3}{4}$ " wide, 14" deep. **Price 89 gns.**

Available only through appointed dealers of quality, Bang & Olufsen products are on permanent exhibition at our new London Showroom, 70/71 Welbeck Street, London, W.1.

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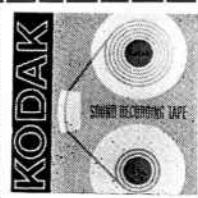
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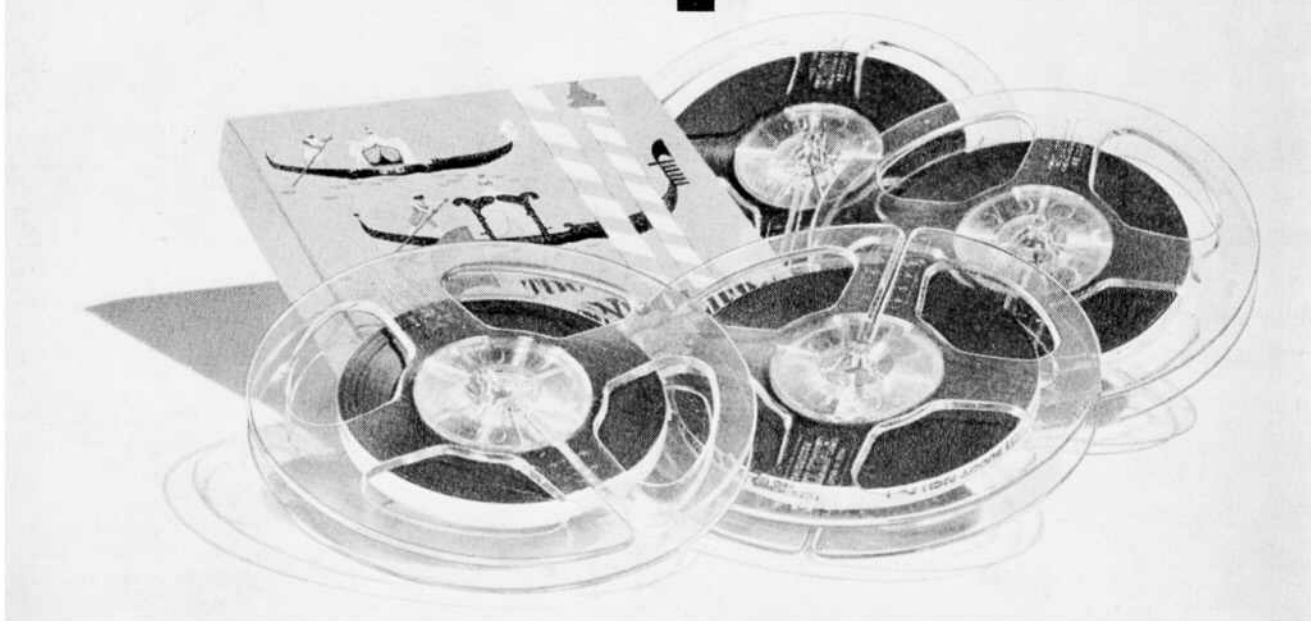
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25 Ian Wallace, Joyce Blair and chorus. Some I enchanted by song. I'm in Love With a Wonderful Guy, and all the unforgettable songs from this great musical. Also in stereo.



28 Star cast sing Beautiful Morning, Out of My Dreams, Surreys with the Fringe, People Will Say We're in Love and all the immortal hits. Also in stereo.



59 The slyest 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.



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



10 Tchaikovsky Violin Concerto. Tossy Sprekowsky with Walter Goehr and USO in a superb performance of this melodious work. Also in stereo.



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



12 Beethoven Eroica. Symphony. Josef Krips conducts the London Symphony Orchestra in a masterly performance of this monumental work. Also in stereo.



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



74 Superb Sarah Vaughan in 10 great numbers. If I Loved You, Saturday, It's Delovely, You'll find me there, etc. Every one a hit.



108 Stormy Weather. Sweet Charlie, Somebody Loves Me, Hold Me, I Can't Love You Anything But Love, 7 more top numbers all with Fabulous Peggy Lee.



106 Mel Torme's velvet voice in 12 top numbers, Body and Soul, 'Round Midnight, Blues in the Night, That Old Feeling, Where Can I Go Without You, etc. Also in stereo.



14 Tchaikovsky's Symphony No. 5. Sir Malcolm Sargent and USO combine to give this famous symphony a dramatic and colorful rendering. Also in stereo.



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



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



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



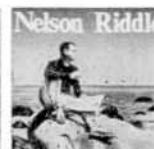
77 In the Mood, Bagel-Call Rag, Chattanooga, Choo-Choo, Serenade in Blue—4 original tracks by the immortal Glenn Miller and his band.



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



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.



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.



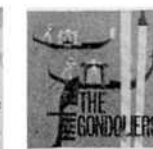
117 Strauss' most popular waltzes—Blue Danube, Emperor, Vienna Woods, Voices of Spring, Roses from South, Vienna Symphony under Rudel. Also in stereo.



111 Ravel's Bolero, Dukas' Sorcerer's Apprentice, Chabrier Espana, Falla Ritual Fire Dance and Dance of Terror, Scherchen conducts Vienna S.O. Also in stereo.

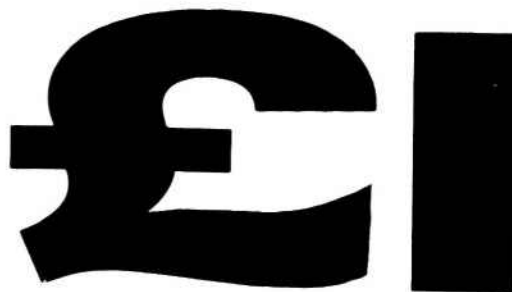


112 Faust Ballet Music: Dance of the Hours; Aida March, Ballet Music; Coq d'Or Hymn to the Sun, Vienna Symph. conducted by Aliberti. Also in stereo.



163 Take a Pair of Sparkling Eyes and all the great songs from Gilbert and Sullivan's Gondoliers. Star cast, Westminster S.O. Farn-Linden Singers. Also in stereo.

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Made For Me, Secret Love, I Believe, Anyone Who Had A Heart, Do-Wah-Diddy-Diddy, My Boy Lollipop, World Without Love, As Usual, Can't Buy Me Love, My Guy.

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129. Name your 12 top hits from musicals in the last 10 years. Here they are, newly sung and arranged with today's wide sound and big beat. If I Ruled The World, Getting To Know You, Some Enchanted Evening, Tonight, 8 other hits.

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131. If you like blues then this is a must. The great Ray Charles sings See See Rider, Kissa Me Baby, Blues Is My Name and 8 more. Available in Mono only.

127. The Seekers, new pace-setting group from Australia, already regulars on TV—and a great hit at the Palladium, The Ox Driving Song, The Irish Love Lilt, Chilly Winds and 9 more.

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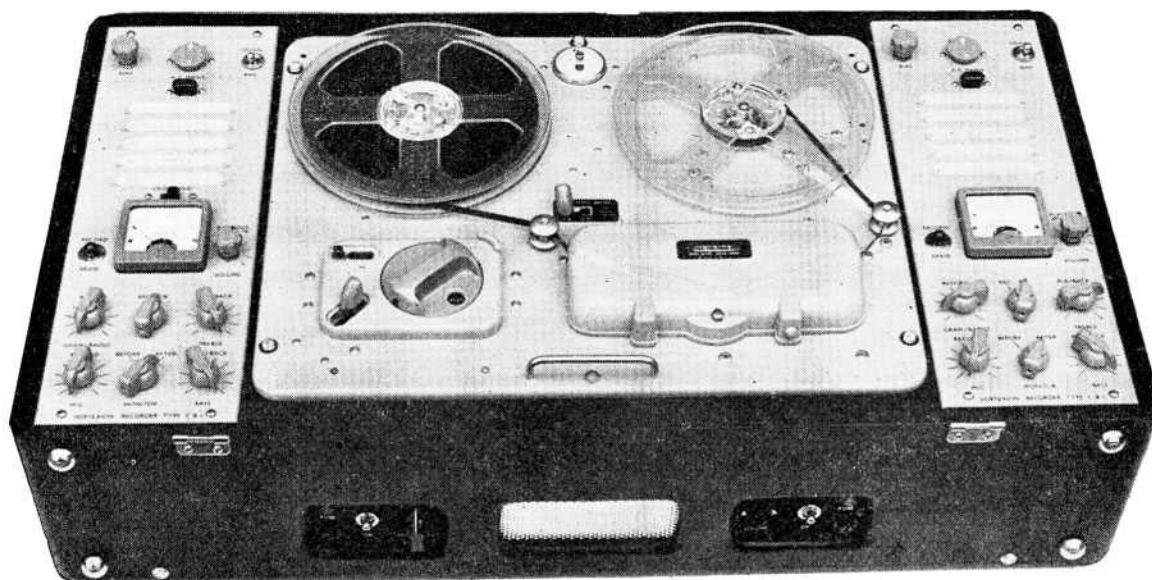


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AMATEUR TAPE RECORDING

VIDEO & HI-FI

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BRITISH TAPE RECORDING CONTEST

By now you will have read about the British Tape Recording Contest and will be well on the way to making your winning (?) tape. I really do hope you will enter this annual contest which is sponsored by leading manufacturers of magnetic tape. Don't be put off by the idea that your tape, perhaps made with inexpensive equipment, will be lost among those made by experienced amateurs with a room full of tape recorders, mixers, microphones and the like. Remember there is a Novice class as well as an Amateur class — Professional too if you happen to be in the recording business.

Last year's winner was an amateur recordist — Ray Stanton King — whose entry consisted of drain pipe noises carefully blended with humorous commentary and was entitled "Sink Symphony". The art of making a winning recording calls for originality and careful editing. Think long and hard about the subject you choose — preparation is the essence of good craftsmanship. As a final word of encouragement I too am taking

my chance with an entry for the professional class. So all ATR readers — please support us and the British Tape Recording Contest, by having a go. Remember — nothing ventured, nothing gained. **STEREOPHONIC BROADCASTING:**

This month we introduce Mr Burrell Hadden who is dealing with stereophonic sound, a subject that has been gradually fading into the background. Although the BBC have discontinued the stereophonic broadcasts via two separate transmitting channels, they are now putting out experimental stereo multi-plex transmissions from F.M. transmitters. If and when stereo broadcasting becomes a service the multi-plex system will no doubt be adopted. In fact the manufacturers of F.M. tuners are prepared for this with special multi-plex adaptors or tuners that can be easily modified. Let's hope that stereo will soon be well and truly re-established with a broadcast service to supplement stereophonic tape recording at home which of course still provokes endless interest. F.C.J.

OUR FRONT COVER: This shows a special control desk designed and so produced by the BBC for use with its experimental stereophonic broadcasts.
(photograph by courtesy of the BBC)



1. Fireworks light up the Burg Katz overlooking St. Goar. Part of a Winefest celebration.

Left: Fireworks light up the Burg Katz overlooking St. Goar. Part of a Winefest celebration. Right: The Clarkson Courier at Birmingham (Elmdon) Airport records details prior to departure for Rudesheim via Luxembourg.



Blueprint for the first ATR/Clarkson six-day sound tour to Denmark on 30th May, is this picture-story presentation of Clarkson's Four-day Rhine Winefest sampled by our travel correspondent Bob Danvers-Walker.

FROM the moment you set foot at the departure airport your tape recorder has got to be at the ready if you're going to work as I do as a travel broadcaster. A professional recordist is a journalist with a microphone. On the other hand if all you want is a little bit of sound here and there and have no sequential story with sound effects, interviews and narrative, etc., in mind, then you will be content to earmark certain highlights of the tour in advance and snatch at random at whatever turns up. But either way a close study of your tour schedule and itinerary will be useful. And never forget that the one person who knows what lies ahead is your Clarkson Courier. Get him to tell you where to be on the alert for good sounds and what to expect. Here's an answer to a basic question if you should decide to go on the Rhine trip. What is a Winefest? You'll need this kind of information when it comes to assembling your coverage, preparing

a script maybe and documenting your tapes. Every year the many quaint and picturesque villages in the winegrowing areas of the Rhine and Moselle valleys hold a "Wine Festival" to celebrate the vintage. The idea goes back many thousands of years to when it was a pagan "thanksgiving feast" to the gods. Now it is done to give the people a holiday and a day of festivity and gaiety after the hard work of the vintage and to show off the fine wine that has been produced.

Now you see how necessary it is for you to have a note book with you. Keeping a 'Dope Sheet' is most important. Names, details of location, first impressions, statistical and historical facts should always be logged if you're making a production out of your journey. Facts are important because it is upon them you'll depend when it comes to writing your story. Never rely upon memory. Be methodical and thorough in assembling your information. A shoulder bag is most useful to carry with you. In it you should put your note book, log sheets, tapes, spare batteries and microphone, a couple of cellophane bags as protection against dust or rain, a pocket torch for night work, a small tool kit perhaps and a spare spool for spooling off if you should ever need temporarily to put aside a half completed tape.

To a recordist the package-deal, six-day, four-day or even two- and one-day trips

have to be viewed closely for their sound potential. Since the Winefest highlight is obviously the festival itself the story has to be built around the festivities. The centre for this tour is Rudesheim on the Rhine. You are based there but make trips from it; which gives you opportunities to record the voice of your courier as he describes the sights en route. And besides, think what a saving it is to record all this information instead of having to write it down. On my copy of the itinerary I earmarked for special attention the Drosselgasse, the little narrow street with its wine cellars and timbered and gabled 15th century Inns because it is here that you will get most of your music and singing. Then the aerial cable cars in Rudesheim take you sailing above the most celebrated vineyards in Germany to the Niederwald Monument surmounted by the buxom bronze figure of Germania—she weighs 64,000 lb. The best way to represent this trip on the teleferique is to record the sound of voices (a variety of tongues will be heard) approaching and passing as each car goes by you (and there are scores of them closely spaced) as you yourself travel upwards in the opposite direction. It gives quite a good dimensional effect. The white pleasure steamer cruises take you on trips to view the many ancient castles bordering the Rhine. This is the busiest international waterway in the world. Busy

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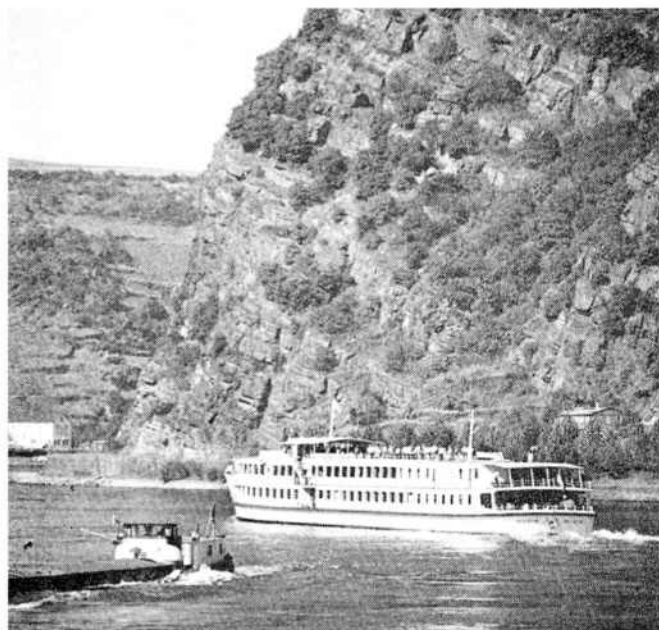
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SWITCH ON FOR FESTIVAL *continued*

tugs, passenger steamers, dark, narrow barges low in the water and flying the flags of many nations pass in everlasting procession. Vineyards pattern the hills on either side. You arrive at St. Goarhausen with the Burg Katz rising behind it and the Burg Maus facing it across the dividing Rhine, giving point to the saying that the two feudal towers are playing Cat and Mouse with each other. Katz was built in 1393 by the Count of Katzenelnbogen (translated Cats elbow)—it is now a private school for boys—while the Maus is said to be haunted. Then on arrival at one of the towns you get caught up in a garlanded, flower-bedecked celebration of the Winefest. Last year this was at Bacharach (deriving its name from the God of Wine) where my tape recorder worked overtime capturing the music playing for the dancing groups of costumed lads and lassies in procession. That same night the town of Bopard lit the night sky with a firework display and torchlight procession. The following day I recorded the carillon of bells from the tower of the Rudesheimer Schloss. According to

legend this peal of bells rings out a phrase from an old Rhine song, the lyric of which says that 'Three young men from the other side of the Rhine are coming over.' These little touches of information make all the difference to a recorded sound. To give you another example. An accordionist was playing aboard the river steamer as we sailed down the stretch of water beside the Lorelei Rock known as the Lurley. This is reputed to possess a remarkable echo capable of repeating a word some five times over. Students, it is said, shout from one side of the river to the other. Being on board I could not put this to the test. But what better to go with the music as we passed the legend-haunted rock than to be reminded of its fame. The Nibelungen treasure is said to lie hidden here, and from the rock a siren was believed to lure men to their death.

'It is the Lorelei;

'She sits enthroned upon the rock-top yonder,

'Her golden locks reflected in the wave,

'While spirit choirs sound from some unseen cave,

'Hidden the mass of clustering vine-leaves under,

'But through their song, filling the air with wonder.

'Is heard the nymph's weird and alluring lay.'

Very much part of the sound of things is the substance of its story. See a thing and it becomes experience. Capture it in picture and you possess its image. Record it and it lives forever with you. My first and last 'takes' were the sound of the aircraft's engines taking us there and bringing us back. Good opening and closing effects with which to bracket the Sound Tour. And according to my notebook our pilot was Captain Andrew Oates, the 1st Officer was Jack Muldoon and, in the language of radio-telephony, the phonetic letters of the alphabet painted on our fuselage were Golf, Alpha, Papa, Bravo, Charlie. And Bravo it was—all the way.

Captions. Top Left: Bob Danvers-Walker records a typical German "Ump-pa-pa" band in the Rudesheimer Schloss. Centre Left: The Lorelei Rock; most celebrated landmark of the Middle Rhine. Bottom Left: The Winefest procession Bacharach.

BBC STEREO BROADCASTS

Stereo enthusiast fans will be pleased to hear that the B.B.C. is broadcasting in stereo again

Until further notice test transmissions using the Zenith-GE system will be broadcast from Wrotham at 91.3 Mc/s on Tuesday, Wednesday and Thursday each week. They will consist of:

1430–1500 test tones 1515–1545 programme test material.

TECHNICAL DETAILS

Instantaneous Deviation of Transmitter (as a fraction of 75 kc/s.).

$$0.9 \left[\frac{A+B}{2} + \frac{A-B}{2} \sin 2 \omega_p t + 0.1 \sin \omega_p t \right]$$

where $\omega_p / 2\pi = 19,000$ c/s is the pilot subcarrier frequency and A and B are the respective left and right stereophonic audio-frequency signals. For 100% modulation in either of the stereophonic channels, A or B varies within the range ± 1 .

Frequency response
Harmonic distortion (at 400 c/s.).

Uniform within ± 0.5 dB from 120 c/s to 7kc/s, and ± 1.0 dB from 60 c/s to 13kc/s. Not greater than 1.5% at 100% modulation.

A to B cross-talk
Sum-to-difference cross-talk
Pilot signal

Better than -30 dB from 60 c/s to 13 kc/s, from A to B and vice versa. When A and B are nominally in phase at 400 c/s the antiphase or (A–B) signal has a relative level not exceeding -25 dB, and vice versa. Frequency is maintained within ± 2 c/s of the nominal value. Phase (in relation to the 38 –kc/s sidebands) is within $\pm 4^\circ$ of that specified for the system.

PROGRAMME DETAILS

Line-up period

During the five minutes preceding both tone and programme test transmissions, 440 c/s tone at 32% modulation on channel A, and 1,000 c/s tone at 33% modulation on channel B will be radiated simultaneously for four minutes (with the normal pre-emphasis) followed by one minute with no modulation.

Further information can be obtained from the BBC, Broadcasting House, London W1. Apply for Technical Information Sheet No. 1602 Issue 3.

MULTIPLE LOUDSPEAKER SYSTEMS

AN alternative to the single full-range speaker is the multiple system. This involves the use of two, three, or sometimes more units, dividing the frequency range in such a way that each unit handles only a limited number of frequencies. In a typical three-way speaker system, the bass speaker might handle from 20 c/s. to 1,000 c/s., the mid-range speaker 1,000 c/s. to 5,000 c/s., and the top unit 5,000 c/s. upwards. The crossover from one speaker to another is by means of an electrical filter unit and will be dealt with later in the article.

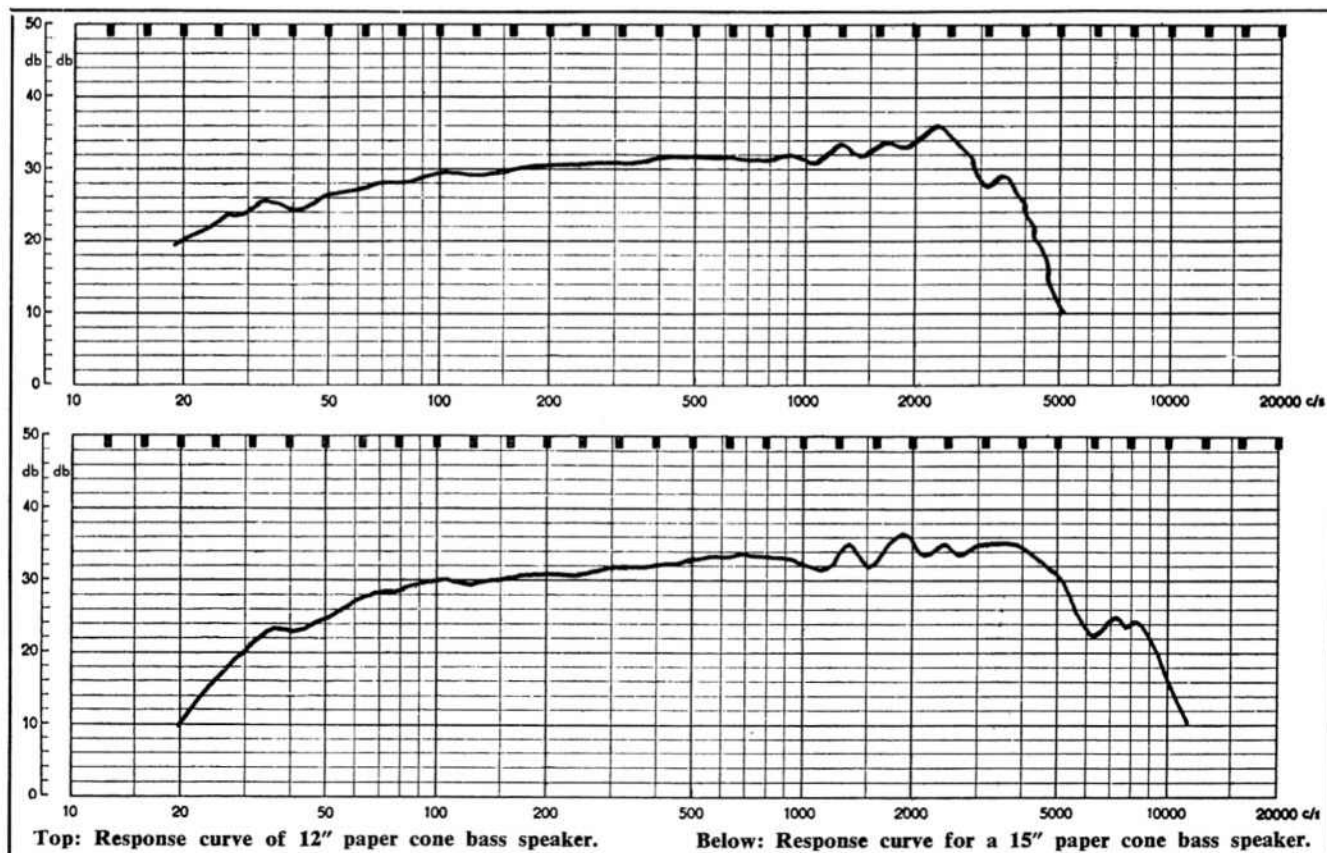
The major advantage in these systems is that the design of each specific speaker is simplified due to the limited range of frequencies that the unit has to handle and the highly conflicting requirements of bass and top reproduction are no longer needed in one speaker. The frequency response and the distortion of the individual units are usually better than full range speakers but there are, of course, disadvantages. The cost of three separate units is normally greater than one full range unit and also it is difficult to cross over from one unit to another in a multiple system without introducing undue distortion. However, a well designed two or three way speaker system will give an extremely good result.

CROSSOVER UNIT

This is an electrical filter unit which will feed the bass frequencies to one speaker, and the top frequencies to one or two others depending upon design. Most loudspeaker manufacturers make such units and I would not normally recommend the amateur to 'do it yourself'. The values of the components are fairly critical and a constant check must be made regarding the break-down of capacitors at high power ratings and the resistance of both chokes and capacitors.

The most simple crossover is simply to feed the top unit through a series capacitor. The bass speaker will then continue to operate throughout the range, and will be supplemented by the top unit only at high frequencies. The capacitor also acts as a safety device to ensure that low frequency signals do not damage the top unit. If the bass speaker is to be cut off at high frequencies then it is fed through a choke as shown below right.

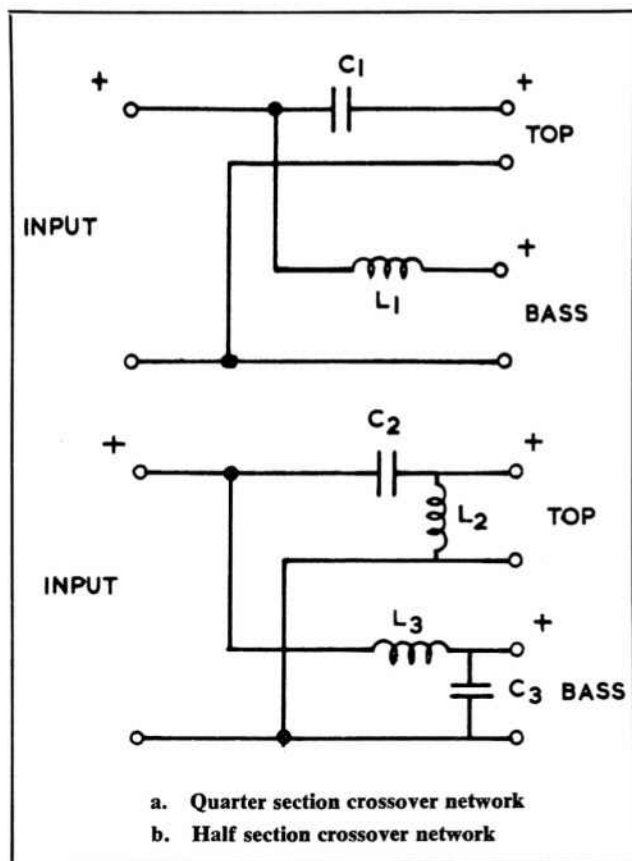
This type of crossover will cause the unit to fall in response at 6 dB/octave. Thus if the crossover frequency is 1000 c/s., at 500 c/s. the top unit is 6 dB down, and at 2000 c/s., the bass speaker is 6 dB down. Such a slow cut off rate means that both units must perform



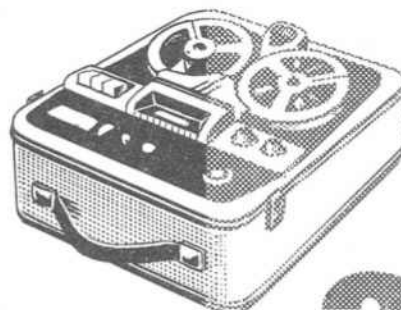
PART FOUR DJ BARNETT

satisfactorily well below and well above the crossover frequency.

Most high fidelity crossover units are of the half section type. These have four components as shown below and a cut off rate of 12 dB/octave. This is a much more practical arrangement and each unit need now only extend about one octave past the crossover point. Values of components for typical crossovers are shown in Table 1, Page 16, when using 15 ohm speakers. When two or more units are to be used together it is essential that they are all connected correctly with regards phase. If a d.c. signal is applied to a speaker the diaphragm will move in one direction while if the d.c. is reversed, then the direction of the diaphragm will also change. To phase a speaker correctly a d.c. signal, obtainable from a 6 volt battery, should be applied to the speaker terminals. When the diaphragm moves forwards, then the positive battery lead is on the positive speaker terminal. This procedure should be tried on all units to be used, and all positive terminals marked + or with a red spot. Then all positive terminals will be connected below.



IS HALF YOUR TAPE RECORDER



WASTED?

The performance of a portable tape recorder is severely limited by the space available for its internal loudspeaker.

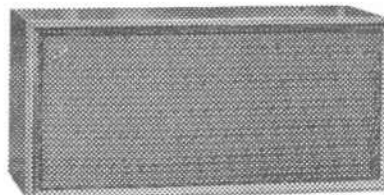
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This unique, patented enclosure design gives optimum results with Wharfedale 8" unit. Impedances are easily matched by fitting the WMT.1 transformer, costing only 13/6.

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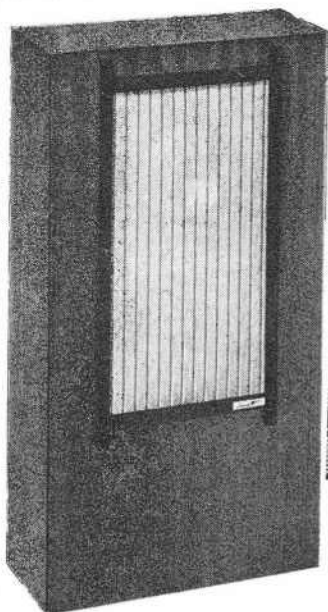


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THE LOUDSPEAKER

BASS SPEAKERS

Generally these are known as 'woofers' and in nearly all cases moving coil units are used. The speaker diameter is large, up to 18", and the cones heavy, straight sided and rigid. Some manufacturers have used expanded polystyrene instead of paper, but this does tend to break-up severely after about 1 kc/s.

The voice coil is also large, about 1½" to 3" dia. and wound in copper wire. Particular attention is paid to the power handling properties of voice coils and lead-

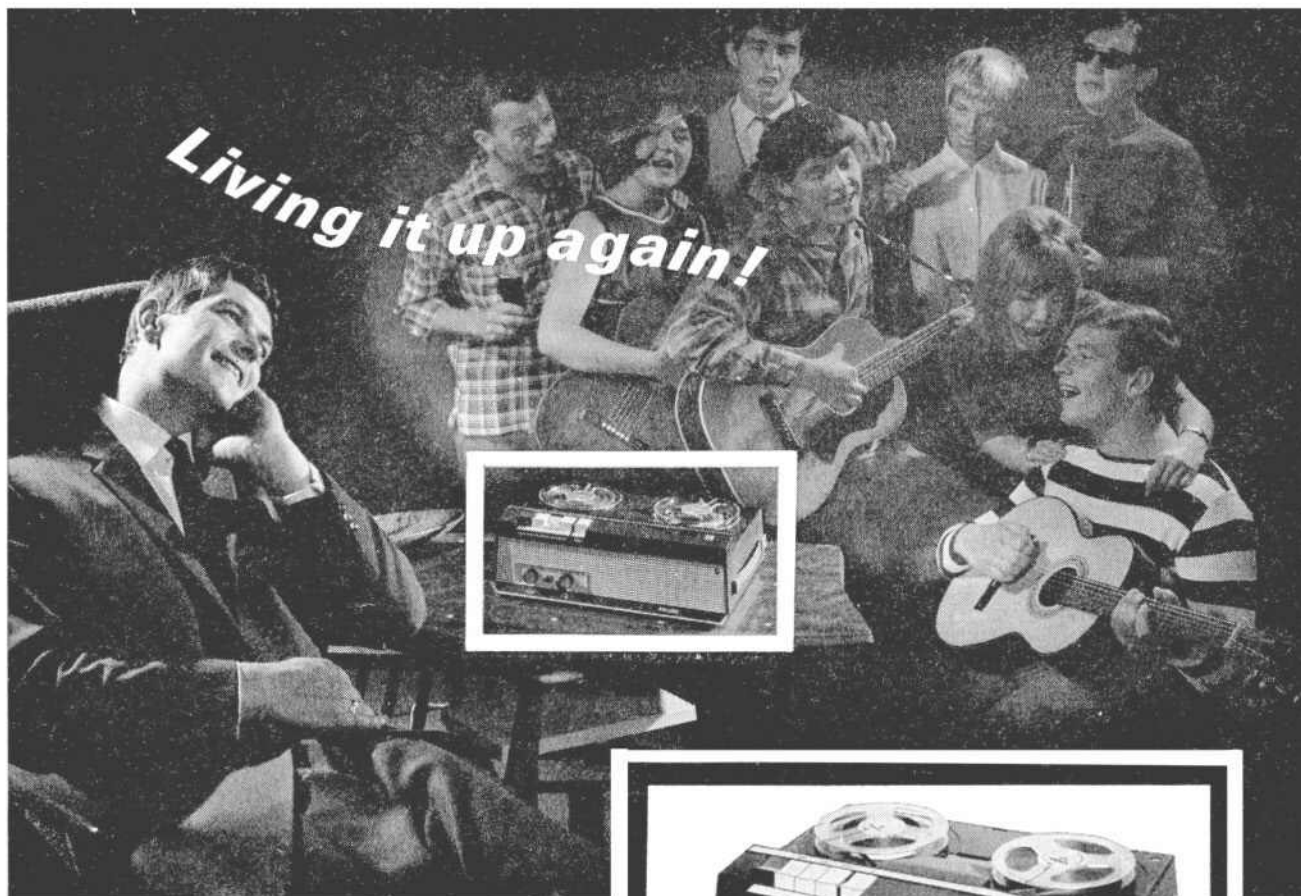
out wire in order to handle large amounts of power at low frequencies. The suspension of the speaker must be capable of large movements without introducing distortion. The resonance of typical units might be, for a 12" speaker — 35 c/s, 15" speaker — 30 c/s, 18" speaker — 25 c/s.

The loudspeaker cabinet is designed basically for the bass speaker, in order to enhance low frequency reproduction. Most paper-coned 'woofers' will have a reasonable response to about 7,000 c/s. Response curves of typical woofers are shown on page 14.

In the next article we shall deal with mid-range and top units.

Crossover Frequency	C1	L1	C2 & C3	L2 & L3
1000 c/s	10 mFd.	2.5 mH	8 mFd.	3.5 mH
5000 c/s	2 mFd.	0.5 mH	1.5 mFd.	0.6 mH

TABLE 1



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Tape Recorder 24 gns
Automatic and Manual Recording Control



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EXPERTS CHOOSE PHILIPS TAPE Follow the example of professionals in recording and broadcasting studios all over the world—use Philips Tape, the **only** tape in the U.K. that is made by a tape recorder manufacturer! A product of Philips unrivalled experience and know-how, Philips Tape has all the qualities needed to make your recordings perfect every time.

ANOTHER MEMORABLE PRODUCT FROM



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VIDEO NEWS

PRACTICAL DOMESTIC VIDEO

THERE are still many problems to overcome before home television recording can become standardised as sound tape recording is at present, and it is only fair to say that at the moment we are in the pioneering stage. From now on I am convinced that development will be fairly rapid, if reports from the industry are to be relied on, and I think they are. But who will join me in this new venture? How many of us already confirmed sound recording enthusiasts will be willing to take the plunge into the deep, unexplored waters of video? It means a deep plunge into one's pocket, too, for remember that in order to see and hear the results of television recording a TV receiver is necessary, and later, of course, will come a camera, not to mention the usual sound paraphernalia we are already so familiar with. There is also the question of 'know how,' which, translated from the American, means *technical knowledge and experience*.

In these articles, Norman Rutherford and I hope to provide some of that basic 'know how,' consisting of a little theory and a little practice. So, before I continue with the construction and operation of the VKR 500, let's take another look at TV itself and work backwards as it were from the professional standard now established in the studios of the B.B.C. and, of course, I.T.A. It will be a long time before the amateur will be able to achieve television recording comparable with that made on the kind of professional equipment shown in Fig. 1. You have only to glance at the photo in order to realize the utter complexity of the electronics that go with a studio recorder like the Ampex unit, just to the right of the picture. Now look at Fig. 2, which shows the Wesgrove VKR 500 set up in my studio at home. So, first of all, we just cannot compare professional with domestic TV recording equipment, but we can try to establish a standard against which to appraise the performance of domestic or, if you like, amateur TV recorders.

THE QUALITY OF TELEVISION PICTURES

When considering picture quality we must also take into account the source of the picture, i.e., from a TV camera via a broadcasting channel and TV receiver, or from a camera direct to tape, or even from another video tape recorder. The signal we wish to record should obviously be of good quality to begin with, but how can we judge our recorded version? With sound recording, one can make an aural comparison between say a live broadcast via an F.M. tuner, hi-fi amplifier and speakers and the tape recorded version. The results can be assessed fairly

accurately, because we have now had a good many years of experience. Equally, of course, the technical performance of a sound recorder can also be established by checking frequency response, distortion, inter-modulation and so on by methods that are also fairly well known, even to the amateur.

Methods for checking the technical performance of professional video recorders are probably already standardized, and eventually the same will no doubt apply to domestic recorders. In fact, I believe Norman Rutherford will be dealing with this.

MORE ABOUT THE VKR 500

However, before we can run, we must learn to walk, so back to the final assembly stages of the VKR 500, namely the electronics. Again some constructional experience and technical knowledge is required, although the whole of the electronics for the VKR 500 are assembled on a printed circuit board. The final connections between the recorder and a TV set call for some knowledge of TV receiver circuitry, and in due course I will be dealing with this in more detail. The instructions supplied with the kit do, however, give sufficient information, but it is advisable to use a receiver with a very stable synchronising system. Preliminary tests do entail the use of a multi-range meter and an oscilloscope, for one must be in a position to check the amplitude of the video signal fed into the recorder, at the recording head itself and again at the output on replay. Rather than modify my family TV set, I am at present using one shown in Fig. 2 which is a Ferguson model, a few years old, but which I obtained second hand from a local TV dealer. However, I got them to re-align the receiver r.f. and i.f. stages carefully for maximum video bandwidth and for minimum sound on TV or vice versa. The ideal video response is up to 3 Mc/s., although few TV receivers ever perform as well as this. For those who are following the construction of a VKR 500, two views of the finished deck, complete with the printed circuits and power supply, etc., are shown in Figs. 3 and 4 respectively.

Finally, I feel I should emphasise the importance of frequency response in video equipment. Unlike sound equipment, one does not just measure the response versus output power, but rather the result of good or bad frequency response in terms of picture quality. This can be done fairly easily with the help of the BBC test card, known as Test Card D (for 405 lines) or Test

RECORDING

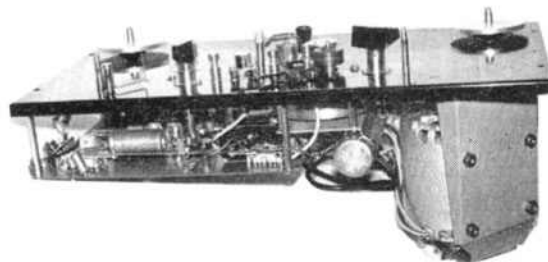
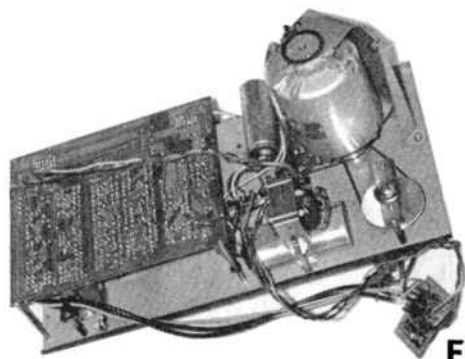


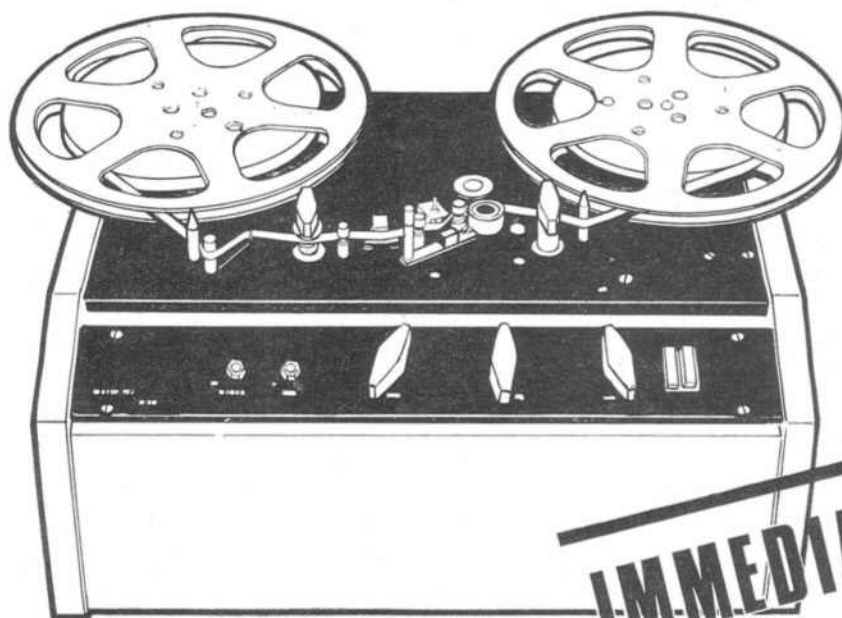
Fig. 1. General view of the Ampex video tape recording equipment in use by the B.B.C. Fig. 2. The VKR 500 recorder completed and ready for testing with a 17 inch TV receiver. Fig. 3. Underside of the VKR 500 deck showing the printed circuits and power supply. Fig. 4. Side view of the completed VKR 500 deck and circuitry.

Card E (for 625 lines). From these test cards one can check the aspect ratio — picture size — contrast, resolution and bandwidth — scanning linearity — line synchronisation — low frequency response — reflections and uniformity of focus. You will notice quite a list of new technical terms which in time will no doubt become as familiar as azimuth alignment, wow and flutter, superimposing, frequency correction, etc. — all terms associated with our present pastime of sound recording,

but which will still be in evidence in amateur video recording.

Next month I will deal with the television test cards, from which a lot of useful information about the performance of a TV receiver and a home TV tape recorder can be obtained, and hope also to show you photographs of pictures actually recorded on a VKR 500 television recorder.

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VIDEO : Speeds 7.5, 10.0 or 12.5 ft. per sec. Recorded Spectrum 2 Mcs. to 1 Kcs. system direct recording with non-integrating sync regeneration. Running time 30 minutes per side maximum at 7.5 ft. per sec. Spool size 11½" maximum. Tracking 2 sound 2 video. Input 1 volt D.A.P. Vision. Output 4 volt D.A.P. Vision. **SOUND:** FM Carrier System. Response 50 Cps. to 10 Kcs. Input 1 volt R.M.S. Output 1 volt R.M.S.

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VIDEO NEWS

TELEVISION TAPE RECORDING FOR THE AMATEUR. N. S. RUTHERFORD.

Part 2. Revision of Some Fundamental Principles.

Since preparing the manuscript for the first article I have had the opportunity of discussing the subject with many persons interested in this field. I have found that some have difficulty in grasping this subject through having no basic knowledge of magnetic recording. I therefore decided it would be an advantage at this stage to insert an extra "classroom" article covering the fundamental processes of magnetic re-cording. It will therefore be an advantage to analyse the basic recording process and to treat some of the more important factors in detail, because without a grasp of these fundamentals difficulty in understanding video recording processes will be encountered.

Record Replay Characteristics of the Idealised System.

If we assume a linear relationship between the current supplied to a recording head and the remnant intensities of magnetisation of a magnetic tape, we will have a B - H curve of the form shown in Fig 1, Page 22. Such an ideal relationship does not of course exist in practice but will suffice for our present discussion. We will also assume that the recording wavelength is long compared with the head gap. If a sinusoidal wave were recorded onto the tape, a flux distribution as shown in Fig 2 would result.

The recording current at any instant can be represented by

$$i = I \sin(\omega t) \quad (1)$$

where I is the maximum value of the recording current. The instantaneous magnetising force H is proportional to i and the remnant intensity of magnetisation Br and the remnant flux Φ_r .

$$\therefore \Phi_r = K I \sin(\omega t) \quad (2)$$

If we take a certain point on the tape and call this t = 0 and take another point a distance x away from t = 0 and the tape is travelling with a velocity V

$$\text{then } t = \frac{x}{s}$$

If a wave is recorded onto the tape of wavelength λ then the frequency corresponding to this wavelength

$$\text{will be given by } f = \frac{s}{\lambda} \quad \therefore ft = \frac{x}{\lambda}$$

$$\text{Substituting in (1) gives } \Phi_r = K I \sin\left(\frac{2\pi x}{\lambda}\right) \quad (3)$$

The equation (3) gives an expression for the maximum remnant flux within the tape and parallel to its surface, and, as can be seen from Fig (2) at Φ_r the maximum value of remnant flux, no flux will enter the replay head. In

fact the maximum flux leaves a surface of the tape at $\Phi_{r \min}$ where $\Phi_{r \min}$ is going through its maximum rate of change.

This point is said to be that of maximum surface induction By

$$\therefore \text{ we can write } B_y = K_2 \frac{d\Phi_r}{dt}$$

$$\therefore B_y = K_3 I \frac{2\pi}{\lambda} \cos \frac{2\pi x}{\lambda} \quad (4)$$

Now on playback we have a head output proportional to the rate of change of the flux entering the head. That is to say, the output will be proportional to the product of the surface induction and the tape velocity.

$$\therefore e = K_4 B_y V = K_5 I V \frac{2\pi}{\lambda} \cos\left(\frac{2\pi x}{\lambda}\right)$$

$$e = K I f \cos(\omega t) \quad (5)$$

which expressed in terms of frequency and time gives From the above we may draw a number of important and fundamental conclusions.

1. The output from the replay head rises in proportion to the frequency of the output. That is to say the output rises at the rate of 6 decibels per octave.

2. The output from the head is proportional to the recording current. The fact that a phase difference of 90° exists, i.e. the change from a sine to a cosine term exists, has no material importance.

Factors Causing Variance From the Idealised System.

The first and most important variant is the fact that the B - H curve is anything but a straight line. However, since the methods of linearisation used in video recording are somewhat different from those used in sound and are empirical in their nature, we will leave these for discussion at a later date.

The next most important factors are those affecting the terminal performance, i.e. at the low and high frequency ends of the spectrum. The factors affecting the low frequency performance will be dealt with in future articles. We will therefore confine our discussions to the losses at short wavelengths.

The effect of gap length is a factor of greatest interest since it is obviously fundamental to the problem of high resolution and video recording. I therefore propose to analyse this effect in some detail.

In Figs 3A and 3B the surface induction of the tape B_y is represented by a sine wave, the direction of the arrows indicating the direction of the magnetic flux, either into or out of the tape. In Fig 3A where the wave-

VIDEO NEWS

length is very much longer than the gap length the value of B_y is almost the same at both pole faces. The effective value of B_y is that at the centre line of the gap, \therefore from equations (4) and (5)

$$B_{ye} = K_3 I \frac{2\pi}{\lambda} \cos\left(\frac{2\pi x}{\lambda}\right)$$

$$\text{and } e = K_4 B_{ye} V$$

$$= K I f \cos(\omega t)] \quad (6)$$

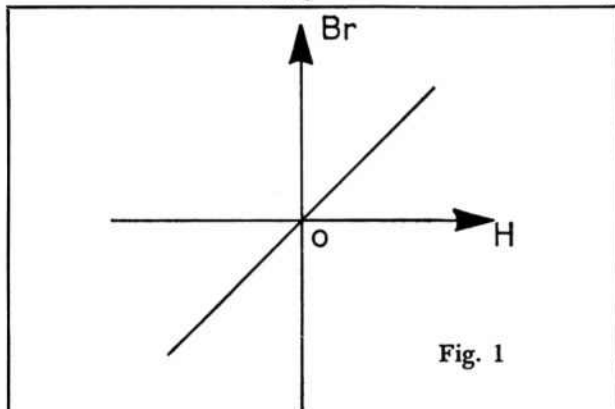


Fig. 1

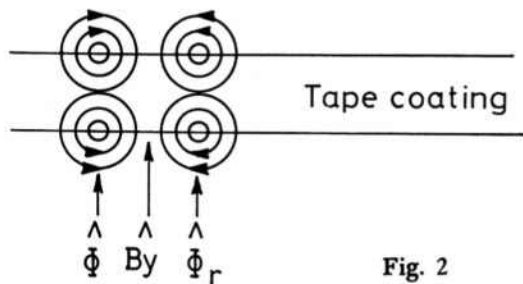


Fig. 2

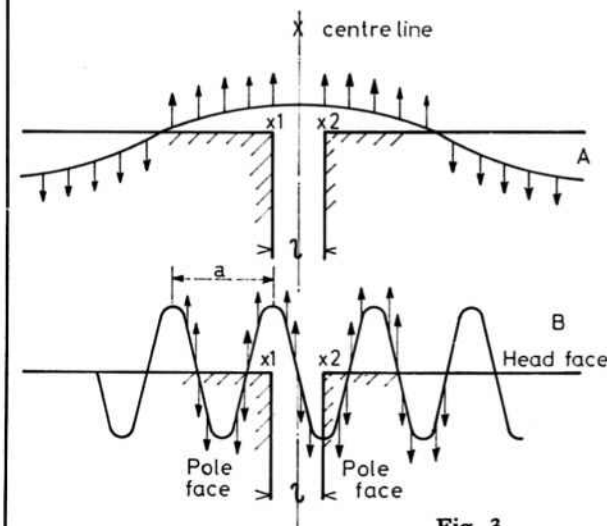


Fig. 3

There is no change from the ideal case. Now in the second case where $\lambda \leq l$ the flux from the tape is both entering and leaving the pole faces. Since this flux must be averaged across the gap, integration of the flux at all points across the gap must be used.

$$\text{At any point in the gap, } B_y = K_3 I \frac{2\pi}{\lambda} \cos\left(\frac{2\pi x}{\lambda}\right)$$

$$\therefore B_{ye} = K_3 I \frac{2\pi}{\lambda} \frac{1}{l} \int_{x_2}^{x_1} \cos\left(\frac{2\pi x}{\lambda}\right) dx$$

$$B_{ye} = K_3 I \frac{2\pi}{\lambda} \frac{1}{l} \frac{\lambda}{2\pi} \left[\sin\left(\frac{2\pi x_1}{\lambda}\right) - \sin\left(\frac{2\pi x_2}{\lambda}\right) \right]$$

Now from an arbitrary point on the tape let

$$x_1 = x + \frac{l}{2} \text{ and } x_2 = x - \frac{l}{2}$$

Now (since $\sin(A+B) - \sin(A-B) = 2 \cos A \sin B$)

$$B_{ye} = K_3 I \frac{2\pi}{\lambda} \frac{1}{l} \frac{\lambda}{2\pi} \left[\sin\left(\frac{2\pi x}{\lambda} + \frac{\pi l}{\lambda}\right) - \sin\left(\frac{2\pi x}{\lambda} - \frac{\pi l}{\lambda}\right) \right]$$

$$\therefore B_y = K_3 I \frac{2\pi}{\lambda} \cos\left(\frac{2\pi x}{\lambda}\right) \frac{\sin\left(\frac{\pi l}{\lambda}\right)}{\frac{\pi l}{\lambda}}$$

Since $e \propto B_{ye} V$

$$\therefore e = K I f \cos(\omega t) \frac{\sin\left(\frac{\pi l}{\lambda}\right)}{\frac{\pi l}{\lambda}} \quad (7)$$

Thus we have shown that the resulting output is the same as for the ideal case, as in equation (5), multiplied by the term

$$\sin\left(\frac{\pi l}{\lambda}\right) / \frac{\pi l}{\lambda}$$

from which we may predict that the output from the replay head will fall to zero when $\lambda = l$

$$\text{because } \frac{\sin\left(\frac{\pi l}{\lambda}\right)}{\frac{\pi l}{\lambda}} \text{ will be zero}$$

Beyond this point, which is known as the first extinction, other maxima and minima will occur at wavelengths which are multiples of the gap length. These have no practical significance when normal magnetic heads are used since other factors and losses tend to mask these maxima.

AUDIOVIEW

THIS month we introduce a regular new feature designed to embrace reports, news and reviews on hi-fi equipment. Not unnaturally we commence with a look at the prospects of the forthcoming Audio Festival. Most of the equipment outlined here can already be seen and heard at hi-fi dealers throughout the country, but will also be on show at the Audio Festival.

In April and to be more precise between the 22nd and the 25th, 'Audiophiles' from all over the country will once more search the stands, climb the stairs and hopefully queue in the corridors for demonstrations of the latest and greatest in hi-fi and tape recording equipment. Will there be anything new? Can we anticipate anything that won't be last year's circuit or loudspeaker dressed up in a new box? From press releases just coming in it seems unlikely that we shall be seeing any devastating new inventions and most manufacturers are inclined to be keeping even new boxes secret until the day the festival opens. We doubt whether there will be anything startlingly new in hi-fi amplifiers for instance. Slightly wider frequency responses perhaps, new styling, use of transistors by some, but this may be all.

Smaller hi-fi loudspeakers may be conspicuous at the side of their larger brothers, tape recorders may look more technically interesting or contemporary depending on which market they are intended for (enthusiasts or just plain domestic) and we may find some improvement in record pick-ups. With stereo radio just around the corner most of the F.M. tuners now available and which will be on show at the Festival will most likely feature multiplex a little more prominently than before. In fact those manufacturers with demonstration rooms will no doubt make full use of the experi-

mental BBC stereo multi-plex transmissions of which details are given in this issue of ATR (page 13).

Among the more prominent manufacturers who are likely to make use of F.M. stereo transmissions are Armstrong Audio, who are also one of the few who may be showing something completely new. We have no details yet, but their current range of amplifiers will be on show on Stand 52 and you will be able to hear them working in demonstration room 347. Their ruggedly constructed power amplifiers have not changed very much but their amplifiers and tuners, etc. have already taken on a new look (page 24). Acoustical (Quad) will be featuring the famous electrostatic loudspeaker (page 24) and of course their range of tuners and amplifiers, etc. Again nothing new to report, but the Quad Multiplex stereo decoder should arouse some interest (page 24). By the way, Quad equipment is used by the BBC (we know because we've seen it there!) so what better recommendation could one need. A worthwhile stop will be at Acoustical Stand 65, or demonstration room 404.

We'll Be There

If you work through from A to Z, one of your first ports of call will be none other than Amateur Tape Recording, Video and Hi-Fi. You'll find us at Stand 50, with a warm welcome and ready to give you all the friendly advice and information you want. Current and back issues of ATR will be on sale, together with our two new sister magazines 8mm Magazine (cine that is) and Camera Magazine, two of the most widely read publications of their kind. Also on sale at the stand will be the full range of Castle Sound Effects records if you want to stock up on mixed sounds, trains, wild animals, backgrounds, electronic music and the like.

Next in line we find Agfa and

Ampex. Agfa for tape with perhaps a special demonstration in room 33 and Ampex for tape recorders of the professional class. Perhaps we might even see something in the video line, who knows.

From A to B takes us in a straight line to B.A.S.F. (tape) but what our old friend 'Tug' Wilson is cooking up this year, heaven only knows. However, you may get a surprise in demonstration room 312, where the staff of B.A.S.F. will be around to talk tape and technicalities.

Surprises too from Brenell, who hope to be showing their brand new STB 2. Read all about it on page 32 of this issue, and see it for yourself in demonstration room 337. Also make a 'B' line for Butoba, and Beyer. With Beyer you will also find Fi-Cord in room 413 or on Stand 10 and we suggest Beyer microphones will be worth a look even if you cannot afford to buy one. However, the Fi-Cord fanatics will no doubt be interested in four new Beyer microphones, one of Brown (S.G.), Boosey and Hawkes which is shown on page 24.

Loudspeakers, Microphones and Furniture

From microphones to loudspeakers via Celestion on Stand 46 and on to tape recording in education. Clark & Smith Ltd. will no doubt have something to offer in addition to their special TR634 'Schools' recorder shown on page 24. Decca will of course be featuring the latest in hi-fi records and equipment and if you are looking for some elegant furniture in which to house all that expensive equipment you'll be buying then look in on Design Furniture Limited at Stand 45.

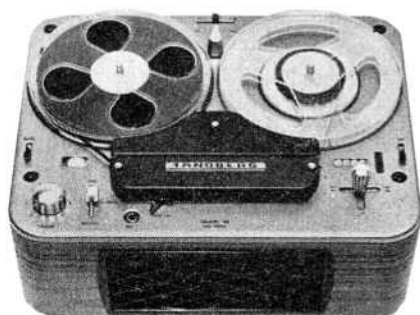
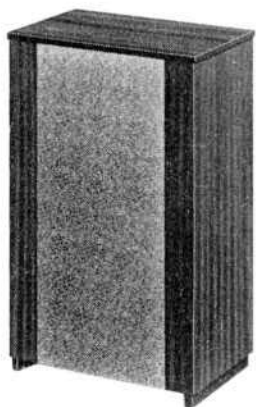
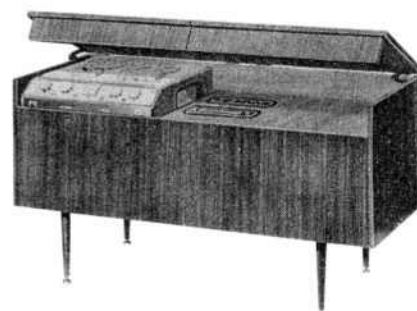
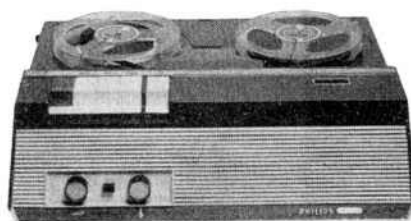
E.M.I., Ferrograph, Fane Acoustics, Goldring, Kodak and Kelly are a few more names to conjure with whilst visiting the Audio Festival; but keep in mind that other top name in hi-fi, H. J. Leak & Co. Ltd., who will be demonstrating ampli-

AUDIOVIEW

Top left: The Armstrong audio integrated stereo tuner-amplifier model 127. Top middle: Model 220 Stereo power amplifier by Armstrong Audio. Top right: The Quad Electrostatic Loudspeaker. Middle left: The Quad Multiplex stereo decoder; Middle: The new Beyer M.110 microphone by Fi-cord International. Middle right: Clark and Smith Model TR.634 Schools' tape recorder; Bottom left: The Leak Varislope 2 stereo amplifier. Bottom middle: Small speaker—less space. The Goodmans Maxim, which will handle 8 watts of audio. Bottom right: The Lustraphone LV/59 microphone, complete with stand.



Top left: The Philips model EL 3300 tape recorder with the unique tape cartridge. Top middle: Philips tape recorder, model EL 3552. Top right: Greig Equipment cabinet for tape decks or turntables, etc. Middle left: A folded horn speaker enclosure by Record Housing Ltd. Middle: The new Rogers Cadet 3 stereo/mono amplifier. Middle right: The Rogers Mini Cadet loudspeaker. Bottom left: The new Tandberg Model 92 tape recorder. Bottom middle: The "Magnetophon 300" by Telefunken. Bottom right: A recent Truvox tape recorder—the R92 - R94 series.



AUDIOVIEW

fiers, loudspeakers and tuners, especially amplifiers like the Leak Varislope 2 stereo unit which should interest those with high fidelity stereo in mind (page 24). You will find them in room 448 or on Stand 69. Of course if this is your first look at hi-fi then apart from amplifiers and tuners you'll be needing a loudspeaker, or perhaps two. Goodmans is one of the first names that come to mind and if you live in a small flat or you haven't much space anyway, take a good look at the Goodmans Maxim which will handle 8-watts of audio. Yes it's there on the bookshelf (page 24).

Tape Recorders and Mono Furniture

Still working down the list of Audio Festival exhibitors we come to K.E.F. Electronics, Lowther and Lustraphone, the last named being well worth a visit by all tape recording enthusiasts for Lustraphone is a name that leads in the world of microphones. The Lustraphone LV/59 shown on page 24 is but one of the many designed for professional and amateur use so if its a new microphone you seek then look no further than Stand 16 or demonstration room 342. Down through the M's we come to three M's or 'Scotch' recording tape by the Minnesota Mining & Manufacturing Co. Ltd., who will be there in demonstration room 422 to discuss tape problems. M.S.S. (tape) and Mullard Ltd. complete the M's. Now let's see what Philips Electrical Limited have added to their catalogue. There is the tape cartridge pocket portable model EL3300 shown on page 25 and the latest low priced (24 guineas) EL3552 which should cater for tape recording on a budget (page 25), Stand 8. Pye will be showing the rather more domesticated kinds of hi-fi on Stand 56 and for the specialist there are amplifiers by Radford Elec-

tronics Limited on Stand 5. Once you've bought a fair amount of equipment however, you come face to face with the problem of where to put it. You may well find the answer on Stand 21, where Record Housing will be showing cabinets for all kinds of equipment. They also do loudspeaker enclosures so we illustrate both for you on page 25.

More Amplifiers and Tape Recorders

Rogers Developments Limited whose new Cadet Mk. 3 stereo equipment shown on page 25 has aroused considerable interest and will be producing some fine sound in demonstration room 44. Along with the Cadet equipment will be the Rogers full range of mono and stereo pre-amplifiers and power amplifiers as well as F.M. tuners and loudspeakers. Of the loudspeakers the Cadet 2 with a horn loaded system will be worth listening to. And how about the Rogers Mini-Cadet shown on page 25 which will handle 10-watts and would make a nice 'extra' to any tape recorder.

Saba Electronics whose stereo tape recorder we review in this issue of ATR (page 37) will of course be demonstrating their products so you will have the opportunity of comparing with our report on the Saba TK230S. They will be in demonstration room 212 and on Stand 47. Tandberg we must include too for they will be on Stand 18 with the latest series 8 and 9 recorders, as well as a range of hi-fi equipment and recording accessories. The series 9 Model 92 Tandberg tape recorder is shown on page 25 and this together with a hi-fi system sounds like the ultimate in sound recording and reproduction. We know, because we've listened to it. Also associated with Tandberg are A. C. Farnell Limited who will have the American Scott amplifiers on show next door on Stand 17.

Those who have visited the Audio Festivals of recent years need no introduction to Wharfedale Wireless Limited, whose demonstrations of realism in sound are always a highlight of the festival. Just join the largest queue you can find and that will be for the Wharfedale demonstrations in room 247.

From loudspeakers to tape recorders this time by Telefunken who will be showing and demonstrating their current range of tape recorders, among which you will find the Magnetophon 300 portable shown on page 25. A visit to Stand 7 or room 237 and you can see or hear the full range of Telefunken recorders and hi-fi amplifiers etc.

Last but not least we mention Truvox, another name widely known in tape recording. This company is also in the hi-fi market with a range of amplifiers and loudspeakers. One of their products is shown on page 25 but we understand they will be showing something completely new at the Audio Festival. Only a visit to Stand 2 will provide the answer.

Buy Wisely and Well

Of course, if you visit the Audio Festival you will be able to look at the most expensive, even if you cannot afford it. On the other hand there will be a good deal on show designed to cater adequately for quality tape recording and high fidelity sound on a budget. We don't however, recommend going as low as a shoe string despite the fact that there are many kinds of equipment widely advertised at bargain (?) prices and all too often, falsely labelled 'hi-fi'.

We do know of good equipment though that will give satisfaction for comparatively low cost and in future Audioview reports will be featuring this. Our next edition will cover highlights of the Audio Festival.

A. LESTER RANDS.

INTRODUCTION TO STEREO

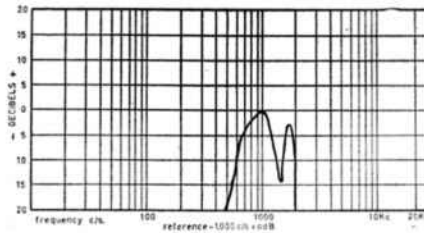
H. BURRELL HADDEN DISCUSSES THE HISTORY OF STEREOPHONIC SOUND

IT may seem strange to some readers that, so many years after the introduction of stereophony as a means of domestic entertainment, this magazine should present a series of articles on the fundamentals of the art. However at this time, with the possibilities of the radio transmission of stereophony coming nearer, indeed, having arrived in the U.S.A. and some countries of Europe, it may be opportune to restate the definition of the subject, and to review its history and the various methods in use of creating a stereophonic effect.

Several definitions of stereophony have been suggested in the past, but the one which seems to come closest to my own conception of the art was given at the Symposium on stereophony held by the I.E.E. in 1959. This said: 'The intention of stereophonic sound reproduction is to produce in the mind of the listener the illusion that he is listening in front of the original sound source, with its own dimensions of width and depth, and with every individual part of the source sounding in its correct position in the whole.' This definition imposes some severe conditions on the technician developing a stereophonic system, probably the most important being that the directional information coming from the sound source must be converted into electrical form with the minimum of distortion, and must be reproduced to the listener as accurately as possible. Various methods of doing this have been proposed, and these will be discussed, and their relative merits compared.

Firstly, however, it might be of interest to take a brief look at the history of stereophonic sound reproduction, a subject that has exercised the minds of various workers almost since sound reproduction became a practical possibility with the invention of the telephone by Alexander Graham Bell towards the end of the nineteenth century. Bell himself experimented with a binaural telephone, using two microphones and a split

headset, in 1892, as a means of obtaining better intelligibility. But even before this, in 1881, a telephone engineer in Paris, Clement Ader, had placed a number of pairs of primitive microphones, designed by Hughes, in the footlights of the Paris Opera, and relayed the performances to groups of listeners in the Palace of Industry. The experiment is described in detail in a contemporary issue of the magazine *L'Electricien*, and it is clear that Ader expected, and achieved, a true stereophonic effect. An approximation to the frequency response of the system is shown below. In spite



The frequency response of the stereo system used by Clement Ader.

of this very restricted response, hardly high fidelity, the report said: 'As soon as the performance begins, the characters are clearly placed . . . and it is easy to follow their movements exactly. Ader's system is more sensitive to delicate nuances than any previous apparatus.'

Soon after this, in 1889, Edison produced the first practical phonograph, but there seems to have been no attempt to combine the Bell binaural telephone with his recording machine. However, in 1898, the American Columbia Company produced a very interesting instrument, which they gave the magnificent title of 'The Multiplex Graphophone Grand'. This was a cylinder machine, using a 5" diameter cylinder, and recorded three separate tracks, reproducing them through three separate horns, each 54" long. The Company claimed only that the machine would produce three times as much noise as a normal Phonograph, but in fact the horns were,

as can be seen from fig. 1, pointing in different directions, and so some rudimentary stereophonic effect must have been present. In fact, so far as can be ascertained, only one of these machines was ever produced. It was shown at the Paris Exhibition in 1889, and then found its way to the palace of the Shah of Persia. It is not clear whether this was a gift, or whether he purchased it, but he wrote the following comment in his diary: ' . . . the reproduction sounded sweeter and cleaner than any of our earlier talking machines.'

From the beginning of the century to the middle of the First World War I have been unable to find any record of work in the field of stereophony, but, of course, the valve amplifier was being developed during this period, and this, alongside the development of the gramophone, paved the way for the future. A patent granted in 1917 described a cutting head for disc recording which would produce both a lateral cut and a vertical cut simultaneously in the same groove, operating on the acoustic principle of the early monophonic cutter, and in 1919 experiments were carried out at the Bell Telephone Laboratories in the U.S.A. by R. M. Allen, using binaural amplifiers designed as hearing aids. At about the same time, the same laboratories produced the first electrical disc cutter head, for monophonic records.

In the early twenties, broadcasting organisations both in the United States and in Europe carried out experiments in stereophonic radio transmission using two separate transmitters, one for each channel, and the series of B.B.C. experiments at that time included orchestral concerts, and excerpts from one of the farewell appearances of Dame Nellie Melba at the London Old Vic. Among the items included was the 'Willow Song' from 'Otello' by Verdi.

During the late twenties and early thirties, great activity in the field of

THE REPRODUCTION OF
ORCHESTRAL MUSIC IN
AUDITORY PERSPECTIVE

As Demonstrated before the
National Academy of Sciences,
APRIL TWENTY-SEVENTH, 1933,
Washington, D. C.

THE LATEST DEVELOPMENT
IN THE
GRAPHOPHONE.
— 24 C —
This new instrument was built for exhibition
AT THE
PARIS
EXPOSITION.



AN INTENSITY OF VOLUME
AND
SWEETNESS AND RICHNESS OF TONE
Which seem almost beyond belief.

THE TONES OF THE MULTIPLEX are far more faithful to the original rendition of voice or instrument than those of any other talking machine. This fact is due to greater discrimination in the process of recording, rendered possible only by the use of separate recording horns and styluses.

The three reproducers are entirely independent one from another, yet so arranged as to reproduce in unison. Results are obtained that it is difficult to realize are within the possibilities of sound reproducing mechanism.

The Multiplex can be converted in an instant into
A GRAPHOPHONE GRAND OF TRIPLE SIZE
by using only one reproducer to cover the entire length of the cylinder.
Special records may be had which will thus give a reproduction ten minutes long.

Designed especially for exhibition purposes at the Paris Exposition, the Multiplex Graphophone Grand is not listed in our catalogue nor carried in our regular stock of machines. But the results obtained from it are so superb, and its reproductions so marvelously faithful, both in volume and tone, to the real voice or instrument, that we have decided to make machines and records of the Multiplex type to order, confidently assuring those who purchase them that they represent the very highest development in the art of sound reproduction.

MULTIPLEX GRAPHOPHONE GRAND
including
3 Records,
3 Reproducers,
1 Special Triple Horn Stand,
3 36-inch Brass Horns,
12 Multiplex Grand Records,
6 Multiplex Grand Blanks.

\$1,000

COLUMBIA PHONOGRAPH COMPANY,

NEW YORK, 140, 142 Broadway.
BRASS, BRONZE, 1100, 1102, 1104 Broadway.
CHICAGO, 100 Walnut Ave.
ST. LOUIS, 1000 Grand Street.
PHILADELPHIA, 1000 Chestnut St.
BOSTON, 110 St. Andrews St.
KNOXVILLE, 10 S. Front St.
WASHINGTON, 100 Pennsylvania Ave.
BIRMINGHAM, 100 Main St.
SAN FRANCISCO, 100 Montgomery St.
SEATTLE, 100 4th Avenue

Fig. 1. Right: The Multi-plex Graphophone grand made in 1898 by the Columbia company.

Fig. 2. Above: Programme announcing the classic stereophonic experiment in 1933.

stereophony was taking place on both sides of the Atlantic, at the Bell Labs and at the Columbia Company in England, now part of the E.M.I. group. Both research teams were working to find a system of stereophony which could be added to motion picture film, which had 'learned to speak' only a few years before. They tackled the problem in rather different ways, and it so happens that the American system was perhaps the more suitable for film work, where large audiences are involved. The British system proved more successful for domestic use, where the number of channels must be kept to a minimum, and the audience to three or four persons. This is a sweeping statement, of course, and at the present time, although both basic systems remain, most stereophonic recordings and broadcasts at the present time contain elements of the two methods. In America the research team was led by that giant of the world of electro-acoustics, Harvey Fletcher. He is now in his early eighties, and was able to record his recollections

of the experiments for a recent B.B.C. programme. The object of the exercise was to develop and produce a complete system, from microphone to loudspeaker, capable of re-creating music in 'auditory perspective', so lifelike as to be indistinguishable from the original. This was, and still is, a very tall order, and certainly in 1933 no equipment existed to make it possible, let alone a system of stereophony. The researchers set out to develop the equipment, and the system. Microphones, amplifiers, telephone lines, and loudspeakers, with a frequency range from 35 c/s to 16,000 c/s all had to be made, at a time when the normal response rarely exceeded 5,000 c/s. All this equipment was eventually assembled for a relay of the Philadelphia Orchestra, playing in the Academy of Music in Philadelphia, and reproduced to a large audience in the Constitution Hall in Washington, D.C. It may be of interest to note that three of the original loudspeakers are shortly to be installed

by Dr. Fletcher at the new Arts Centre at Brigham Young University at Salt Lake City, Utah. Dr. Fletcher says they are still as good as anything that is obtainable today. The 1933 relay is still the classic experiment in stereophonic reproduction, and Fig. 2 is reproduced from Dr. Fletcher's own file copy of the programme of the occasion. Nothing quite as spectacular as the Washington demonstration was staged by A. D. Blumlein and his research team working in Hayes, England, but they nevertheless developed a complete system of stereophony, and their work culminated in the filing of British Patent No. 394325, which describes everything from microphone technique to a means of disc recording. If the Bell experiment was the classic demonstration, this was the classic patent. In the next article we will discuss the different methods used by the British and American workers, and show how their results are applied in stereophonic reproduction today.

F.M. TUNERS

BY E.A. RULE

F.M. TUNERS are generally regarded as 'local station' receivers, since the range of an F.M. (frequency modulated) transmitter is normally 50 miles or so.

The whole country is therefore covered by having many transmitters, each one sited so as to overlap the service of the other. Each station has its own transmitting frequency, so that adjacent stations do not interfere with each other. The limited range also means that stations which are sited far apart can use the same frequencies without interference, something that is impossible with A.M. (amplitude modulation), as any evening's listening on the medium waveband will prove. The main advantage of F.M. transmission is, of course, the extended audio frequency range which is made possible by the wide bandwidth that can be accommodated by both transmitter and receiver.

On the medium and long wave services, the bandwidth has to be restricted to about plus or minus 4 Kc/s., as the various stations are only 9 Kc/s. apart. A wider bandwidth would mean that more than one station would be received at the same time, together with unwanted whistles caused by heterodyning.

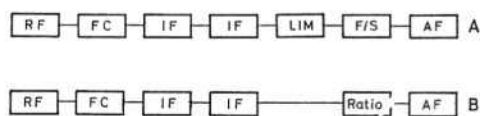
Frequency modulated transmitters operate in the very high frequency (V.H.F.) band of 87 to 108 Mc/s. In the U.K., each transmitter station radiates the Home, Light and Network Three programmes on separate frequencies 2.2 Mc/s. apart, for example, 89.1, 91.3, 93.5 Mc/s. With an A.M. transmitter, the power output of the transmitter varies according to the audio modulation, but its operating frequency remains constant. With an F.M. transmitter, the operating frequency is changed at a rate dependent on the frequency of the audio modulation. The amount by which the frequency is changed is called 'frequency deviation' and is determined by the

volume of the audio. The difference between the two types of modulation also has an important bearing on electrical interference, as we shall now see.

Electrical Interference

Most types of electrical interference are due to car ignition, electric motors, lights being switched on and off, etc. If the resultant radiation is received on an A.M. receiver it can ruin programme reception by buzzing, clicks, and other noises, which, added to the whistles and squeaks already present on the M.W. and L.W. bands, is very unsatisfactory, to say the least.

Electrical interference is a form of amplitude modulated signal, and is therefore difficult to reject from other amplitude modulated signals, such as a programme transmission. With an F.M. receiver, we are only concerned with converting the frequency modulation of the transmitter into audio signals, and a special 'limiter' circuit can be fitted to the receiver to prevent any form of amplitude modulation reaching the output. The 'limiter' also prevents other forms of impulse signals from being reproduced, except where the impulse is so strong it 'knocks a hole' in the F.M. signal. A very strong electrical impulse can, in fact, overload the first stages of an F.M. receiver for a small fraction of time, and although the pulse is prevented by the limiter from reaching the audio output, the 'hole' in the signal remains and cannot be replaced. This is why, when an F.M. tuner is working correctly, noise can sometimes be heard on a signal, but not when the set is tuned between stations. Car ignition is the most common source, and the hole-in-the-signal effect shows that the limiter is working correctly. If the limiter is faulty, ignition noises can be heard loudly between stations, although the cure for this is to improve the aerial



DIAGRAMS OF TYPICAL F.M. TUNERS

RF = Radio Frequency amplifier 88—108 Mc/s.

F.C. = Frequency changer.

IF = Intermediate frequency amplifier.

LIM. = Limiter.

F/S = Foster-Seeley demodulator.

Ratio = Ratio demodulator.

A.F. = Audio Frequency amplifier.

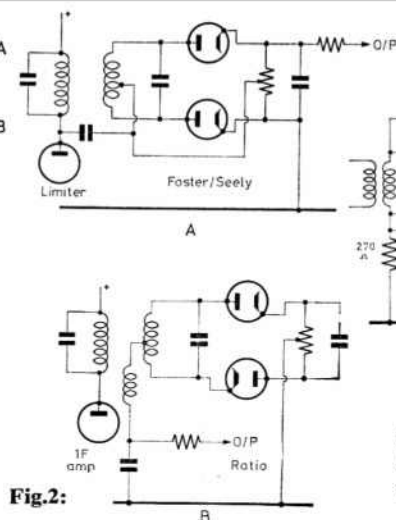


Fig. 2:

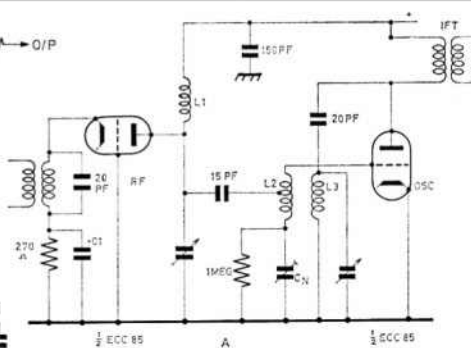


Fig. 3A:
A grounded grid R.F. stage local oscillator.

system. This will be dealt with later in another article.

F.M. Tuner Circuits

Figs. 1A and 1B show block diagrams of typical modern F.M. tuners, the main difference between them being the method of converting the frequency modulation into audio signals, and the type of limiter used. Fig. 1A employs a Foster-Seeley demodulator and Fig. 1B a 'Ratio' demodulator, the basic circuits for these being shown in Figs. 2A and 2B. The better class of F.M. tuner employs the Foster-Seeley demodulator, as it is generally held that the distortion factor is lower than that of the Ratio demodulator, although in practice this is not always true. Experience shows that by careful adjustment the Ratio demodulator can equal the performance of the Foster-Seeley circuit. The Foster-Seeley circuit is not as effective in rejecting A.M. signals as the Ratio demodulator circuit, and an extra limiter stage is usually provided. When correctly set up, the Ratio demodulator is in itself an efficient A.M. rejector, and is cheaper to produce.

R.F. Stages and Frequency Changers

There are many possible circuit arrangements, but the most common is shown in Fig. 3. This is a 'grounded grid' r.f. stage, with a self-mixing local oscillator. The local oscillator has a double-wound tuning coil, which provides feedback between anode and grid to maintain oscillation. A point of interest is the grid winding and trimmer, Cn. The coil is centre-tapped, and by adjusting Cn to match the internal capacity between grid and cathode of the oscillator valve, the centre tap is maintained at 'earth' potential. The signal can be injected at this point without affecting the oscillator. Fig. 3B helps to clarify this point.

A further advantage is that, since no oscillator voltage appears at the signal injection point, radiation from the oscillator via the r.f. and aerial is reduced to a minimum. The grounded grid also helps in this respect, because it forms an 'earthed' screen between the anode and cathode. Keeping the oscillator frequency and its harmonics from the aerial is very important, because if

these are radiated they can cause interference to other receivers, most notably television.

Intermediate Frequency Amplifiers

Intermediate frequency amplifiers in F.M. receivers are very similar to those used in A.M. receivers, and in practice the two can be combined. Fig. 4 shows a typical F.M. i.f. stage. The frequency used almost universally for F.M. i.f. stages is 10.7 Mc/s., and the i.f. transformers are designed to provide an overall bandwidth of between 180 Kc/s. and 250 Kc/s. This also depends on the type of receiver, the number of stages, the required selectivity and maximum permissible distortion.

The better class of F.M. receiver would normally have a bandwidth of between 180 Kc/s. and 220 Kc/s. A minimum bandwidth of 180 Kc/s. is acceptable for high quality, low distortion mono F.M., whilst stereo will require a slightly larger bandwidth, but this will be dealt with in a later article. Some cheaper receivers may have a bandwidth as wide as 350 Kc/s., which is quite satisfactory, except in areas where stations operating close to each other in frequency are receivable at comparable signal level.

Limiters

The limiter stage, Fig. 5, is normally used only with a Foster-Seeley type demodulator. By working the valve at a very low anode and screen voltage, the maximum output is limited to a pre-determined level. Once this level has been reached, no further increase in signal input will have any effect on the output level. The overall gain of the receiver is designed so that even a weak signal will reach the limiting level; thus any noise pulses, etc., have no effect on the signal, since they are reduced to the same amplitude as the signal itself. Remember, the demodulator only responds to changes in frequency. Problems concerning impedance matching, suitable aerials for F.M. reception and connections to tape recorders and hi-fi amplifiers will be dealt with in later articles.

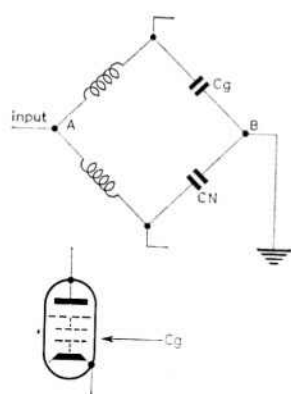


Fig. 3B:
When $CN = Cg$ the bridge is balanced and point 'A' has same potential as 'B'.

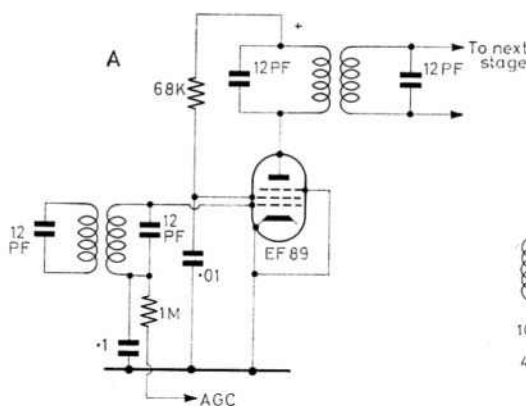


Fig. 4:
Typical F.M. i.f. Stage.

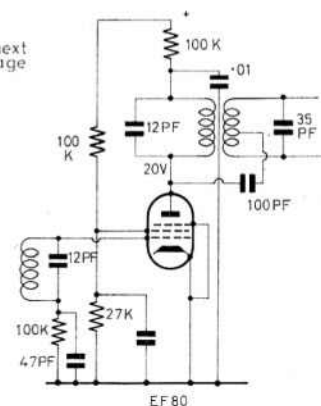


Fig. 5:
Typical Limiter circuit (note low anode voltage).

Brenell

The tape recorders made for enthusiasts-by enthusiasts

Everyone concerned with the manufacture of Brenell tape recorders is an enthusiast, taking infinite care and patience with each facet of production. Constant research ensures that every possible, worthwhile, refinement is incorporated and that each Brenell machine is built to the stringent specifications laid down. This is why the name Brenell is synonymous with quality and reliability.

Features common to all Brenell models :-

4 tape speeds $1\frac{1}{2}$, $3\frac{1}{2}$, $7\frac{1}{2}$ and 15 ips - 3 Papst outer rotor motors (hysteresis synchronous for capstan drive) frequency correction at all speeds - pause control - monitoring and superimposing - $8\frac{1}{2}$ " dia. reels - fast rewind (1200 ft. in 60 secs.) - all deck switches interlocked - unique, reliable braking system - digital rev. counter - hinged decks.

STB 2/5/2



A NEW model—The STB 2/5/2

This versatile mono/stereo recorder has numerous features which will delight the advanced amateur or the professional. Here is a brief specification :-

Especially designed for use with high fidelity stereo installations - adjustable attenuators on all input channels to ensure perfect matching with all auxiliary equipment - dual concentric recording level and playback level controls - cathode follower output - four channel mixing on mono programme sources - twin recording and twin playback pre-amplifiers - comparison of original and recorded signal - adjustable bias level - recording facilities for 1/2 and 2/2 track - playback facilities for 1/2, 2/2, 1/4 and 2/4 track - sound on sound facilities - two edgewise meters for recording level, tape output level and bias level - optional extra:- stereo power amplifiers and monitoring speakers.

ALTERNATIVE MODEL STB 2/5/2 has special deck to accommodate $10\frac{1}{2}$ " N.A.B. reels.

MARK 5/3



Narrow gapped record/playback head for extended frequency response - double gapped ferrite erase head to minimise erase noise - magic eye recording level indicator (meter at extra cost) high quality amplifier (can be used independently of tape recorder) headphone monitoring.

All the features of the Mark 5/3 plus:- Separate record and playback heads - separate record and playback amplifiers - recording level meter - mixing of input signals - tape monitoring whilst recording - separate bass and treble controls.

MARK 5/3M

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THE BRENELL STB 2.

SUCCESS IN STEREO

by DAVID VICKERS



THE accumulation of superb technical knowledge and skill that has culminated in Brenell's latest model, the STB 2, is based on many years' experience in the field of tape recording. Brenell Engineering Co. Ltd. had already established a high reputation for precision engineering when, in 1950, some of the leading British radio manufacturers asked them to design a tape deck in kit form. This was a follow-up to the radio trade's highly successful television receiver kit, the Viewmaster. Brenell were faced with the difficult task of designing and manufacturing the component parts for a tape deck which could be easily assembled by an unskilled person and still give good results. Having produced the prototype, Brenell were then commissioned to manufacture the tape deck under the name 'Soundmaster.' This was an outstanding success; the 'Soundmaster' was responsible for introducing the new creative hobby of tape recording to thousands of people, and its performance and reliability played a large part in gaining the confidence and interest of the public. The high quality of these machines has been proved by the number still in use today by some of the early enthusiasts.

However it became apparent that not everyone had either the knowledge or desire to build their own deck, and

Left: Skilled fitters who work to the rule "quality before quantity" assembling decks in a corner of the Assembly Shop.

Right: One of the secrets of low wow and flutter is contained in the extreme accuracy of balance of the flywheel. Brenell pay particular attention to this operation.



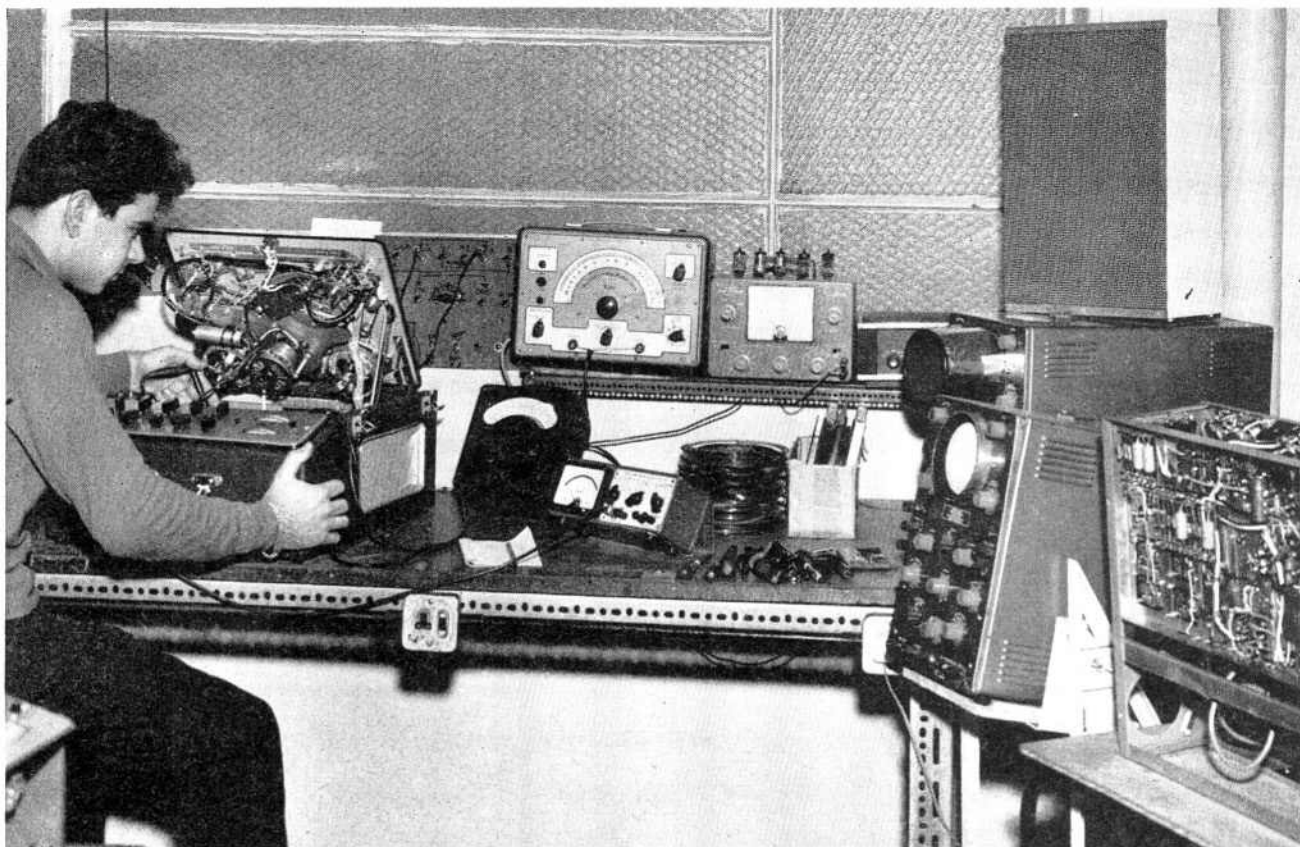
Brenell were inundated with requests for factory-assembled equipment at reasonable cost. They introduced a factory-built and tested tape deck to be used in conjunction with either an amplifying kit, especially designed by leading electronic engineers, or an assembled amplifier made by Brenell themselves. The idea of making the two main items for a tape recorder for incorporation into one's own hi-fi system was another feather in Brenell's cap.

As interest grew in creative recording, the natural development for Brenell to follow was to manufacture the complete tape recorder assembled and ready for use. This was the first Brenell tape recorder, the popular Mk. II. The high quality of this instrument gained them an excellent name with all those associated with recording at home and abroad. They continued developing tape recorders, incorporating new ideas and features culminating in the latest range of the Mark 5 Series 3 and the Mark 5 Type M Series for mono and the STB 2 for stereo.

The STB 2 in particular, has many new features to attract enthusiasts. It may be used for recording stereo-phonically or monaurally from radio, microphone,

amplifier and pick-up. Its four input channels (two per track on stereo and four per track on mono) have pre-set sensitivities to enable the correct recording levels to be obtained from a wide variety of input signal levels (even pick-up compensation is incorporated). The tape monitoring facility is a boon to busy recording engineers and A-B switching enables the recorded quality to be immediately compared with the input signal. Track-to-track transfer is accomplished with very little deterioration, and the machine is a joy to use for adding perfectly synchronised extra recordings, i.e., playing a duet with oneself or adding speech and sound effects to background music for film work. Four tape speeds and the ability to replay 1/2, 2/2, 1/4 and 2/4 track tapes makes this machine one of the most versatile available.

Such a high quality machine deserves high quality associated equipment, and the high fidelity enthusiast need have no qualms about combining it into his most prized collection of equipment. The playback termination is designed for use with external pre-amplifiers and amplifiers, but should the unit (comprising deck, recording and replay pre-amplifiers) be required as a



SUCCESS IN STEREO

Above: Every machine undergoes a rigorous testing procedure to ensure that it meets the high specification, both mechanically and electrically.

Below: A well equipped demonstration room is at the disposal of dealers and tape club members who wish to examine and have demonstrated the current range of Brenell tape recorders.



complete tape recorder there are available the necessary power amplifiers and speakers for easy installation into the cabinet.

Brenell's North London factory where these machines are produced is a spacious, clean, well-lit building and it is obvious that the emphasis is on the high quality of manufacture and assembly and not on production rates. The basic 4-speed tape deck which is used on all the current models will accommodate four heads and tape reels up to 8 $\frac{1}{4}$ " diameter. A special model which takes reels up to 10 $\frac{1}{2}$ " diameter has proved extremely popular, not only with the enthusiastic amateur recorder but with recording and broadcasting studios, research departments of industry and universities, etc. Brenell machines have a world-wide market and are used by education authorities, cinemas, shipping lines, supermarkets, H.M. Forces and Police, etc.

For the convenience of visitors to London and tape clubs, Brenell have an excellent demonstration room with accommodation for twenty-four people and demonstrations can be arranged at short notice without any obligations or sales pressure.



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TAPE RECORDERS · HI-FI

218 HIGH ST. BROMLEY. KENT. RAV. 4000

TAPE RECORDER OF THE MONTH

SABA TK230S

FOUR TRACK SLIDE SYNC PULSE
TAPE RECORDER. F.C. JUDD, A. INST. E.

THIS month my choice is the SABA TK.230S stereophonic four track tape recorder which, in my opinion, is a fine example of mechanical and electronic engineering from one of the large Western German manufacturers of hi-fi equipment and tape recorders. The appearance of the Saba TK230S alone gives this impression although the U.K. distributors not only demonstrated the recorder for me but also stripped one down for me to examine the finely engineered mechanism under the deck plate. For example such refinements as roller bearing tape guides, zero setting tape position indicator, provision for sync pulse colour slide operation with auto slide projectors, and an automatic tape cleaner, etc., are not apparent until one has thoroughly examined a recorder of this calibre.

FACILITIES OF THE TK230S

It seems to have provision for almost everything, but the most valuable, to my mind, is the built in sync pulse system for operating automatic slide changes. Slide enthusiasts will no doubt welcome a facility such as this which employs one of the four available recording tracks. For example a sound recording made on track 1 can be matched with slide sync pulses recorded on track 4 which leaves also tracks 2 and 3 for similar use.

Then of course it is a stereophonic recorder with two track stereo available on tracks 1 and 4 or 2 and 3. With equal versatility it will operate as a four track mono recorder with provision for making multi-track recording, i.e., recording from one track to another.

If this isn't sufficient then add microphone and radio mixing and/or microphone and recording mixing from one track to another, full push button control, instant temporary stop facility, two tape speeds, provision for external mixer, loudspeakers or amplifier and high fidelity performance. Now you have some idea of the Saba TK230S.

Although no microphone is supplied the price (94 gns) does include a spool of tape and spare spool, recording lead and cleaning brush. Several useful accessories such



as mono or stereophonic microphone, stereo playback attachment Saba Regie-Mixer, etc., are available. The distributors will supply a full list on request.

PERFORMANCE

The specification is shown in detail in the panel and as I have mentioned the price of the Saba TK230S is 94 guineas. The specification quotes a frequency response of 40-20,000 c/s. at $7\frac{1}{2}$ i.p.s. and 40-15,000 c/s. at $3\frac{3}{4}$ i.p.s. with a dynamic range of -60 dB. This is a fairly ambitious claim but I am assured that every machine distributed in the U.K. is checked to see that the electrical and mechanical performance agrees with the specification. However, a demonstration of this recorder is convincing and the quality of reproduction is superb. Each output stage (one on each channel) delivers 5 watts of audio, or combined for mono playback, 10 watts. ▶

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PULSE COUNTER

Will check the speed of an internal combustion engine by measuring the sparking rate.

IMPEDANCE MATCHING UNIT

For matching a high impedance source to a low impedance input—i.e. from a microphone to an audio amplifier or tape recorder.

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TAPE RECORDER OF THE MONTH

The deck controls are smooth in operation and there is of course a recording level indicator, tone control, and the usual tape winding facilities of forward or reverse fast re-wind. Incidentally the large power output per channel means that to achieve really spatial stereo one has only to connect two external speakers and space them sufficiently wide apart. One cannot expect full stereo width of course via the internal speakers of the tape recorder because of the close spacing. Nevertheless the reproduction is still pleasing.

SERVICE AND SPARES

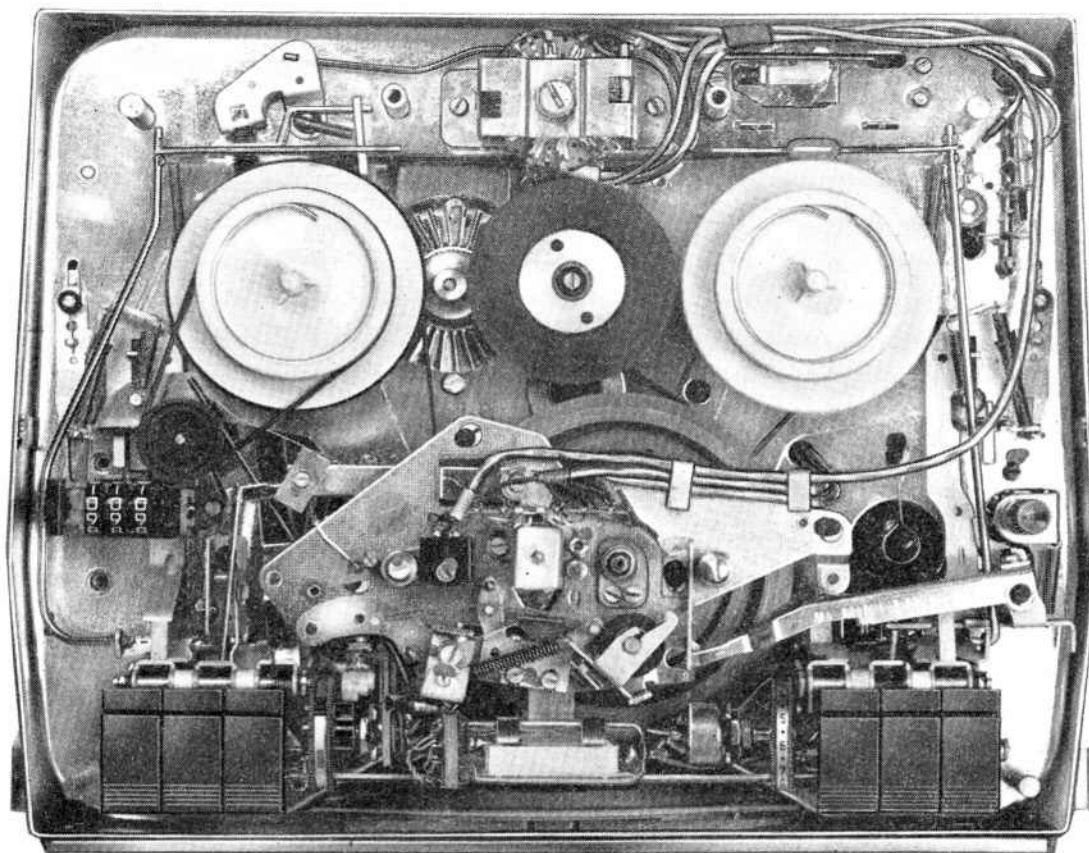
A visit to the Service Department located at the distributors' warehouse clearly showed that the buyers of the Saba TK230S, or indeed any Saba product, need have no fear of being unable to obtain adequate spares and service. They have an elaborate service department but competent engineers and dealers may be interested to know that a full quota of spares are available to them. This also includes spares and service for older Saba recorders which were originally distributed by another company.

Again I have chosen a recorder in the higher price bracket but one which will no doubt enjoy the prestige it deserves. In this so far brief search around the tape recorder market, the so called ideal recorder hasn't yet been found but then who is to say exactly what the ideal tape recorder shall be? Perhaps next month I will go shopping for something a little less expensive but which could be classed as a useful recorder with a good performance. Meantime if you are interested in the Saba TK230S why not write to the distributors for their brochure. They are Saba Electronics Limited, Eden Grove, London N7.

TECHNICAL DATA

Power supply	A.C. 50 c/s (60 c/s also possible)
Consumption	Approximately 70 watts
Mains voltage	117/220 volts
Tape speeds	3½ and 7½ inches per sec.
Tape reels	3ins. to 7ins.
Maximum running time	4 × 2 hours.
Transistors, tubes and rectifiers	2 transistors, 6 tubes, 4 rectifiers
Track system	Four-track
Frequency range	At 7½ i.p.s.—40-20,000 c/s At 3½ i.p.s.—40-15,000 c/s
Dynamic range	60 dB or greater
Wow and flutter	±0.15% at 7½ i.p.s. ±0.25% at 3½ i.p.s.
Input and sockets provided for	Gramophone, radio, regiemixer, pedal switch, slide synchronizer, time-switch, stereo microphone
Output stages and speakers	2 push-pull final stages, for stereo 2×5 watts, monaural 10 watts. Two loudspeakers.
Socket provided for external loudspeaker	3-6 Ohm Also included is a built-in mixer unit with inputs for two sound sources.
Weight	About 28½ lbs.
Dimensions	16½ × 14½ × 7½ ins.

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ATR/4

Tape & transistors

THE RECORD - LEVEL INDICATOR, ITS PURPOSE AND PERFORMANCE

THE signal in the record channel is also applied to some device capable of indicating the level of signal applied to the record head. This, of course, is the 'record-level indicator'. Many transistor tape recorders employ for this purpose a single-stage voltage amplifier feeding a rectifier and moving-coil current meter. The signal is extracted from a convenient point in the record channel and applied to the voltage amplifier.

RECORD-LEVEL INDICATOR

The simplest arrangement in this respect consists of a metal rectifier or germanium diode in a shunt rectifier circuit with a preset 'sensitivity control' and meter movement. A more sophisticated set-up features a bridge rectifier circuit, often composed of four germanium diodes, as shown in Fig. 1. Here Tr1 is concerned solely with amplification of the record signal for the meter circuit. Maximum gain is given by the common-emitter configuration and the record signal is fed into the base via the 10k preset resistor. This, in conjunction with the 68k, forms the base potential-divider for setting the operating point of the transistor, as we have considered in past articles in this series.

The 1k in the emitter from d.c. stabilisation and the 100 μ F shunting it avoid degenerative feedback. The collector is loaded resistively, and the audio signal across this load is coupled to the bridge rectifier through the 4 μ F electrolytic. The rectifier system powers a 100 μ A meter movement. The audio signal is thus rectified and the meter deflects in proportion to the signal amplitude. The preset control is necessary to set the meter deflection just below full modulation (i.e., record-level) relative to the record current in the head. The head current for this condition depends upon several factors, including the amplitude of the h.f. bias, the type of head and the type of tape.

To record the tape fully the head current may range from about 50 μ A to 120 μ A as governed by the factors mentioned above and also by the performance specifications of the instrument. The greater the magnetic intensity imparted upon the tape, the greater will be the distortion on playback. High quality machines may record to a level that does not produce much more than about 2 per cent. third-harmonic distortion on a 400 c/s sine wave, while the 'popular' category machine may purposely record to a higher level to mask certain shortcomings stemming from economy of design.

In this respect, low-level recording can considerably aggravate signal-to-noise ratio problems. We have all discovered that the background noise on playback is

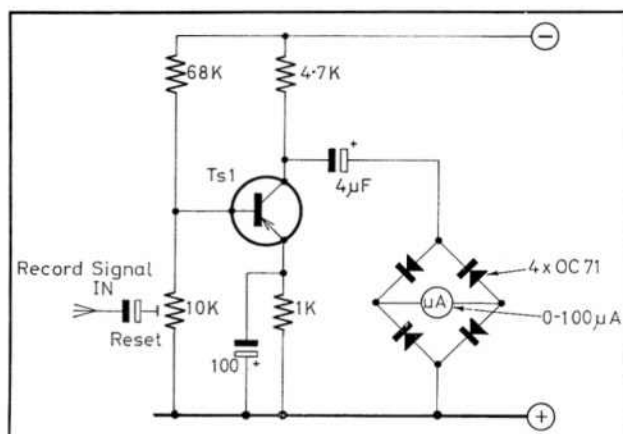


Fig. 1. The transistor amplifier in this circuit steps up the record signal to a level which can be rectified and then applied to a microammeter to provide an indication of record-level.

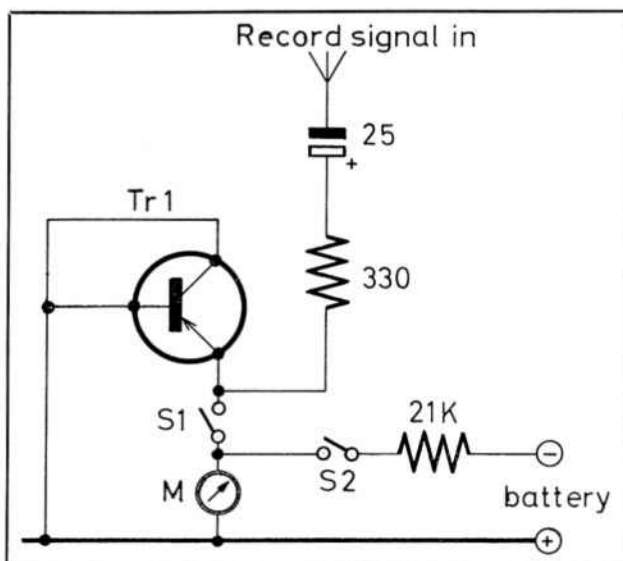


Fig. 2. In this simple circuit a transistor is employed as the meter rectifier (by use being made of the emitter junction) and the signal from the output of the record channel is fed through the capacitor and resistor to the emitter. Switch S1 is closed on 'record', with S2 open, while to measure the battery voltage, S1 is open and S2 is closed, the 21k resistor then acting as an ordinary multiplier to turn the microammeter into an ordinary voltmeter. This arrangement is employed in the Philips EL3300 transistor recorder.

that much higher when we record only to a low level. This is because inherent tape noises show up more when the recording level is low and also — more important — because to reproduce a low-level recording at normal volume the playback gain control needs to be set to a higher level, an action which also steps up the background noises of the amplifier itself — such as hiss and hum. To help mask these sort of troubles one is often tempted to increase the record level, but while this action improves the signal/noise ratio on the one hand it increases the playback distortion on the other.

NOISE/DISTORTION COMPROMISE

It is the job of the record-level indicator to see that the tape is neither under-recorded nor over-recorded to suit the compromise of distortion on the one hand and poor signal/noise performance on the other. The maker knows the current required in the record head to ensure that his specification figures are achieved, so it is simple for him to feed a controlled signal into the record channel, adjust its level for the optimum record current in the head and then adjust the 'record-level' preset to get the meter to indicate record-level peak.

The enthusiast is not usually able to make such a critical adjustment himself, but he can, as least, adjust the preset (i.e., that shown on the circuit in Fig. 1) to give the best record/playback performance when a tape record is made with the record-level indicator kicking towards maximum peak.

For extra sensitivity, some machines may incorporate two voltage amplifier stages prior to the meter movement and rectifier, but whether this is necessary or not depends upon where in the record channel the signal for application to the record-level indicator is extracted. If the signal is extracted after, say, the first amplifier in the record channel, then two amplifier stages for the level-indicator would probably be used. However, if the signal is obtained at the record channel output, at the point from which the head is fed, then only a single amplifier stage may be used or the level indicator may be fed direct from this signal after rectification.

In some machines the record-level amplifier may be one of the voltage amplifier stages which is employed on 'playback' but which is redundant on 'record'. The 'record/playback' switching would be arranged in this case to switch the appropriate amplifier stage to the level indicator amplifier in the 'record' position.

It is not uncommon to find that the record-level meter can be switched to indicate playback signal, battery voltage and, in some cases, the amplitude of the h.f. bias as well.

RECORD-LEVEL/BATTERY VOLTAGE

A simple arrangement used in the Philips EL3300 for record-level and battery voltage is shown in Fig. 2. Here a transistor is employed as the record signal rectifier. The collector and base are shorted and the emitter junction acts as the rectifier. For indicating the level of the record signal, the signal at the output of the record amplifier is applied to the emitter through a 25 μ F

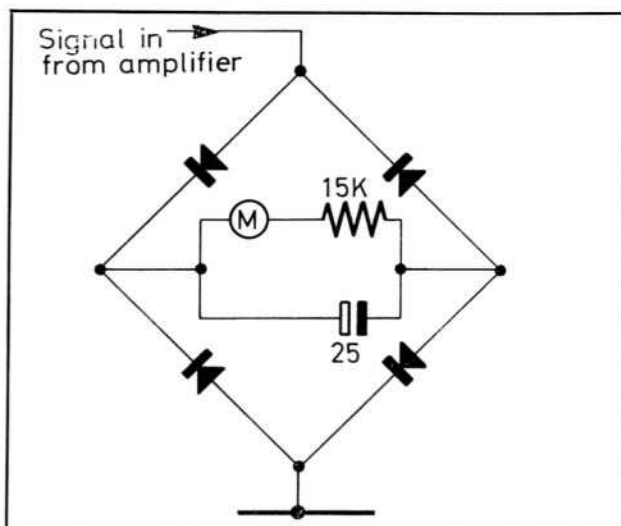


Fig. 3. A slow decay on the record-level meter is possible by including a resistor in series with the meter and a capacitor across the meter/resistor combination, as shown.

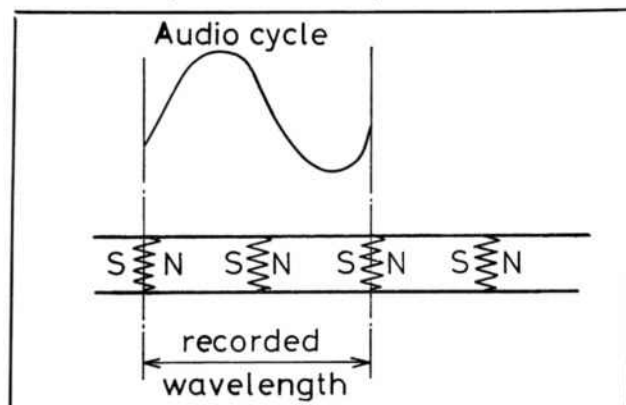


Fig. 4. Here is shown the small "bar magnets" recorded on the tape due to the programme signal. The higher the frequency of the signal, the shorter the magnets.

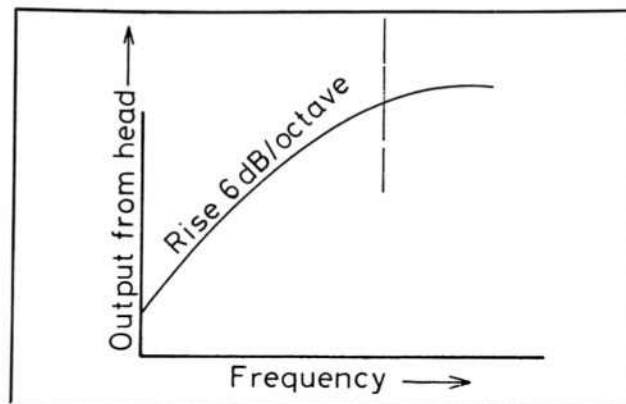


Fig. 5. The output from the playback head, due to a tape of constant magnetic induction over the audio spectrum, rises at the rate of 6dB per octave until it reaches the frequency where the head and tape losses cause the rate of rise to decrease and eventually the output falls.

TAPE AND TRANSISTORS

isolating capacitor and 330-ohm resistor. S1 switches 'on' and the meter M deflects in proportion to the amplitude of the record signal.

For checking the battery voltage, S1 switches 'off' and S2 switches 'on'. This disconnects the movement from the emitter junction and puts the 21k multiplier resistor in series with the battery and the movement, the latter which then acts as an ordinary voltmeter.

The type of level indicators described are essentially 'peak programme meters'. This is, they respond to the peaks of the audio signal. This type of indication is best for tape recording since the tape tends to overload on the peaks of signal, and a meter which is based on an integrating action fails to show such peaks, indication being related more to the overall loudness of the programme. A meter of this kind is scaled in volume units (VU's).

SLOW DECAY CHARACTERISTIC

Ideally, the peak programme meter should respond very rapidly to the signal peaks but decay relatively slowly. This action facilitates the setting of the record-level control. The type of meter movement and rectifier system has a bearing on this, and true PPM's are designed for speedy rise and slow decay performance. It is possible to introduce the effect artificially in some cases by connecting a resistor and capacitor in the meter circuit, as shown in Fig. 3. The resistor will reduce the sensitivity of the level indicator generally, but in equipment featuring a 'sensitivity' adjustment, as in Fig. 1, the preset can usually be adjusted to compensate for the loss in sensitivity resulting from the addition of a resistor. So much, then, for record-level indicators.

PLAYBACK CHANNEL

We now come to the playback channel. The problem here is to amplify the very weak signals in the playback head without introducing excessive noise and also to provide a bass-lift characteristic. The playback head when under the influence of the recorded magnetism on the tape is rather like a very small dynamo. That is, across the winding of the head is produced a very small alternating voltage corresponding to the frequency of the original sound.

The strength of this signal voltage is governed by the strength of the magnets imparted to the tape, the number of turns on the head winding and by the rate of change of the magnetic field across the head gap. The first two of the above factors are fixed (a) by the recording (i.e., by its depth) and (b) the design of the playback head. The third factor is related to the frequency of the signals recorded on the tape.

A complete cycle of audio signal causes on, say, the first *half cycle* the pole pieces either side of the gap on the record head to polarise magnetically north-south and on the subsequent *half cycle* to change to south-north. On a constant tone signal (sine wave), therefore, the head pole pieces alternate continuously in polarity.

Since the tape is passing the pole pieces at a constant

speed, this effect imparts upon the oxide surface of the tape two small bar magnets for each complete cycle of signal. This is shown in Fig. 4. The overall length of the two magnets is thus equal to the recorded wavelength of the signal, a factor which is worth keeping in mind. Now, one can appreciate from the drawing that the length of the magnets decreases as the frequency increases and the wavelength decreases. I described earlier in this series how the tape induction falls with increasing frequency due to the self-demagnetisation of the very short magnets that the record head endeavours to impart upon the tape. It was also shown in the same article how this trouble is partly countered by recording with a treble lift. (ATR Feb. 1965).

With a dynamo, the faster the speed of the armature or magnetic rotor, the greater the output voltage. With a playback head the same principle applies. Instead of the armature or magnetic rotor, however, we have the magnets on the tape. Clearly, the shorter the magnets, the quicker they as a whole pass the gap. This means that the shorter, 'high-frequency' magnets give a greater rate of change of magnetic flux across the head gap than the longer, 'low-frequency' magnets.

By the same token as the faster rotor speed of a dynamo giving a greater output voltage, so the shorter magnets passing the playback head give a greater voltage from the head winding. On playback, then, we obtain from a tape of constant magnetic induction over the audio spectrum, an output which rises progressively with the frequency, as shown in Fig. 5.

6dB PER OCTAVE

The rise in output voltage is at the rate of 6dB per octave. A rise of 6dB means that the voltage doubles for each octave. One would expect this, thinking of it in the light of the foregoing. Each octave the frequency doubles. Therefore, the rate of change of flux across the gap of the playback head doubles. From the dynamo analogy, this is the same as the rotor speed doubling. It is only natural, then, that the output voltage should double as the frequency is raised over each octave, or doubled.

In practice, this natural rise in output voltage only goes on up to a certain frequency. The rate of the rise then decreases, and as the frequency is further increased the output voltage tends to fall. These effects result from the self-demagnetisation of the very short, high-frequency magnets on the tape, as we have seen, and also from the losses in the playback head itself. Losses tend to attenuate the higher frequency signals and thus cause a drop in the output voltage. We have seen that the drop is partly countered by the treble boost applied during the recording process.

We certainly need to do something about the bass attenuation, for if the voltage from an unequalised head amplifier were applied direct to a channel with a flat response, we should be very much troubled by apparent treble boost. In transistor tape recorders we can use the inductance of the playback head to assist with boosting the bass and next month I will show how this is accomplished.

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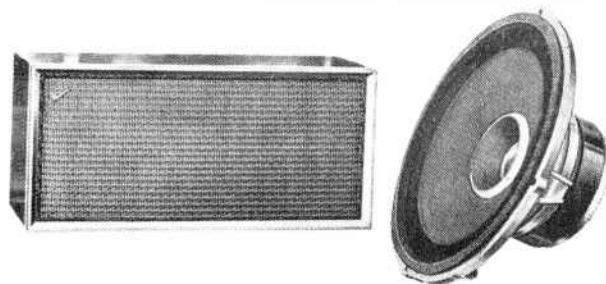
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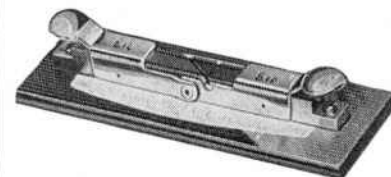


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TAPE CLUB NEWS

ONE POINT which has been cropping up with increasing regularity of late has been the question of the ideal number of members for a club. Some clubs feel that in a small club with limited membership there is a much greater sense of loyalty, while others are proud of the record membership they have enrolled.

There is much to be said for the small club, and it is true that members of such a club feel a far closer tie between themselves. Organisation costs for a small club are generally much less too, particularly as it is often possible to meet in a private house, rather than going to the expense of hiring a room. But against all this there are a number of disadvantages, notably the limitations of equipment. Unless a small club has some particularly wealthy members, it may well prove difficult to acquire much in the way of ancillary equipment. Demonstrations too, may be difficult to arrange, for a company may feel it is just not worth the expense of sending a representative any distance if he will have a maximum audience of six.

But perhaps the gravest disadvantage of the small club is the lack of competition. In a large club of perhaps twenty, thirty, or even forty members, there is terrific scope for competitions, between both individual members and teams, and rivalry can be very keen. Half a dozen experts in a large club can set a really high standard as an incentive to their fellow members; one expert in a small club seldom has the same effect.

One club in particular seems to be proving these points. Rugby club are now proudly announcing an all-time record membership of 55, and are wondering if this a national record for a tape club, as well as a personal one. Certainly the club is doing excellently this year, going from strength to strength, not only in numbers, but in activity and success. Is there a greater safety and more security in numbers? Has any club ever had more than 55 members? I'd be interested to hear.

CLUB OF THE MONTH

Again there's no doubt that **Rugby** are the tops this month. With that all-time record membership I told you about, there's no shortage of brains to supply the ideas, or of hands to carry them out. Nine of the members joined in the club's first year—1958—and deserve a big hand for loyalty and enthusiasm. Craziest money-raising idea came from Len Stephens, who auctioned a tiny banana and thus raised 8d for club funds! Len is also directing a club group to provide tape and tape/slide shows to local homes for the aged, while Rosemary Scott and Alec Lovett are directing the re-formed drama group. An excellent talk on amateur radio, complete with a two-way link-up to Sutton Coldfield, was made possible by the club's landlord, who very kindly permitted a 15-foot aerial to be erected for the occasion.

GOING INTERNATIONAL (1)

Glad to see **Southall T.R.S.** back in the League picture. They seem to be going quite international, providing P.A. for a big function in aid of European unity, at which the local borough of Hayes and Harlington was presented with the first official European flag for their outstanding work for the promotion of European unity. A team of four used a total of six mics, three recorders, mixer, 50 watt amp., column loudspeakers, etc. A copy of the recording has been placed in the borough archives and another copy is being sent to M. Lujo Tonic-Sorinj, Austrian M.P. and representative of the Council of European Municipalities.

A copy of another tape, this time of a local Christmas service, is being sent to America. Club meetings are now being held at Talbot Road School, Southall, each Monday at 7.30 p.m. Membership enquiries should be made to Mr. R. Guest, 13 Fleming Road, Southall.

ON THE BEAM

My hunch about the hitherto silent Scottish clubs seems to have been right on the beam. **Dundee** Tape Club secretary Charles Aitken tells me that any sounds, however hi-fi, are apt to be

rather shattering if listened to within two weeks of December 31st! This explains the club's five-week recess! Since then, however, things have worked their way back to normal. Charles himself gave a discussion and demonstration of microphones and mixer units, and Chairman Don Smith provided a tape/slide show. A visit to the language laboratories of the local Education Authority has been arranged, and all members are keen to see just how effective the multi-tape deck teaching unit is.

JOINT SUCCESS

During the festive season, **Great Yarmouth T.R.S.**, aided and abetted by other clubs up and down the country, successfully recorded greetings, messages and requests for people in local old folks' homes from their friends and relatives. This scheme worked so well and pleased so many, that the club has been asked to provide similar programmes throughout the year. Great activity has been centred around the recent club Trophy competition, and a Member's Tape Night also kept everyone busy.

AS OLD AS THE HEATH

After a highly successful visit to **Thorn-ton Heath** club to give a demonstration, Mr. Nat Cohen discovered a recorder that he had forgotten he possessed. Wondering if it might be of some use to the club, Mr. Cohen rang John Bradley and described the machine. Estimated date of production—1948 or '49. Speed— $3\frac{1}{2}$ i.p.s. only. Tracks—apparently full track only. Spools—7-in., similar to the modern Ferrograph style. Tape—paper. Tape—paper! And, when the machine found its way into John's hands, those paper spools were transferred on to a rather more modern machine and reproduced perfectly!

ACCOMMODATION PROBLEMS

Members of the **Hinckley T.R.C.**, finding themselves faced with a possible accommodation problem, have taken the foresight of solving it before it arises! The landlady of their present premises warned them that she would be leaving, and that the new landlord might not

agree to continue their tenancy. Naturally the club is disappointed, for much hard work has been put into making the room suitable for recording, etc. However, someone remembered that the local Labour club had offered them the use of their clubroom if ever it was needed, and arrangements have now been made for the club to take this offer up.

ALL THE NOISES IN THE ARK

Has your club ever been asked to record all the noises in the Ark? One club which has this somewhat dubious task on its hands is the **Walthamstow** and District T.R.S. A local school has requested the complete sound effects to back their production of "Noah," a play by Andre Obey. Another local group is also seeking help—this time in the form of an illustrated talk in sound on tape recording. The club is, unfortunately, losing the services of its very hard-working secretary, Tony Norton. Tony has just announced his engagement (Congratulations!) and doubtless domestic issues will preoccupy his mind.

PIRATES OF PENZANCE

A complete production of that famous Gilbert and Sullivan work, "The Pirates of Penzance," has now been taped by the **Ipswich** and District T.R.C. The recording, made by Colin Lockwood and Paul Cross has been presented to the Ipswich Blind Society for a future programme. Another Lockwood (David) presented an interesting film show, which included many travel films which had other members gasping for their summer holidays. More than 50 members and friends of the club attended the recent social evening with buffet dance, with Russell Burgess as M.C. and Ken Lingley providing a Tombola session. Mr. Dakin, of Elstone Electronics, and Mr. Griffith, of World Record Club, have both been recent visitors to Ipswich.

IMPROVEMENT SESSIONS

Members of the **Derby T.R.** Club have decided to set aside a portion of each meeting to the theory and practice of improving recordings. The more accomplished members will be available to give

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TAPE CLUB NEWS *continued*

advice and practical assistance to those who have not yet found their recording feet, so to speak. Also, to give the less-experienced members a chance of success, the club competitions have been divided into two sections — one for those who have won previous competitions and the other for those who have not yet scored a success.

81 IN THE SHADE

A recording made at a temperature of 81° F. in the shade may seem rather far fetched to those of us who are still struggling to shake off the last clutches of winter. The tape in question arrived at the home of Ken Upton, Secretary of the Brighton T.R. Club, from a friend in Singapore. So vivid were the descriptions of life in the East that the tape was taken to a recent club meeting, but unfortunately our not-so-warm British weather prevented some members from turning up to hear it! Chairman Ralph Vivian has also entertained fellow members with stereo recordings made in local churches.

HELP!

I make no excuses for including the following letter word for word. It comes from Mr. H. Calman, Secretary of the Epping and District Tape Club. He says — "After sounding the few locals I know with tape machines, then a letter to the local newspaper a couple of months ago, together with running (virtually single handed) a hospital Sound Magazine, there still remains only three of us constituting a club! Any tape/letter/parchment or pigeon post will be answered the same day of receipt—I promise ex-

press service to anyone helping to formate this club. Please Mr. Club News Man—I am on my knees at last! The words of a desperate man indeed, so please wake up, all you recorder owners in the Epping area, before Mr. Calman goes round the bend!

SPLITTING RESPONSIBILITY

Kettering and District T.R. Club is to be split into sections for the first time this season. This means that responsibility will be much more evenly shared — one group organising demonstrations, another making documentaries, and a third for outside recording. A good way of making everyone pull their weight. After the sixth A.G.M. Secretary M. F. York of 4 Edward Close, Kettering was re-elected.

FOR ALL TASTES

South Devon T.R. Club arranged their recent annual dinner and dance to suit all tastes — Chicken dinner, dancing, games, bar, etc. — at 15s. per head for 4½ hours. This followed the club's Ladies Night — an idea which really has caught on fast with all clubs. "Cinema Organ Recordings and some of the stories behind them" was the title of a fascinating lecture given by Peter Wills, club committee member.

TURNING TO CINE

The latest issue of "Tape and Cine Reel" has arrived from International Tape and Cine, but it seems to be turning more and more to cine. Apart from an excellent article by Roger Pirie and a few news items on tape products there was little for the real tape addict. But

what there was was well presented, and I was pleased to note that the club is to hold a tape competition.

GOING INTERNATIONAL (2)

The Thanet club writes "It's about time something was printed in your magazine about the best club in the country." So now I've had some news I'll pass it on. The club is now offering a number of facilities — cheap tape, a sound magazine, club competitions, news letters, round robins, etc. As this is now an international club with over 100 members, applications for membership are invited from everyone, everywhere. Secretary is Mr. George Watson, 3 Westworth Avenue, Westbrook, Kent.

FAMOUS NAME?

Is there a famous name in your club? In news from the North London club the name Ron Goodwin keeps cropping up. This Ron is now Chairman of the club, and recently performed his first official duty when he presented a pewter tankard, the Tape of the Year trophy, to Sinclair and David Scott.

NEW SECRETARIES

At Hazel's Club tape recording section the new Secretary is R. J. Johnson of 83 Abbey Road, Aylesbury, Bucks., . . . and Malcolm Parker, of 74 Copdale Road, Leicester, has been elected Secretary of the Leicester Tape Recording Club.

AUDIO FAIR (Hotel Russell, London, 22-25 April). Club Secretaries wanting free tickets should write now to Mrs. C. T. Cook, ATR, Haymarket Press Ltd., 86/88 Edgware Road, London, W2.

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2	Southall	7	Walthamstow
3	Dundee	8	Ipswich
4	Great Yarmouth	9	Derby
5	Thornton Heath	10	Brighton

THE LEAGUE TABLE

1. Rugby	42	16. I.V.A.S.	9
2. Thornton Heath	36	18. Ipswich	8
3. Walthamstow	35	19. Barnsley	7
4. Derby	20	20. Brighton	6
5. I.T.A.C.	19	20. Hartow	6
6. Hinckley	18	20. Radio Scotland	6
7. N. London	15	23. Esperanto	4
8. Boston	14	23. Epping	4
8. Southall	14	23. Ferrograph	4
10. Dundee	13	23. Friern Barnet	4
11. Great Yarmouth	12	23. Hazells	4
11. South Devon	12	23. Kettering	4
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