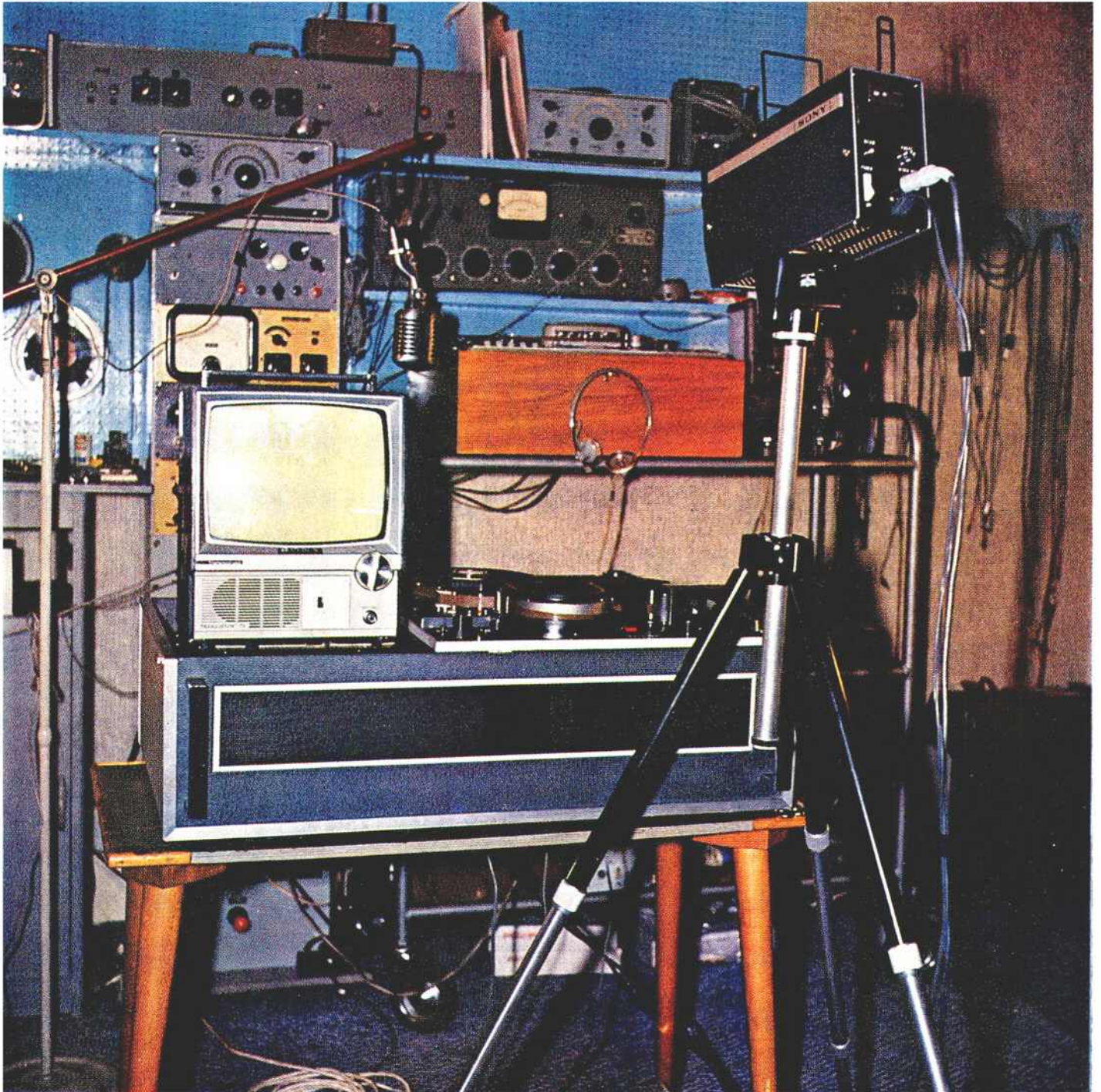


# Amateur Tape Recording

AUDIO-VIDEO

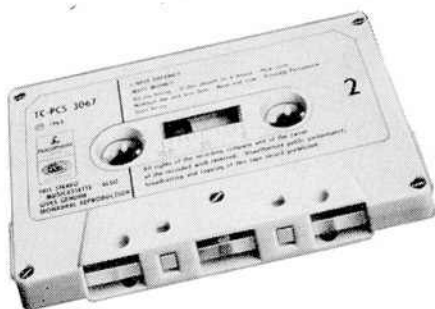
March 1967 Vol 8 No 8 2/6



**FIRST AMATEUR VIDEO SHOW—Page 26**



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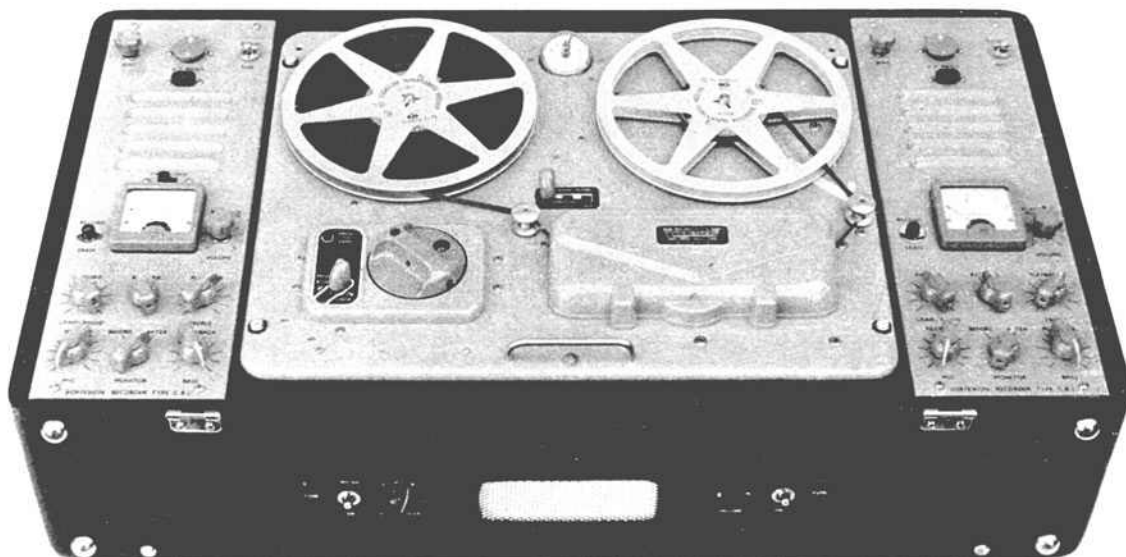
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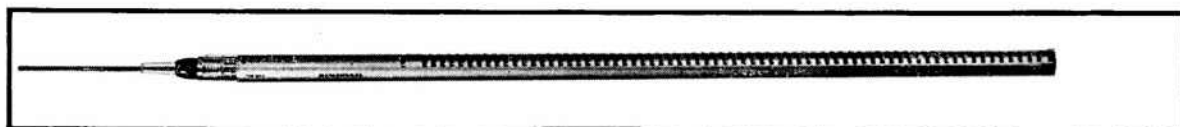
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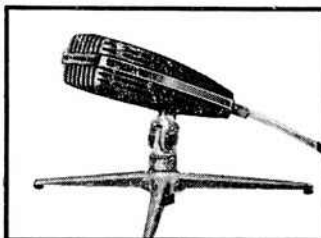
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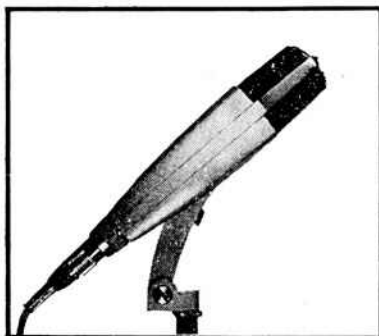
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**Transistors:** 2SB381 (x6), 2SB382 (x2), 2SB383 (x2), 2SC297 (x1), 2SC298 (x4), 2SD64 (x6).

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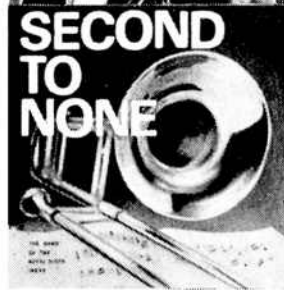
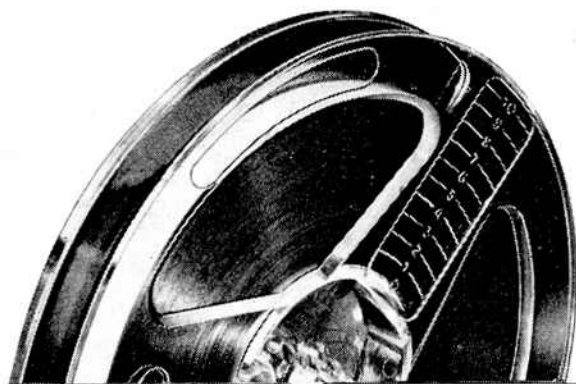
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**37** Sinfonia/Faris play Tchaikovsky's melodic 'Serenade for String Orch'; Bach's immortal 'Air on G String'; Boccherini's Minuet; Handel's 'Berenice'.



**22** The Moonlight, Pathétique and Appassionata... world's three greatest sonatas played by famous TV pianist.



**151** As Long As He Needs Me, Consider Yourself, all the famous tunes with Ian Carmichael, Joyce Blair, full supporting cast.



\* **81** The fabulous Sinatra swings and sings 12 top songs. Don't Worry About Me; Melody of Love; Look over your Shoulder; White Christmas; etc.





**1** The complete score from this great musical. With Ian Wallace, Joyce Blair and Chorus.



**31** John Hollingsworth conducts the Sinfonia of London in a thrilling performance of this famous ballet music.



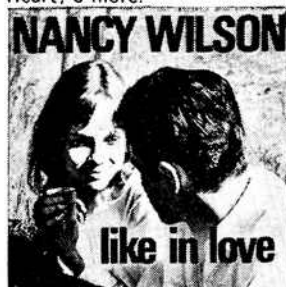
**196** Steam team! George Shearing and Dakota Staton team up in Cuban Carnival; Yesterdays; Blues in My Heart; 8 more.



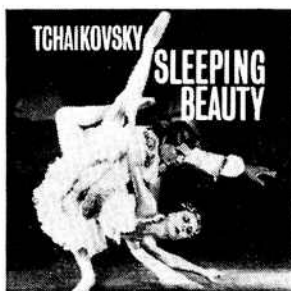
**16** Sinfonia of London, conducted by Muir Mathieson, give a splendidly moving performance of this well-loved work.



**14** Sinfonia of London under Muir Mathieson give scintillating performances of Bizet's two delightful suites.



**263** Street Where You Live; People Will Say; All of You; Night Mist—12 tops, with Billy May Orchestra.



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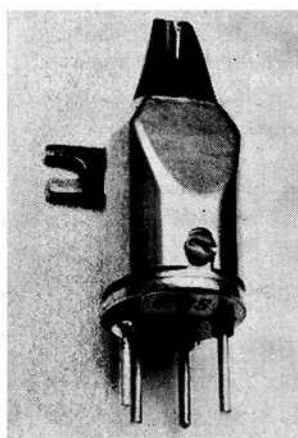


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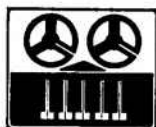


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# Amateur Tape Recording

AUDIO-VIDEO

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## EDITORIAL COMMENT

### The British Amateur Tape Recording Contest

Plans for the 1967 *British Amateur Tape Recording Contest* are already under way. A provisional committee has been formed under the chairmanship of Mr C. Rex-Hassan, the International Audio Festival and Fair Director.

The Secretary of the BATR contest is John Bradley of the *Federation of British Tape Recording Clubs*. We hope to publish full details of the contest categories in the next issue of *ATR*, and from time to time news items on the contest as well as articles on making contest tapes will be featured.

### 'ATR' Sponsors Video Show

On page 26 of this issue you will find a

fully illustrated report on the first all-amateur video recording of a complete television show sponsored by *ATR*. It was produced and recorded by the *Walthamstow and District Tape Recording Society*. Is this the beginning of a new era in magnetic recording? We think it is and we must congratulate the Sony Corporation of Japan on having produced the first video tape recorder complete with camera and monitor display that not only performs extremely well but has come very close to being within reach of amateur recording enthusiasts.

We would also like to congratulate British manufacturers as well, but unfortunately their respective development departments haven't yet finished their tea break so the design and production of British-made domestic video tape recording equipment has been held up for a year or two! With the exception

of the Telcan and Wesgrove video recorders, which were unfortunately failures, there has been no other indication whatsoever of anything coming from British manufacturers, at least nothing under £1,000 or so.

More about planning for Video next month.

## FRONT COVER

Our front cover this month shows the Sony TCV2000 Video tape recorder set up in the *ATR* Editor's own studio for investigation into the creative possibilities in video. A full report on the first all-amateur video show recorded with Sony TCV2000 appears on page 26.

# ON TEST UHER ACCESSORIES

by Peter Knight

## SLIDE PROJECTOR SYNC UNIT

This is known as the **Uher Dia-Pilot II** and is an accessory that will synchronize any tape recorder and automatic slide projector for the tape-controlled automatic changing of slides. The unit is completely self-contained with its own power supply that operates in conjunction with a fully-isolated mains transformer and metal bridge rectifier system. It employs three transistors, a relay and a tape head and works from 50Hz mains over 110 to 240 volts.

In operation, the unit is placed on a level surface by the side of the tape recorder, preferably to the right or, if this is not possible, to the left, as shown at (a) and (b) in Fig. 1, and tape from the appropriate spool is passed round the head assembly on the unit as the diagrams show. The unit proper is mounted on a heavy stand and can slide up and down a carriage so that the height of the head can be adjusted to match that in the recorder, thereby allowing the tape to pass in a perfectly horizontal plane. A knurled screw locks the unit once the correct height has been established.

The appearance of the unit is revealed in Fig. 2, and here can be seen the height adjustment, the head arrangement and the push-button controls. The unit's head embraces the lowest quarter of the width of the tape, corresponding to track 4, and along this track are recorded 100Hz pulses at positions which pass across the head at the moment of a required slide change. The remainder of the width of the tape is thus available for ordinary programme material. This means, then, that the unit is suitable for use with both two- and four-track recorders. With four-track machines it is possible to have stereo sound accompanying the slide programme if required, but this not possible on two-track machines since the track carrying the control pulses must be free from audio signal.

Synchronization is effected by first recording the sound to accompany the slides while the slides are being displayed on the screen. The slides in this instance are changed in the normal way by pressing the button on the projector's remote control cable. It helps if a script has previously been prepared of the narrative, sound effects, fade-ins and so forth. When a tape has been so processed and edited it is set up again in the recorder ready for complete playback and is passed round the head of the sync unit as already described. The idea is now to record the control pulses at the appropriate points along the control track, and this is done by depressing the *record button* on the unit, which is indicated by the illumination of a red pilot lamp.

The tape is then played back and at the points in the script where a slide-change is required

the *pilot-pulse button* is depressed. This, of course, is done while the slides are again displayed, but this time a slide change occurs automatically each time the pilot-pulse button is depressed. The whole of the slide/tape programme is run through in this way, adding pulses on the control track at the required points. Once the pulses have been recorded the record button is depressed again, which causes the red light to go out and a blue one to come on. The slides and tape are again returned to the start. This time the recorded pulses on playback automatically take control of the slide changer,

changing the slides at the points in the commentary which have been previously determined.

The 100Hz signal for recording the pulses is picked up from across a 150 ohm connected in series with the ac side of the bridge rectifier. The mains supply is 50Hz, of course, but the full-wave rectification action automatically produces 100Hz ripple voltage, and this signal is switched direct to the unit's head in the *record* position. This is rather a different idea from some auto slide change units, which use an oscillator of much higher frequency for pulse recording.

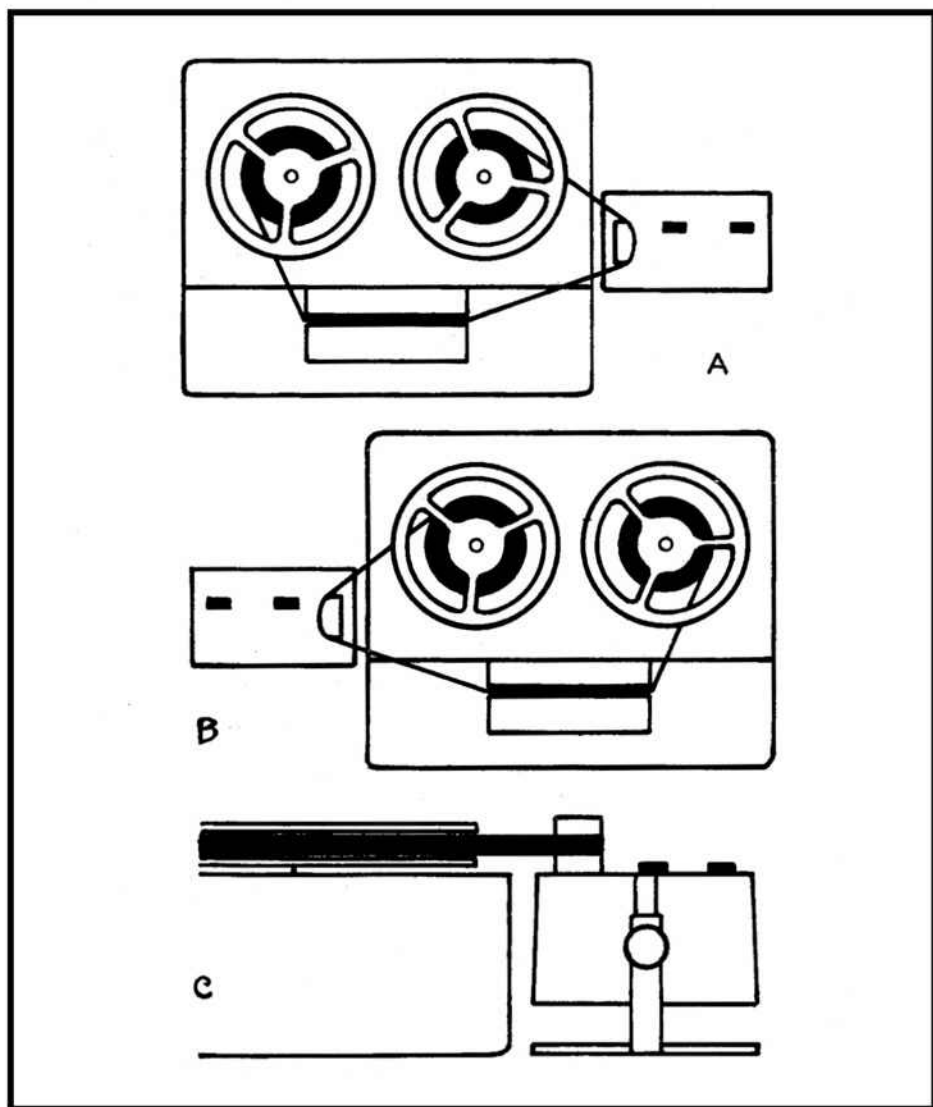


Fig. 1. The synchro-unit may be placed to the right (preferred) or to the left of the recorder as shown in (a) and (b) respectively. The height can be adjusted to obtain a perfectly horizontal tape motion, as (c).



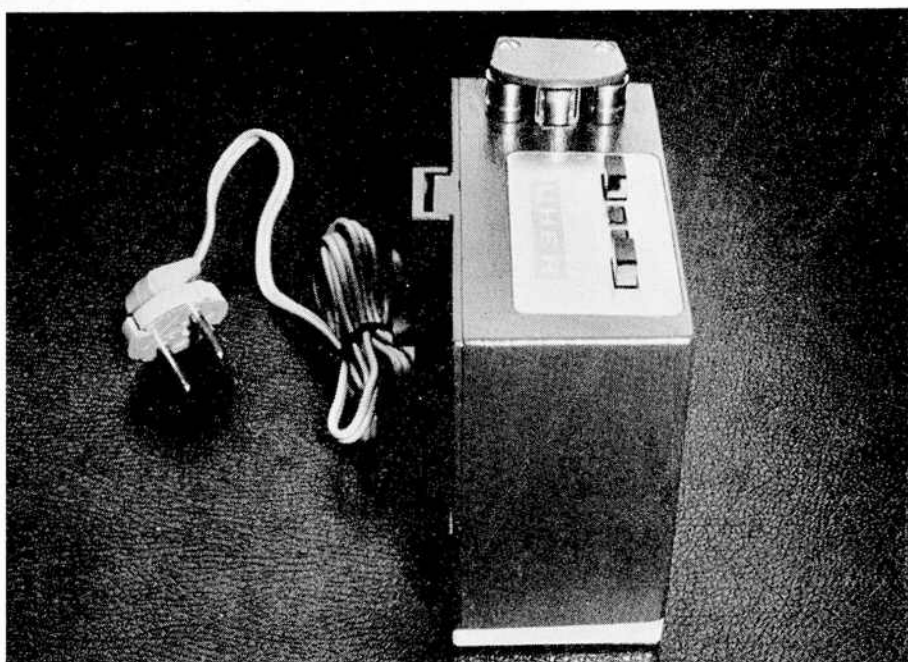


Fig. 3. General appearance of the Uher Akustomat F411 (auto stop/start unit).

Fig. 2. Left, general appearance of the Uher synchro-unit.

On playback (i.e., the 'sync' position), the 100Hz pulses pass the head and are amplified by two cascaded transistors. The output is fed to a diode, which translates the 100Hz to a dc voltage. This voltage is then applied to a switching transistor, in the collector circuit of which is a relay winding. Contacts on this relay operate the slide projector, causing it to display the next slide.

A DIN socket terminates the relay contacts on tags 2 and 3, and with auto projectors carrying a socket for tape unit control, it is only necessary to couple this to a similar socket on the projector. However, many projectors have no such control socket, and with these it is necessary to make connection between the unit's DIN socket and the contacts of the press-button on the ordinary remote control cable. This is generally not a very difficult problem.

Many auto projectors feature press-button focusing as well as slide changing, and it is important not to destroy this facility when coupling to the synchro-unit. In many cases it is possible to make up or have made up a special lead for coupling to the synchro-unit without effecting the remote focusing action.

The unit is very substantially made, is extremely easy to install on pretty well all machines and is by no means difficult to get working very effectively. There is no undue wear on the tape (or the oxide) by passing it round the unit's head owing to the nature of the tape guides used.

#### Maker's Specifications

**Power Requirements:** 110, 130, 150, 220, 240 and 250 volts, 50 or 60Hz. **Consumption:** 2.5W. **Fuse:** 100mA, inert-type 5 x 20mm. **Control Frequency:** 100Hz (on 50Hz mains). **Transistors:** Three type AC151.

#### AUTO STOP START UNIT

This interesting device is called the Uher Akustomat F411, and it is shown in Fig. 3. It is suitable for use with all Uher tape recorders equipped with a corresponding DIN

socket to accept the DIN plug termination on the unit and wired for auto stop/start. The idea of the unit is to start the recorder automatically on the commencement of any audio signal, and to stop it automatically when the audio signal ceases. It is thus possible to set up one of the suitable Uher machines in conjunction with the unit and to arrange for the machine to make a recording only when the sound to be recorded occurs. At all other times the machine will be quiescent and not using tape. The machine will then become quiescent again as soon as the sound signal ceases.

The unit works on all sound signal sources, such as microphone, radio, tv or any other source, and it is powered from the parent recorder through a DIN plug/socket system, into which is also connected the relay contacts of the unit for switching the tape transport of the recorder. Signals are picked up from the recorder and applied to the base of the first transistor (in common-emitter mode) of a four-transistor circuit, via a potentiometer which sets the operating sensitivity of the unit. Further amplification is provided by the second transistor which operates in the common-collector mode. Across the emitter circuit is a time-constant circuit composed of a 250μF capacitor and a variable resistor network in parallel. This is coupled to the base circuit of the third transistor which, in conjunction with the fourth transistor, forms a relay switching system, the relay winding being in the collector circuit of the fourth transistor.

When the unit is in receipt of signal, the relay contacts close and the transport mechanism in the tape recorder is energized. When the signal ceases the contacts open again but not until after a time period governed by the setting of the time-constant resistor just mentioned. Thus, the tape does not halt immediately the signal is terminated. This avoids the machine stopping during natural pauses in the signal source and the time constant can be adjusted by control labelled 'T' (see Fig. 3) from 500mS to 5S, as required. The sensitivity is adjusted by the control

labelled 'S', which simply increases the signal amplitude applied to the first amplifier transistor in the unit, as already explained. This control is set to its fully anti-clockwise position for normal sensitivity, and a substantial increase in sensitivity is achieved by turning it clockwise.

Once connected and correctly adjusted, the unit operates completely automatically and the action is very reliable. At the time of the test, the author did not have a suitable Uher machine available, but signal from the monitor socket of a different make of recorder was applied to tags 2 and 3 on the unit's DIN socket, while a suitable powering voltage was applied to tag 1 (a negative voltage relative to tag 3). When recording, the closed relay contacts, reflected across DIN tags 3 and 4, were arranged to operate the recorder's solenoid-operated pause control. Although this was rather a 'lash-up' affair, it did at least reveal the workings of the unit, but one would certainly feel happier with the unit properly terminated to a partnering DIN socket on the recorder, such as fitted to the Uher 4000 series, 4002, 4004, 'Royal Stereo' and Universal 5000' models.

Not all other makes of recorder could be adapted to accommodate the unit, however, but on those which were adaptable it would be desirable to have a DIN socket fitted to take the DIN plug of the unit. This is not a particularly simple exercise, however, and the non-technical type would be well advised to leave the job to a technician conversant with tape recorders.

The author found the unit particularly useful for dictation, the tape stopping when one 'dries up', starting again as soon as speech is resumed, thereby avoiding the old method of hand or foot remote control. The unit has many other applications as will be appreciated, and is suitable for any where automatic, signal-controlled stopping and starting would be desirable.

Further details and prices of these units are available from the UK distributors, Bosch Ltd, 205 Great Portland Street, London W1.

# RECORDING ORGANS

by **A. Lester-Rands**



Fig. 1. The Sennheiser MD421 studio cardioid microphone.

We frequently receive letters seeking advice on recording organs, particularly church organs, which may have to be included in recordings of weddings or choral performances. *Where is the best place for the microphone? Can a successful recording be made with only one microphone? What is the best type of microphone?* These are questions commonly asked and very often difficult, if not impossible to answer, since one may be dependent on the other. There are also other factors which may be unknown; for example, the acoustics of the environment always influence a recording no matter what kind of microphone is used.

## The Organ in the Background

Where the sound of an organ is merely the accompaniment to a choir or congregation it may not be necessary to have the microphone close to it (assuming only one microphone is available). All one can really do is to place the microphone strategically between the voices and the organ with the object of trying to obtain some sort of 'musical' balance between the two. If two microphones can be used, then one can be placed near the organ and one to the side of, or facing, the voices. It will, however, be necessary to mix the sound level from each in order to obtain a 'musical' balance. If trial runs for balance are possible so much the better. Such 'rehearsals' are, however, rare unless the music is being specially performed for recording, in which case one can usually enlist the co-operation of the organist and others taking part musically.

One of the most popular kinds of recording in which organ music and choir may be featured is the wedding service and ceremony which tape recording enthusiasts are often called upon to record for a friend or relative. Most letters on this subject simply say: *'I have an XYZ tape recorder, with a crystal microphone and want to record a wedding service. Where would be the best place to locate the microphone in order to pick up the actual ceremony as well as the organ, choir and congregation?'* The first consideration is the length of the cable which is usually attached, or can be attached (or extended), to a crystal microphone. Its length is necessarily limited. Long cables, i.e., over 20 feet, can impair the upper frequency response and introduce hum. So with the normal length of cable one is bound to have the tape recorder itself close by. Provided the tape recorder can also be conveniently situated, the microphone can only be located in one place –

as close as possible to the chancel steps where the ceremonial words are spoken. Here it should be possible to obtain full recording level on speech and at the same time take in the organ, choir and congregation, also at good recording level. When one has two or more microphones and provision for mixing, then one microphone can be used for the organ and choir, one for the spoken words. A third might be used for the congregation.

## Organ Recitals

When recording the organ alone for the sake of its own sound and music, the problem is quite different. To begin with, the quality of reproduction becomes of paramount importance and a simple crystal or cheap moving coil microphone just will not do. Neither will

a poor quality tape recorder. I recall an instance when a young organist came to me with a tape recording of his own playing of an extremely fine church organ. He wanted a disc copy made. The recording had been made at 3½ ips on a very cheap tape recorder with a nondescript crystal microphone and obviously by someone with very little knowledge of tape recording. The quality was atrocious and would have sounded even worse after being copied again on to a disc. I put the organist and a Ferrograph with a high-grade ribbon cardioid microphone into the car and off we went to make the recording again. So if you are ever asked to record a church organ, think twice. Is your equipment good enough? To which you may well retaliate by asking another question. What equipment *is* good enough?

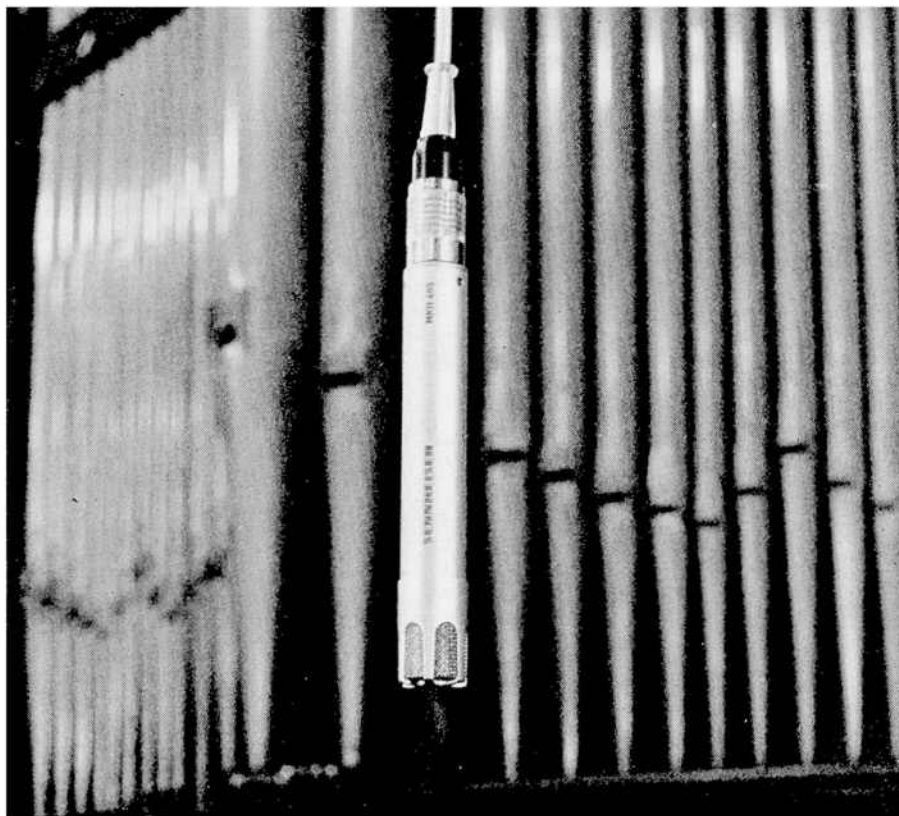


Fig. 2. The Sennheiser studio condenser microphone type MKH405.





Fig. 3. The Lowery Hilton electronic organ. The microphone is a Shure 55S ribbon cardioid.

The organ, to quote G. A. Briggs, is the largest of all our musical instruments and covers the widest frequency range. It also has the greatest variety of tone colours (*Musical Instruments and Audio* by G. A. Briggs—a book worth reading). On large instruments the lowest note may be the 32 ft C4 pipe which sounds at 16.35c/s (Hz). The highest note may be the C5 which sounds at 8,372c/s (Hz) although some organs can cover the range of 16 to at least 16,000c/s (Hz) which is ten octaves. Whatever the tuning range of the organ may be, there is also the harmonic or overtone range which embraces more or less the whole of the audio spectrum. Few microphones and even fewer tape recorders will cover the entire frequency range required for successful *high fidelity* recording of any organ, pipe or electric (or electronic). Even assuming that a full frequency range recording can or could be made, there still remains the problem of *reproducing* it. The loudspeaker incorporated in even the most expensive tape recorders will not reproduce

the lower frequencies. The only way in which the full frequency range of a successful recording can be heard is to reproduce it via a high-fidelity amplifier and appropriate loudspeakers.

Tape recorders such as the half-track Ferrograph, Tandberg, Revox, the Telefunken M24 and other comparable machines will, with a suitable microphone, make a worthwhile recording of most pipe and electronic organs. The microphone is really a greater problem and not many will reproduce below about 40c/s (Hz). The Reslo miniature broadcast ribbon, the Sennheiser MD421 shown in Fig. 1, the Shure 55S and other comparable microphones are really essential and will produce good results when recording pipe organs. Electronic organs present a special problem and few microphones other than high-grade studio condenser types can be used (Fig. 2). Electronic organs produce their sounds through loudspeakers and the high order of low-frequency sound pressure from the bass

notes can cause intermodulation to take place at the microphone diaphragm. The result is a peculiar kind of distortion that sounds like overloading but isn't. Never record an electronic organ with the microphone close up if it is a ribbon or dynamic microphone.

Many electronic organs have an output socket suitable for direct feed to a tape recorder. If possible, this should be used for recording, in which case the microphone can be eliminated. Remember, however, some electronic organs feature the rotating 'Leslie' loudspeaker and the special sound it produces cannot be recorded via direct connection to a tape recorder. The Lowery organ shown in Fig. 3 has this type of loudspeaker which produces a rather pleasing tremulant effect. The only way to record this is to employ a microphone, the signals from which can be mixed together with a direct output from the organ pre-amplifier. Care must be taken with the placing of the microphone with respect to the Leslie speaker and the main organ loudspeakers.

# TAPE RECORDER SERVICING PART XV

**This month Gordon J. King  
deals with recording level  
indicators**

Last month we looked at the circuit of the fluorescent or 'magic-eye' type of recording level indicator. This is successfully employed in the majority of inexpensive 'domestic' recorders. Its main function is simply to indicate to the operator when the level of recording signal applied to the head is likely to push the tape into saturation and thus the point when heavy distortion will be recorded.

The more sophisticated meter type indicator is necessary to give a measure of the recording level *percentage*. It was mentioned last month that 0db on the scale of such a meter corresponds to 100% recording level and that *minus* decibels correspond to levels below 100%. For instance, -6dB would indicate 50% recording level, -12dB 25% and so forth. These percentages are often given on the scale in addition to the equivalent dB ratio, but if not they can easily be discovered from a decibel table.

It is possible to fit a meter type indicator in place of the original fluorescent indicator,

but to undertake this job successfully one really needs to be a little knowledgeable with regard to the circuit of the recorder concerned and conversant with do-it-yourself electronics! Anyway, the following text should enable the enthusiast to perform such a conversion without ill effect. The idea of the meter indicator is to get the meter to deflect in accordance with the level of signal voltage at the recording head. We know, of course, that it is signal *current* in the head winding that determines the degree of magnetization imparted to the tape oxide, but since the current depends on the voltage across the winding, it is far easier to indicate signal voltage than current, since both give the same effective indication of field strength across the head gap.

The basic set-up is a rectifier arranged to translate the signal voltage present across the head winding to a dc voltage across a load resistor. This voltage is then used to deflect the pointer of the meter. The greater the signal amplitude, the greater the meter

deflection. This very simple system gives rise to problems. First, the meter requires power to work the pointer, and by the direct rectifier system explained this can only be provided by the recording output stage, the net result being that the indicator circuit tends to damp the amplifier.

Moreover, this damping is non-linear owing to the non-linear nature of the rectifier, and this in itself can give rise to bad inter-modulation distortion. This is avoided by feeding the rectifier through a 'hold-off' resistor of fairly high value, but when this is done insufficient signal voltage reaches the rectifier and it is then difficult to secure full deflection of the meter unless one of ultra-sensitivity is used. A 'buffer' valve (or transistor) is often used, therefore, between the recording output stage and the meter rectifier, and often a double-triode valve is adopted in the meter circuit, where one half operates as a triode buffer/amplifier and the other half as the signal rectifier, this triode being strapped to form a 'diode'.

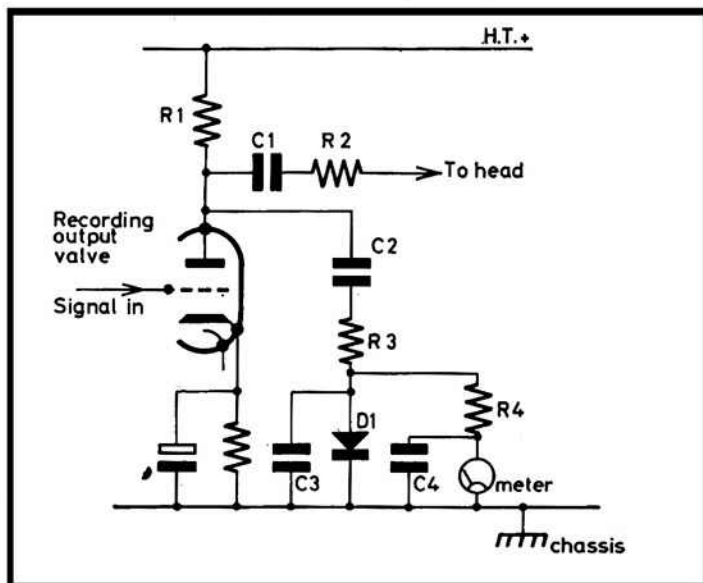


Fig. 1. Simple parallel diode meter indicator circuit.

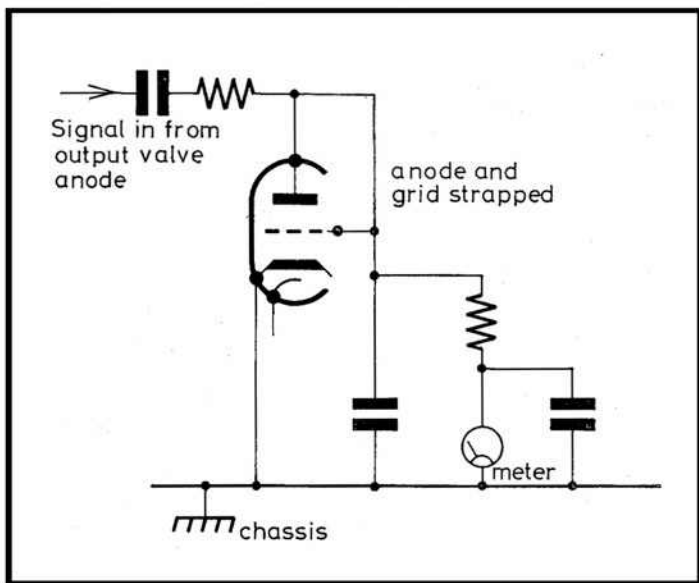


Fig. 2. This circuit shows how a strapped triode can be used instead of a diode.

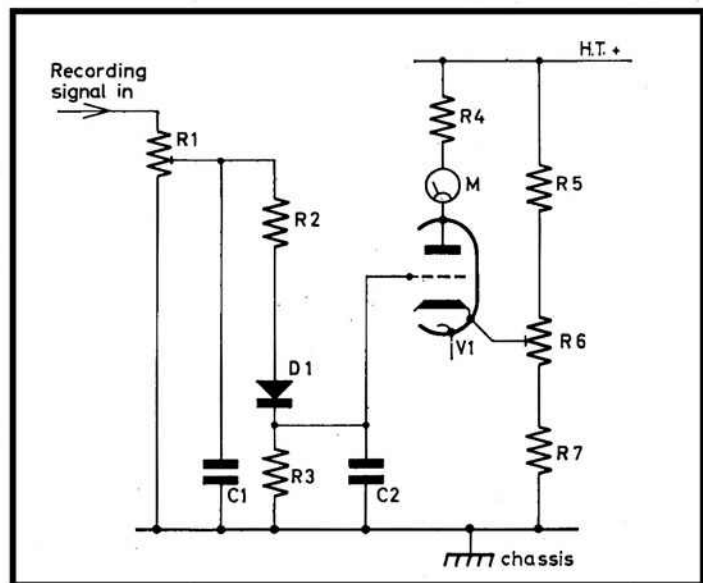


Fig. 3. The basic valve voltmeter indicator, where power for the meter movement is provided by the meter valve and not by the recording signal.

### Simple Meter Level Indicator

Nevertheless, the simple rectifier-only circuit is sometimes encountered in less exacting equipment and in equipment using a high impedance head, the signal voltage across which is high. A circuit of this kind is given in Fig. 1. Here the recording signal across the anode load R1 is fed to the head through the coupling/isolating capacitor C1 and also through R2, while the signal to the rectifier is coupled through C2 and the 'hold-off' resistor R3. Now, on positive-going half-cycles of signal the rectifier, D1, conducts and the signal is effectively by-passed to chassis. On negative-going half-cycles, however, the rectifier fails to conduct and the signal current passes through R4 and through the meter M, which deflects in accordance with the signal amplitude.

Capacitor C3 across the rectifier serves to by-pass the hf bias signal, and if this were open-circuit or missing there would be a continuous deflection on the meter due to the signal bias. Capacitor C4 across the meter movement provides a time-constant so that the voltage rise on transients is fairly rapid, while the decay time is increased. This, of course, happens due to the rectified signal charging C4, the discharge then being through the meter winding. It is worth recalling that quite a high signal voltage is required at the anode of the recording amplifier valve in this type of circuit to push sufficient signal current through the head winding for full recording depth. This is because the signal current has to flow through R2, which is of fairly high value in practice – typically 18Kohms.

The reason for this resistor is to swamp the changing reactance of the head winding with changing frequency, thereby ensuring that a *constant current* flows through the head winding at all frequencies. Without this resistor, the head current would be high at low frequencies (when the head reactance is of a low value) and lower at high frequencies (when the head reactance increases in value). The resistor thus makes the impedance at the anode of the recording amplifier valve appear fairly constant at all frequencies, since its value (in ohms) is much higher than the head reactance (also in ohms) even at high frequencies. This means that the rectifier can be fed through a high resistance (to avoid non-linear distortion effects as previously described), while still letting through sufficient current to work the meter. The value of R3 is thus influenced by the sensitivity of the meter movement and by the impedance of the recording head. Sometimes R4 is omitted (especially where the meter sensitivity is not very high), in which case the movement (which is high resistance) is connected directly across the rectifier.

Fig. 2 shows an arrangement similar to that in Fig. 1, but here a strapped triode is used instead of a rectifier. The triode section of an ECL86 is often employed for this application, the pentode section then being used as the playback output valve. The operation of the circuit is the same as for that in Fig. 1.

### Valve Voltmeter Indicator

Sometimes the dc voltage delivered by the rectifier (either a diode or strapped triode) is fed to a triode arranged as a valve voltmeter, as shown in Fig. 3. This idea reduces the loading on the recording output valve

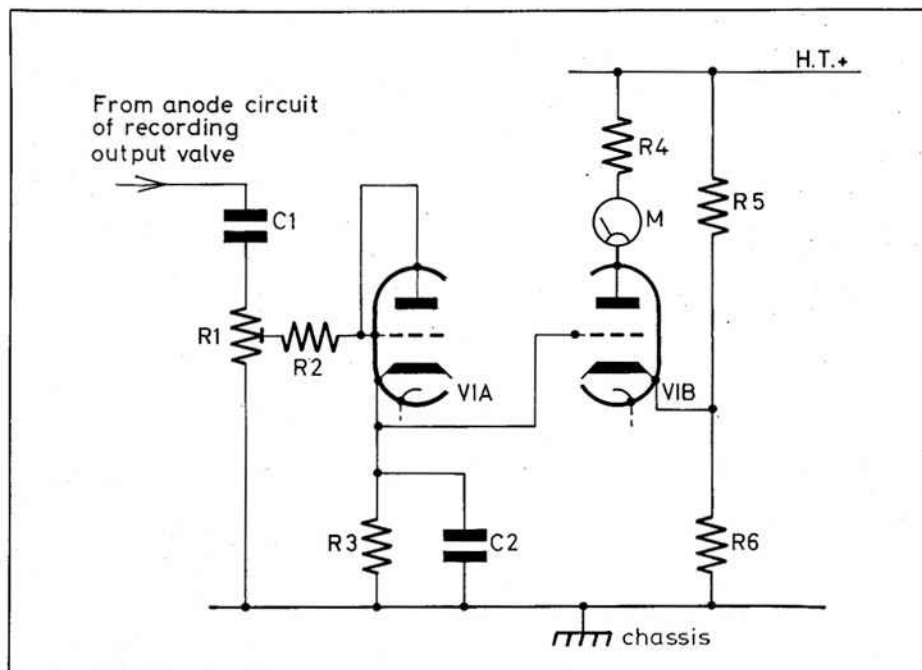


Fig. 4. A practical valve voltmeter recording level circuit. Suitable component values are: C1 0.1μF, C2 0.02μF, R1 1Mohms, R2 100Kohms, R3 2.2Mohms, R4 100Kohms, R5 470Kohms, (adjust for zero meter reading), R6 12Kohms, M 0–1mA.

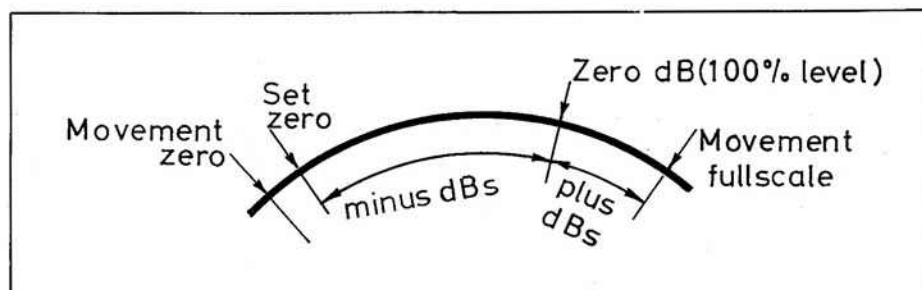


Fig. 5. Calibration of meter scale.

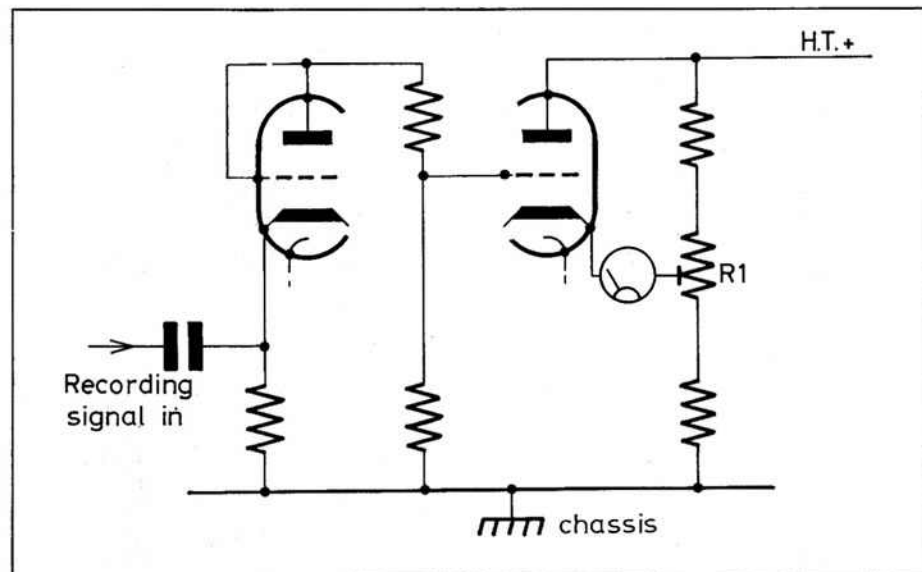


Fig. 6. Alternative valve voltmeter circuit.

and permits the use of a less sensitive meter movement, since in this circuit most of the power for meter deflection is supplied by the triode and not by the signal itself. The diode D1 is in a series rectifier circuit and the

recording signal fed to it through R2 is regulated to the required reference point by the preset resistor R1. C1 is of fairly small value (about 500pF) to by-pass the hf bias signal from the rectifier and R3 is



## TAPE RECORDER SERVICING PART XV

Continued

the diode load, across which the dc voltage is developed. C2, in parallel with R3, provides the time constant, allowing the meter to give a readable indication on transients and a slower decay, as may be required. The greater the value of C2, incidentally, the greater will be the decay time.

Valve V1 forms a valve voltmeter in conjunction with the meter movement in its anode circuit, and this may have a full-scale deflection of 1mA (or even higher). The bias of the valve is set by R6 (another preset) to give anode current cut-off and zero deflection on the meter. The rectifier is connected ('cathode' to load R3) so that it produces a positive voltage at the top end of R3, relative to chassis. This positive voltage is connected direct to V1 grid, which means that it counteracts the cut-off bias and thus causes the meter to deflect in proportion to the signal amplitude. Resistors R5 and R7 'pad' the preset R6 so that the correct biasing conditions are established approximately at the centre of its range. R4 is a current limiting resistor, the value of which is selected to suit the meter movement employed.

A completely self-contained meter indicating system can be built around a double-triode valve, as shown in Fig. 4. This has much in common to the circuit in Fig. 3, but a strapped triode is used instead of a separate diode. The signal from the anode of the recording output is coupled to the preset R1 through the isolating capacitor C1, and the selected level of signal is coupled through R2 to the anode/grid of the valve section V1A. Positive-going voltage at V1A cathode is directly connected to the grid of V1B, and the bias of this valve is set by the potential-divider made up of R5 and R6. With no signal applied the meter M should register zero (but see later) and the value for R4 is selected to suit the meter used. C2 gives the required delay, as already explained, and suitable values for the components are given in the caption.

The meter scale can be calibrated so that about 70% deflection corresponds to full recording level, this deflection, of course, being set by R1 when the recording signal level is for full recording depth. Sometimes V1B bias is adjusted so that just a very small amount of anode current flows on zero signal, the calibration below the 70% mark then taking this small current into account (see Fig. 5). An alternative circuit where the input signal is applied to the cathode of the strapped triode and where the meter is connected in series with the cathode of the valve voltmeter valve is shown in Fig. 6. Here the 'set-zero' control is R1. The principle of operation of this circuit is similar to those already described.

Next month we shall briefly recapitulate on the ways of setting up this sort of valve voltmeter indicator (relative to the recording signal level), investigate transistor circuits and then explore some of the automatic recording level circuits that require no recording level indicator.

# THE THINGS YOU SAY

## Hi-Fi Snobbery

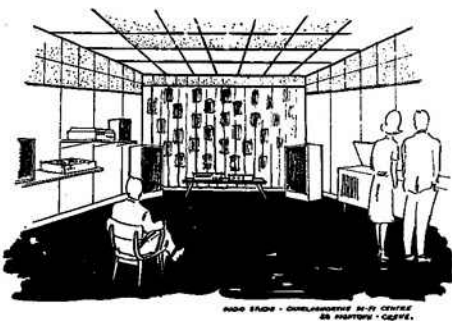
Your current article (December) *Test Report on the Beogram 1000* was what one would expect, impartial and to the point, but I detected a note of snobbery in the reference to the absence of an automatic switch-off on this equipment. I refer to the words 'of course', there is no automatic switch-off at the end of a record'. The 'of course' is the reason for my putting pen to paper, as it implies that the idiots like me who are waiting and searching for the transcription deck with an automatic switch-off and return arm are asking for something which is definitely not hi-fi.

I did my own 'research' on the Beogram 1000 some time ago, and whilst I liked it I did not buy it because 'of course' it did not have an automatic switch-off. I was forced to purchase a LAB80, although I do not use the automatic loader or changer. I do find the automatic switch-off makes my laziness much more enjoyable and I do not have to 'stand guard' until the record expires.

Please, Mr Knight, an automatic switch-off on a transcription deck is not gimmicky and hi-fi does not have to be laborious just to prove itself. I fail to see why such a refinement is frowned upon. When I find a transcription deck with the specification I require and will switch off and close down when the record is finished I'll buy it 'of course'.

RAF Wyton, Hunts

T. J. Maxwell



The Audio Studio at Charlesworths Hi-Fi Centre, offered as a clubroom for Crewe tape enthusiasts.

## Calling Crewe Tape Enthusiasts

It occurs to us that there may be some local tape recorder enthusiasts who would like to form a Tape Recording Club in Crewe, in which case we would be most pleased to offer them the full facilities of our Audio Studio at our new Hi-Fi Centre.

The local Recorded Music Society, (which we have helped to promote), use our studio for their meetings and we would be willing to give whatever assistance we could to promote a local Tape Recording Club.

Our new Hi-Fi Centre at 28 Hightown, (adjacent to our Head Office and Main Showrooms), is devoted exclusively to Hi-Fi Equipment,

Tape Recorders and Record Reproducers, with an emphasis on 'quality' before price.

The building comprises a ground floor Showroom with a comfortable and well appointed Audio Studio on the first floor.

N. R. Charlesworth (Director)

CHARLESWORTHS OF CREWE LTD.

## A Beach Boy Fan Hits Back

The Beach Boys are receiving favourable pre-recorded tape treatment from EMI and I was pleased to learn that their latest set of original works is now available at 3½ ips. Russ Allen, only a semi-Beach Boy admirer, reviewed this issue in the December *ATR* but his comments were somewhat misleading. Allow me to take a closer look at these. From Mr Allen's criticism of *Pet Sounds* it is difficult to assess whether he is a Beatle follower. If he is, then he has not studied them in true comparison with their American equivalent, as the Beach Boys are regarded in some quarters. The similarities are not revealed in their respective performances but more in the ideas of harmony, composition and the odd, rich and sometimes startling effects which can only be achieved in the recording studio. The resultant sounds are way out, but both groups of talented musicians are working on new, and in some ways similar lines, giving the pop scene a truly musical appearance. It is my belief, for instance, that *Eleanor Rigby* and *Good Vibrations* performed by the Beatles and Beach Boys were the best records of 1966. While extensive use of the organ is made on *Pet Sounds*, it is untrue to suggest that this gives a constant religious impression, but perhaps Mr Allen and I would also agree about church music. The reviewer wonders how the Beach Boys perform when in concert, in reply to which I would suggest that he listens to their concert recording. I understand that their public appearances have improved since this issue became available, but if the argument of studio against concert work is viewed in this manner, much of the *Beatles Revolver* long player could not be produced in a concert hall without the addition of recorded sound from back stage.

To give another impression of *Pet Sounds* is a big step forward even by Beach Boy standards, for in this release exciting use is made of the orchestra without its merely being an accompanying tool. This effort is an improvement on all previous attempts to present something which stands on its own in a quite inimitable way. In the past the group relied mainly upon their own instruments, but here is a record which employs a wide instrumental bodywork which makes the recording boys scratch their heads at the realization that a Beach Boy session is bound to create the type of problems which can only be caused by perfectionists. *Pet Sounds* is an astonishing album, a whole-hearted work with an equally masterly recording. With pre-recorded good wishes.

Greenfield, Oldham

Mike Howell

# FERROGRAPH ON EMERGENCY FIRE SERVICE

by W. H. G. Metcalfe

'Our Ferrograph equipment has provided recordings of information which is very useful in disputes and as evidence in court cases, and has given invaluable assistance particularly when times are in dispute' said Mr H. Scattergood, Chief Communications Officer, Manchester City Fire Brigade. The equipment, built by Ferrograph in 1953 and installed in the Central Control Room of the Manchester City Fire Brigade Headquarters, has been in use continuously twenty-four hours a day since it was first switched on. Only occasionally has the equipment been switched off to change the odd valve, and once to replace a record head which had been accidentally damaged by a screwdriver. Built on standard racks, the equipment consists of a dual channel recorder and a mono recorder. The dual channel machine records the '999' messages on the top track and simultaneously time signals from 'TIM' are recorded on the lower track - it is thus possible to provide indisputable evidence of the actual times messages are received at the control centre. The recorder continues to operate for thirty seconds after the message has been completed in order to record additional time information as a double check. The mono recorder is in the lower half of the rack and is fitted with a Ferrograph endless loop cassette. This machine operates at the same time as the dual track machine in the upper part of the rack, and provides instantaneous replay of recorded messages. This saves valuable rewind time on the dual track recorder should the receiving operator have missed some vital information or when the caller may have gone off the line. Both re-

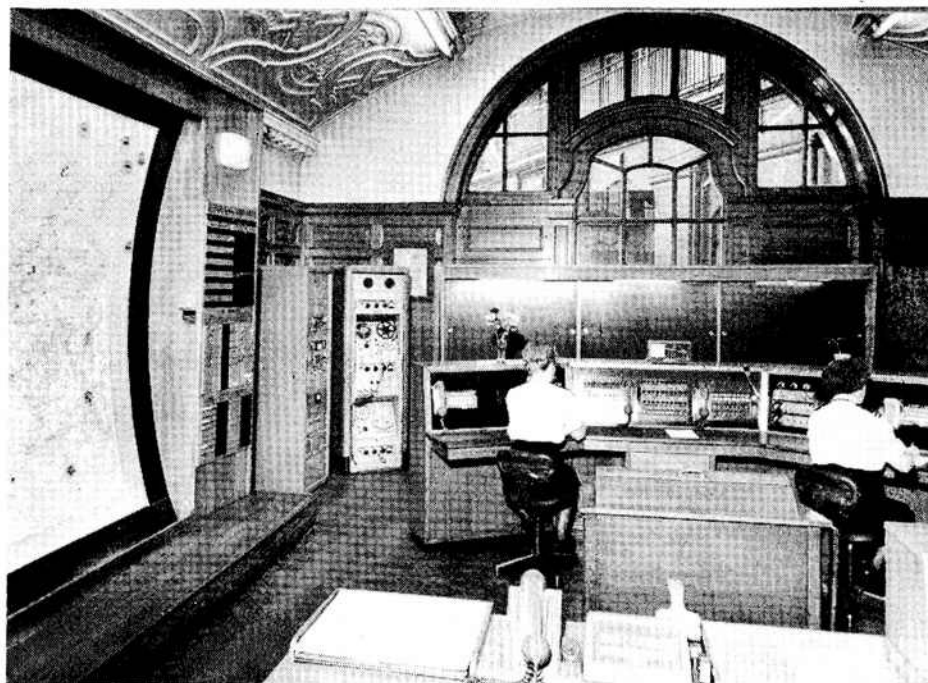


Fig. 1. The central control room at Manchester City Fire Brigade Headquarters.

orders are brought into operation immediately the control desk operator depresses the key to receive a '999' call. From January to mid-September 1966 the Manchester City Fire Brigade received and recorded 5,154 '999' calls - they average between six and seven thousand such calls every year.

The Chief Communications Officer Mr Scattergood replayed an actual recording of a '999' call which was a perfect example of an incomplete call - a male voice made the call and only gave the telephone number, dropped the handset and tried to help his wife and children to escape. A perfect actual documentary of the sound of the fire raging and the cries of the trapped family was recorded. The children were eventually saved but both husband and wife perished in the flames. By not giving the address valuable time was lost in tracing the location from the telephone number and Post Office records. The recording, with time injection from 'TIM', provided valuable evidence that both the Brigade and Telephone department acted with the maximum speed in ascertaining the address of the caller.

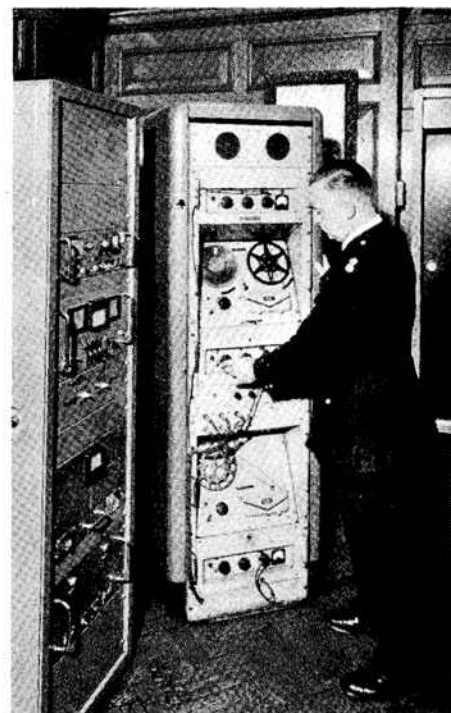
The completed recorded tapes are carefully indexed and stored for a minimum period of thirty days - certain tapes with special information which could be required for evidence are always extracted from the main file and retained until the case is closed. As with every Fire Authority, Manchester City receive a proportion of false and malicious calls, and during the past few months their Ferrograph recorder has been instrumental in providing the evidence to trap three such offenders, all of whom were in need of psychiatric treatment. In catching this type of misguided individual, the chances of fire appliances being called out on false alarms has been considerably reduced.

The importance of having a magnetic recording of every call received was stressed by Mr

Scattergood and he was asked why a duplicate machine was not provided as a standby in case of breakdowns. He replied: 'Our Ferrograph has proved so reliable and trouble-free since 1953 that we haven't felt the need for a second machine.'

In actual fact they do have another Ferrograph tape recorder - playing background music in the social club!

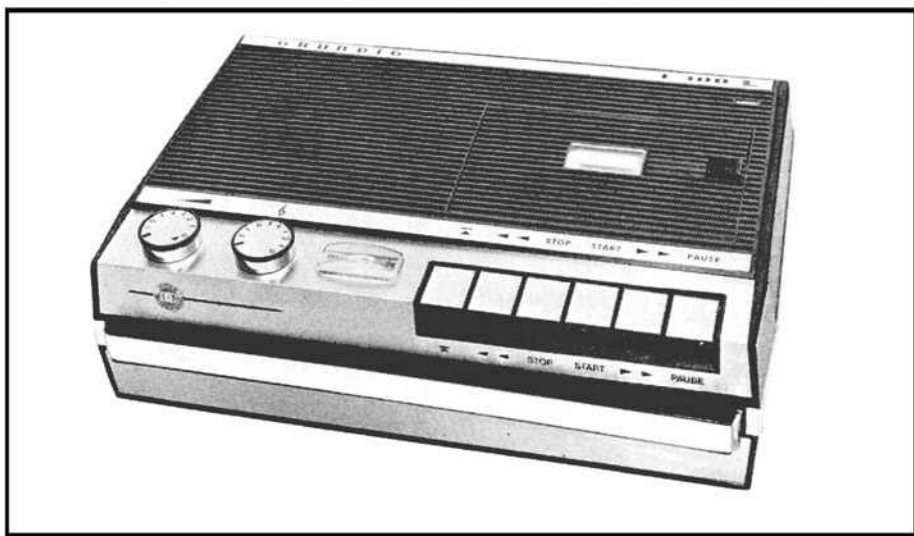
Fig. 2. The special Ferrograph dual-channel '999' message recording equipment is in operation twenty-four hours a day.





# ON TEST GRUNDIG C100L

by Peter Knight



The Grundig C100L is a battery-powered, fully portable (almost semi-miniature) tape recorder designed for use with so-called *DC International* tape cassettes. It will not take different cassettes or standard  $\frac{1}{4}$  inch tape and spools. The tape cassette is a slim, rectangular plastic case accommodating a supply of tape and two reels for delivering and taking-up the tape within the cassette. The design is such that the tape is exposed along the straight front of the cassette, and the unit as a whole is patterned in conjunction with the recorder or vice versa. The great advantage of the cassette is that it can be dropped easily into position on the 'deck' in place of the usual spools without the need for threading tape round the head assembly and on to the take-up spool. There is never any fear of the tape spilling or tangling. When the cassette is properly mounted, the cassette reels (note the use here of 'reels' rather than spools) automatically locate on keyed spindles of the machine, while the length of exposed tape falls neatly between the capstan and pressure roller. On *record* or *play* the tape is pushed against the heads and the pressure roller pushes against the capstan, thereby transporting the tape through the machine in the normal way.

There have been several attempts both in European and American countries to popularize tape cassettes. In Britain, Garrard was one of the first firms to produce such a device, and a machine was in fact produced simply for playing tape records housed in this design of

cassette. It is understood that an automatic machine taking this type of cassette is currently employed in some background music systems. Garrard cassettes take standard  $\frac{1}{4}$  inch tape, while those of the DCI system are loaded with  $\frac{1}{8}$  inch wide tape. This width, however, can accommodate two tracks. The cassettes take tape sufficient for two times 45 minutes playing or for two times 60 minutes, designated DC90 and DC120 respectively. At this stage it should be mentioned that there is another cassette system very similar to that of DCI. This is used by Philips, and it may be recalled that the Philips recorder, designed for cassette operation, was reviewed in the December 1965 issues of *ATR*. This copy is still available (price 3s, post paid) from the publishers.

The Philips cassette is a little smaller than the DCI type, but note that they are *not* interchangeable. While the *tape width* is about the same, the Philips runs at a velocity of  $1\frac{7}{8}$  ips (a standard speed), while the DCI uses the sub-standard speed of 2 ips. It is a pity that this lack of standardization exists, but this is commercialism! The cassette machine is less versatile than the conventional  $\frac{1}{4}$  inch tape, spooled machine, especially so far as creative recording is concerned. Nevertheless, the cassette system has advantages for some activities. Cassette-loaded music tapes, both to DCI and Philips standards, are being made available, and these will have appeal to the younger generation. Cassette machines are small enough to be carried around like transis-

tor radio sets, and there is no great difficulty in recording one's own music tapes from disc or radio (albeit, unlawfully!).

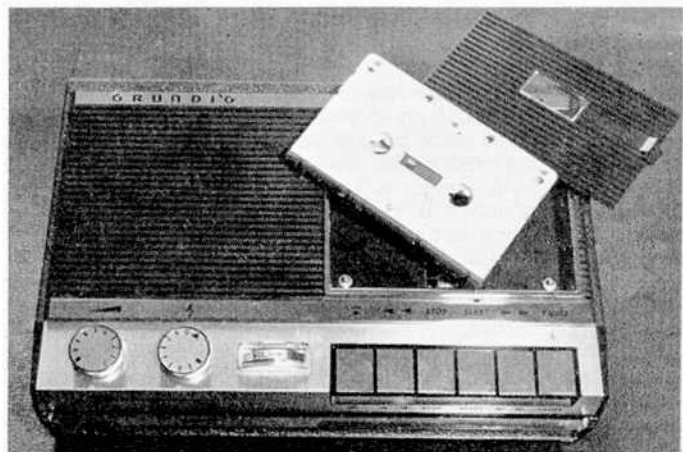
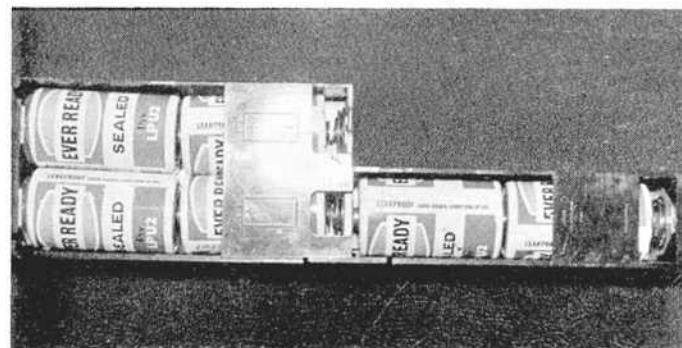
The C100L runs very well in a car, for instance, and there is sufficient audio power to overcome most car noises (not always the case with transistor radios). It is also useful for dictation work, and its inbuilt battery power allows it to be used anywhere. It is very silent in operation (hardly any motor noise at all) and can thus be used in quiet environments, such as at classes and lectures to assist with subsequent studies.

The batteries (six U2 cells) are accommodated in a plastic housing which can be detached completely from the body of the recorder (see Fig. 1). For mains operation, the battery housing can be replaced with a mains power unit (this is an 'extra' and not included in the price of the basic machine). It is also possible to run the recorder from an external dc power supply ranging from about 6 to 12 volts. A DIN socket on the side of the recorder is available for the connection of such a supply - from a car battery, for instance.

There are two more adjacent DIN sockets, one for taking monitor headphones or ear-piece or for extracting a signal for application to a second recorder or external amplifier system (*when recording*) and the other which has universal connections to provide recording from a radio set, tuner, microphone, other tape recorder, record player and for giving a replay output of 600mV across 15 ohms. It is worth noting that only the DIN plug/

Fig. 1. Below, the battery pack can be removed and replaced by a mains power unit.

Fig. 2. Right, the cassette can be lifted out easily by pressing a key.





socket system can make such a diversity of connections possible from a single outlet! The control panel of the machine carries two control knobs for (i) recording level and playback volume and (ii) 'tone' (progressive treble cut) with a switch clicking 'off' at the end of its travel to cut the internal speaker if required. Next to the rotary controls is a moving-coil recording level meter with the usual red zone indicating recording overload. This meter, however, also has a second calibration to indicate battery voltage, and this is brought into action as soon as the machine is switched on. The on/off and deck controls are handled by a row of six press-keys. There are two for re-winding the tape, one for 'start' which, when depressed, instigates playback. For recording, this key together with the recording key must be depressed and locked on. The fifth is a 'pause' key which releases the pressure roller from the capstan. This can be 'locked' in the pause position by depressing once, and is released by a second depression. This useful function is rarely found in other machines where the usual arrangement is to hold the key under pressure for the pause condition. The sixth is the 'stop' key which cancels all previous deck programming.

A sunken area just above the press keys accommodates the cassette, which is lightly retained when inserted. A transparent window on each side of the cassette shows how much tape is available for use. The inserted cassette can be covered by a plastic, clip-in lid. This also has a 'window' coinciding with that on the cassette. Once the cassette has been inserted it is virtually impossible for it to fall out. The correct way to remove it is to press firmly down on the stop key. This causes a lever to rise underneath the cassette, thereby pushing the cassette up sufficiently to permit removal (see Fig. 2).

The machine will record and playback either in the vertical or horizontal position. It can, in fact, be carried around in the vertical position like a transistor radio by means of a handle which slips up from the sides of the cabinet. This can be pushed back to disappear almost completely from view when the machine is used domestically in the horizontal position. It takes just over 100 seconds (with a new battery) to 'wind' a DC90 cassette from one reel to the other. This has to be done by keeping pressure applied to the appropriate 'wind' key, for there is no locking facility here. This may appear to be undesirable on the face of it but it is really a good idea, for quite a lot of battery energy is dissipated on winds, and 'locked on' wind keys can be forgotten. There is no usual end of tape stop on this type of machine, and at the end of a tape quite a big load is applied to the motor by the spool clutch action. The tape must be well secured to prevent it from breaking away from the reels – a condition that would make it necessary to dismantle the cassette. Small rubber 'plugs' can be inserted in cassettes making it impossible to set the deck to 'record'. This facility is useful when the machine is used for playing tape records, for then there is no danger of accidental erasure.

The most striking aspect of the machine when it is first switched on is the almost complete lack of motor noise. Indeed, it is necessary to listen carefully to determine whether the motor is, in fact, running – or to look through the 'window' to see whether the tape is in motion. Much of this is due to the special type of dc motor used in the machine. This does not employ the usual commutator and brushes.

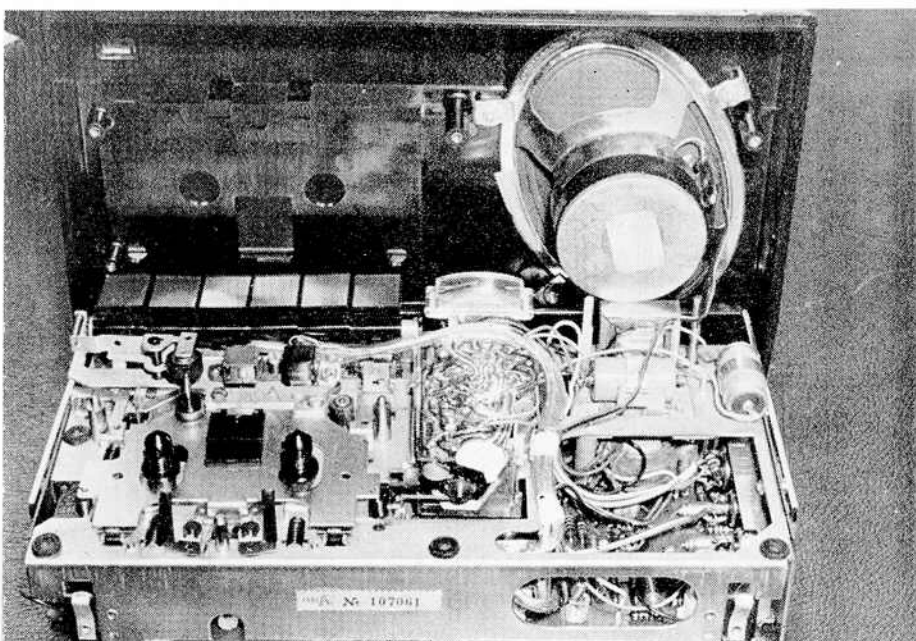


Fig. 3. Interior of the Grundig C100L.

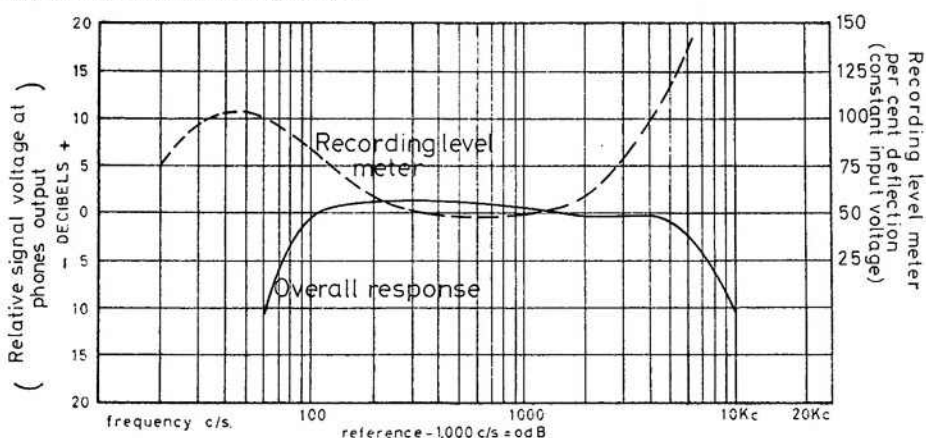


Fig. 4. Frequency response v. recording level meter response.

Instead, it uses switching transistors and diodes. These are arranged so that a rotating magnetic field is developed between the field windings, and it is this magnetic field that pulls round the rotor at a constant speed. The system contains six transistors, six diodes and one Zener diode for stabilization, and it is built on a small printed circuit board directly above the drive motor.

The rest of the recorder uses six transistors, three as signal amplifiers and the other three as driver and push-pull output on playback. When recording, the push-pull output transistors work as an hf oscillator supplying the erase current and bias. Of course, the machine is not designed for high quality reproduction, for this is not possible at the low tape speed of 2 ips. However, the elliptical inbuilt speaker provides reproduction equally as good as that possible from the best of small transistor radios, and by running the playback output signal from the DIN socket – mentioned earlier – into a good amplifier or larger tape recorder the reproduction is surprisingly good for such a low tape velocity.

The noise performance is also pretty reasonable, bearing in mind that less than half the  $\frac{1}{4}$  inch tape width is employed per track. The 'sizzle' that some battery models exhibit, often due to the action of the brushes and governor in the drive motor, just does not

exist on the Grundig, even at full gain on playback. Incidentally, to identify the track being used, the sides of the cassettes are numbered, and when changing track it is necessary simply to extract the cassette, turn it over and then re-insert it.

Printed circuit board construction is employed throughout, and the machine is fairly easy to dismantle. It is extremely well made, and has many of the characteristics of small transistor radios. The tape mechanics are a work of art, and there is no indication that they will be likely to cause undue trouble (see Fig. 3). The overall frequency response was checked by recording the tape with a signal applied at the microphone input at intervals over the frequency spectrum, and the measuring then signal delivered at the 'phones' output socket on a calibrated audio valve voltmeter. The full-line curve in Fig. 4 shows the result of this test, while the broken-line curve shows how the deflection of the recording level meter varied over the audio spectrum. This indicates severe treble and bass boosting on record as a means to counter the falling response on playback. But in spite of this apparent boosting, the signal/noise ratio is remarkably good, even when the machine is used to provide the programme material for a hi-fi amplifier system. The quality is not hi-fi,

continued on page 50. 19

# SOUND SCENE

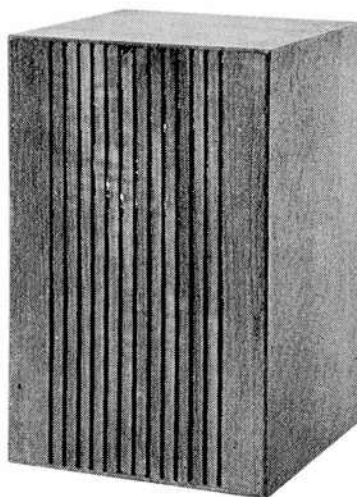


Fig. 1. One of the new DNH loudspeakers now being distributed by Highgate Acoustics Ltd.

## Electroniques Hobbies Manual

This 608-page reference book is designed for use on the bench to assist radio, recording and electronics enthusiasts in constructional projects. It not only gives salient details (including prices) of some eleven thousand items available, but also dozens of useful circuits and hints on how to obtain best performance. This unique radio hobbies manual, and all the components described within its pages, are now on sale from selected retailers throughout the country. Appointed dealers display an Electroniques blue and green sign.

Electroniques (STC) Ltd is a recently formed components and equipment supply service for radio, recording and electronics enthusiasts. Their range of components is the largest available from a single source and covers capacitors, valves, transistors, resistors and hundreds of other components as well as modules, test equipment, tools and other radio accessories. The entire range is illustrated in the *Electroniques Hobbies Manual* which retails at 10s 6d and is well worth buying.

## New Book on Transistor Equipment

Our regular technical contributor and reviewer Gordon King has written yet another excellent book. This one is called *Rapid Servicing of Transistor Equipment* and is published by George Newnes at 30s. The book is intended for the service technician changing from the familiar valve technique to the less familiar transistor. It is also a very useful guide for students and amateur radio, recording and electronics enthusiasts (there are also chapters devoted to audio and video). The book as a whole is a systematic guide to the servicing of transistor radio, television, tape recording and high fidelity amplifier equipment with an emphasis on quick diagnosis of faults. The earlier chapters of the book describe the operation and principles of semi-conductors and transistors. Subsequent chapters deal with fault-finding in the various fundamental types of circuit, for example, audio and video amplifiers, rf circuits, oscillators, etc, and include special quick fault-finding charts. A separate chapter is devoted to transistor radio receivers and includes fault-finding and

alignment charts. The final chapter deals with repairs to transistor equipment and printed circuit boards. The eight chapters of this book are profusely and clearly illustrated and, as always, the author presents his material in a concise, but nevertheless informative and practical way.

## DNH Loudspeakers

Highgate Acoustics, who are also the distributors of Lowe Opta tape recorders, etc, have taken over the agency of Den Norske Høytaler Fabrik A/S loudspeakers, now available from stock. These hi-fi speakers can be obtained in 4 or 15 ohms models and are as follows:

1. Pressure chamber B420/T – price 19 guineas.
2. The B455/T shown in Fig. 1 retails at 13 guineas including tax £1 17s 0d.
3. B616 – a single pressure chamber speaker with double cone in a fabric covered in walnut cabinet. This retails at £5 5s 0d including tax.

Further details from Highgate Acoustics, 71/73 Great Portland Street, London W1.

## Useful Microphone Holder (Fig. 2)

This idea comes from *ATR* reader L. Tebutt of Stamford. He recommends it for outdoor recording particularly to avoid the noises often produced by handling. He says: 'I find this gadget most useful. It is easily made from an old jeep aerial and is no problem to carry. A bone or metal ring bound to the microphone cable completes the arrangement, as shown in the diagram.'

## Three New Sound Effects Records

This month we add three new effects records to those already available through *ATR*. First is a mixed effects record MFX4 containing ten tracks. These include various car sounds, the sounds of hovercraft and some typical Continental effects. The second new record is BGX2, which contains six tracks of background sounds, viz. London Airport with passenger announcements in four different languages, train interior (continuous), children playing and racing cars. The third record is devoted to rhythmic electronic music and contains four compositions, *Automation*, *Perpetua*, *Merry-go-round* and *Tempotune*. This record is ideal for introductory and effects

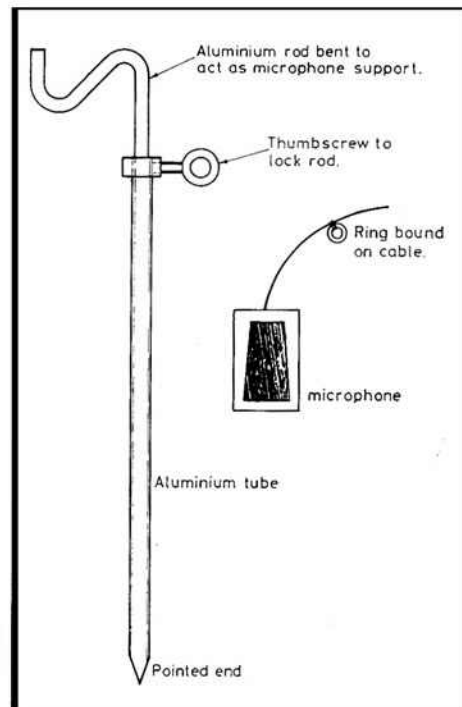


Fig. 2. Details of the useful microphone holder by *ATR* reader L. Tebutt

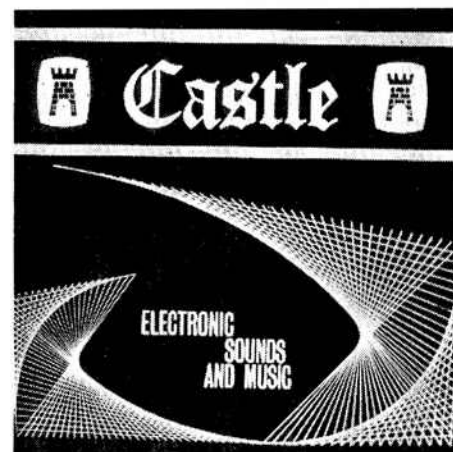
music. As our other records, the material is copyright free for amateur use in tape, slide and cine film productions and for amateur dramatics. Here are details of the contents of the three records:

**MFX4 – Mixed Sound Effects:** Hovercraft (passing), hovercraft departure, car start and drive away, car engine rev and tickover, car starter, car skid, car skid and crash, Continental street sounds and glockenspiel, warning siren, warning bell.

**BGX2 – Background Sounds:** London Airport main lounge, passenger flight announcements, English and German, passenger flight announcements, English and French. Train interior (continuous), children playing, racing cars (circuit).

**EFX3 – Rhythmic Electronic Music:** *Automation*, theme of electronic rhythm and melody. *Perpetua*, sound and rhythm suggesting movement. *Merry-go-round*, fairground or street organ theme. *Tempotune*, electronic sounds in rhythm.

See page 50 for the full list of *ATR* sound effects records, including those above.



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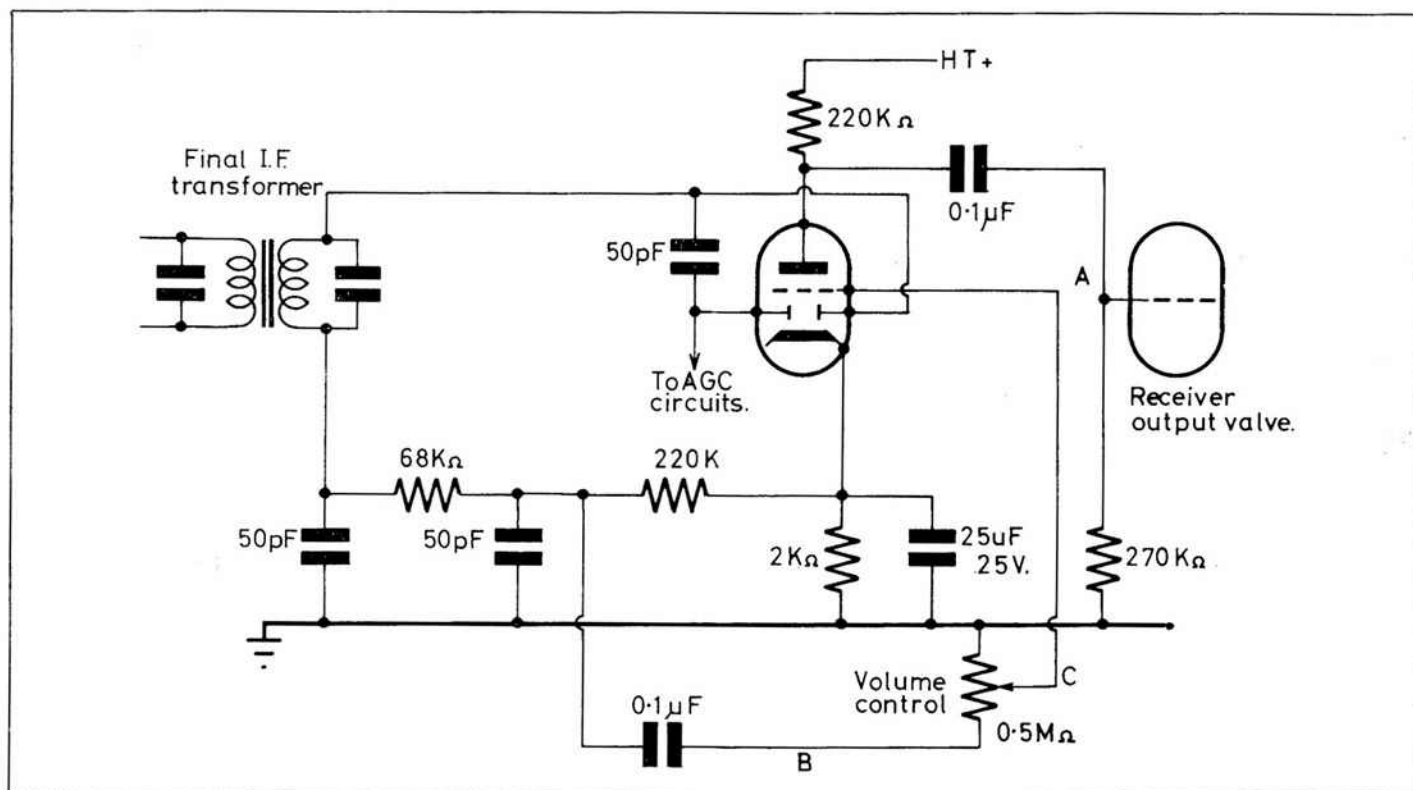


Fig. 1. Typical detector — If stage in an AM radio receiver. Signals for recording can be taken from points A, B or C.

# RECORDING RADIO PROGRAMMES by J. B. Dance M.Sc.

If one wishes to record a radio programme it is only necessary to place the microphone in front of the speaker of the radio receiver and record the sound in the normal way. This is, however, about the worst possible method of making a recording from a radio programme, since any other noise in the room picked up by the microphone will appear on the recording. In addition, the distortion associated with the receiver power output stage and the loudspeaker will be present in the recording.

## Signal Supply Point

Many people take a signal from the external speaker terminals of the radio receiver and feed it into the 'radio' input of the tape recorder. By doing this they eliminate the distortion associated with the speaker of the radio receiver and at the same time eliminate any room noises. However, the distortion present in the radio receiver output stage (where most of the distortion occurs) and that due to the speaker transformer will still be present in the recording. Nevertheless, if a signal is taken from the external speaker terminals of the receiver (or from the secondary winding of the speaker transformer) a low impedance output is obtained.

Details of how the best possible results can be obtained using radio receivers of various types now follow. It must be stressed, however, that these methods should not be employed with receivers employing live chassis. If any connections are made from such receivers to a tape recorder, there is great danger of electric shock. The circuit of the detector and the first audio amplifier stages of a typical valve radio receiver for the medium and long

wave bands is shown in Fig. 1. Signals suitable for recording can be taken from the points marked A, B or C, but remember that the output will be of high impedance and the capacitance of a long screened connecting cable might tend to reduce the high frequency response. If however, one of the points A, B or C is connected to the input of the cathode

follower circuit of Fig. 2 the low impedance output provided by this circuit will then be ideal for feeding to a tape recorder even via a long screened cable. It is essential that the cathode follower circuit of Fig. 2 be mounted in the receiver fairly near to the point from which the audio signal is taken.

In most cases the audio signal can be taken

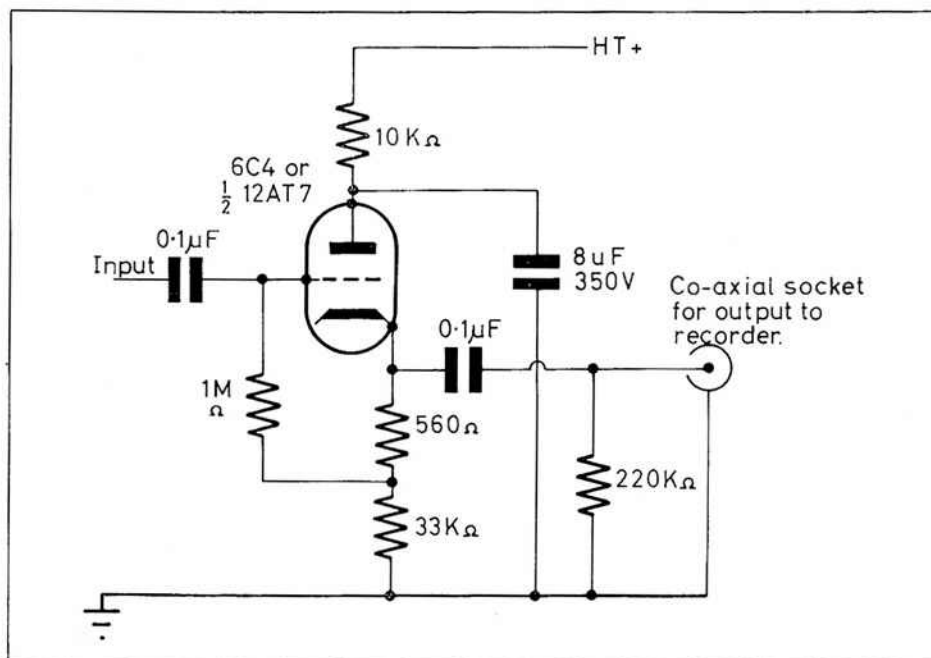


Fig. 2. Cathode follower circuit (see text).

from point B in Fig. 1. The receiver volume control will not then affect the signal voltage to the tape recorder. Thus the output from the loudspeaker of the radio receiver can be used to monitor the signal and the volume from the receiver adjusted to the desired level or even turned down completely without the recording being affected. If the output to the cathode follower is taken from point C of Fig. 1 the amplitude of the signal being fed to the recorder will be varied as the receiver volume control is adjusted. Point A provides a higher audio signal level than points B or C, since the signal is amplified by the triode valve stage before it reaches point A. In almost every case the audio signal level at points B or C will be adequate to operate a tape recorder. The values of the components shown in Fig. 1 are typical but may vary slightly between one receiver and another. The circuit of Fig. 2 provides a signal with an output impedance of a few hundred ohms and can be used for feeding a signal into a very long length of co-axial cable without appreciable high frequency attenuation occurring.

### FM Receivers

The circuit of the ratio detector stage of a typical FM receiver using valves is shown in Fig. 3. As in the case of a medium and long wave receiver, the output provided by this detector circuit is of relatively high impedance. However, the cathode follower circuit of Fig. 2 may again be used as an impedance transformer. The audio output signal from Fig. 3 is connected to the input of the circuit of Fig. 2 in order to obtain the desired signal.

### Transistor Receivers

The impedance of transistor circuits is generally much lower than that of valve circuits and it is usually possible to obtain satisfactory results by connecting a piece of co-axial cable directly to a suitable point in the transistor receiver in order to obtain enough signal for recording. The collector of the first audio amplifier stage is the most suitable point from which to take the signal, but if a very low impedance output is required, an emitter follower circuit could be incorporated into the receiver. The emitter follower is a transistor circuit which has properties very much like that of the cathode follower of Fig. 2. A simple emitter follower circuit is shown in Fig. 4.

No matter which of these methods of taking a signal from a radio receiver is adopted, the recording cannot be better than the quality of the signal provided by the radio receiver itself. A medium and long wave superhet receiver will not supply the full high frequency response of the signal at the transmitter since the sidebands in the incoming signal will be attenuated by the selective intermediate frequency transformers. However, an FM receiver is capable of providing a first-class signal from which good recordings can be made.

### Copyright

People who record programmes from BBC broadcasts are reminded of the following copyright notice issued by the BBC.

### BBC SOUND AND TELEVISION PROGRAMMES

Under the Copyright Act, 1956, and the Performers' Protection Acts, 1958 and 1963, the following permissions have to be obtained before a record or film is made of any BBC programme:

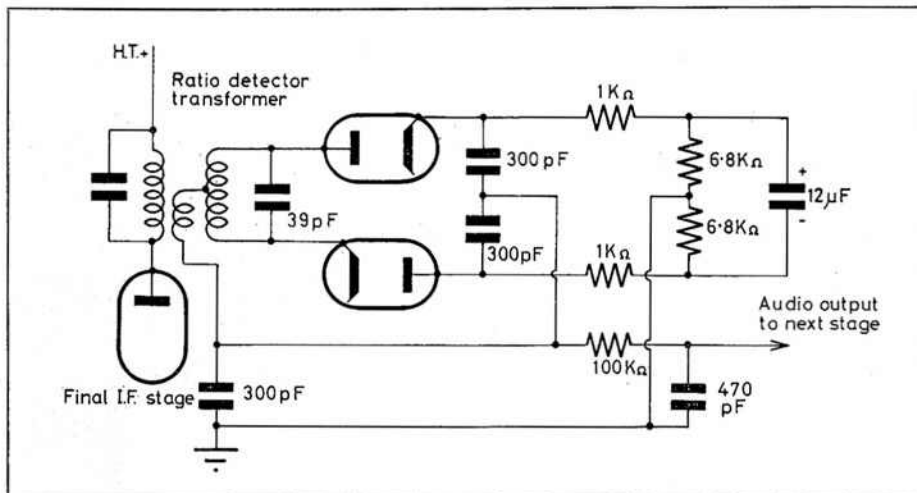


Fig. 3. Typical FM detector stage.

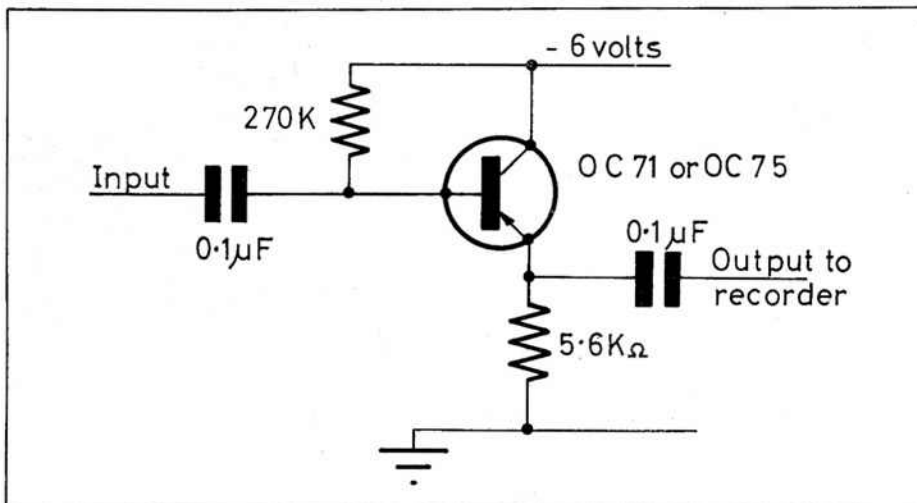


Fig. 4. Transistor emitter follower has characteristics similar to a valve cathode follower (see text)

#### (a) Rights of the BBC

The permission of the BBC is not needed where a record or film is made for private purposes, but prior permission must be obtained from the BBC in the following cases:

- (i) Making a record of a sound broadcast or of the sound part of a television broadcast, otherwise than for private purposes.
- (ii) Making a film of any sequence of images in a television broadcast sufficient to be seen as a moving picture, otherwise than for private purposes.
- (iii) Showing a television broadcast in public to a paying audience.

#### (b) Copyright Musical and Literary Material

The permission of the owners of the copyright in musical and literary material used in BBC sound or television broadcasts must be obtained under the Copyright Act, 1956, before such material is recorded or filmed (unless the recording can be described as fair dealing for the purposes of research or private study) or before it is performed in public (whether the audience pays or not).

#### (c) Gramophone Records

Gramophone records are covered by a separate copyright protection under the

Copyright Act, 1956, and any unauthorized re-recording of gramophone records either directly or from a broadcast (including re-recording on to tape whether for private purposes or otherwise) is an infringement of the copyright in the gramophone records which is normally controlled by the issuing record company.

#### (d) Performers' Rights

Under the Performers' Protection Acts, 1958 and 1963, the permission of any performers taking part in a broadcast must be obtained for the recording or filming of their performances unless the record or film is to be used only for the private and domestic purposes of the person making it.

#### (e) BBC Schools Broadcasts

As a result of special arrangements made by the BBC with copyright owners and artists' unions, records of BBC Schools Broadcasts in its sound services only (but not other broadcasts) may be made by schools without obtaining the above permissions provided that the records are used only for instructional purposes in class and that they are destroyed at the end of the school year (or, in the case of radiovision programmes only, at the end of the third school year).

# WHAT'S IN A CLUB?

## Graham Harris

A short while ago I received a letter from a new secretary of an established tape recording club in which he asked for my opinion on the ingredients of a successful society. Here, I thought, was a man worthy of the name 'club secretary'. The reason for this request? 'To get more members!' Such a gesture is both noble and conventional but not – and brutal honesty must prevail if tape recording clubs will flourish – the be-all and end-all of the matter. Membership is an archaic measure of a club's success. Naturally a club with a hundred members on its books, compared with a group of half a dozen, should be flushing over the edges with assorted monies. The question is, however, *what's the point?*

Before I'm labelled as a congenital idiot, I'll hasten to add that where money is concerned I am an avid collector, quite unable to hoard enough of the stuff. That, perhaps, is just a personal eccentricity. In the more democratic case of a tape society money should not be the important factor for its success. It's rather sad really that more than enough people have (and hold on to like grim death) the impression that the kitty is the ultimate thing. Rich societies can, of course, afford to have professional speakers (the human kind), and if they have their own lock-up room they can pop out and buy equipment whenever the urge takes them. Generally, clubs of this gilt-edged nature are few and far between.

Let's face it, we club members of the tape fraternity have, during the past few years, been faced, at some time or the other, with liquidation. It's a sad and terrible feeling, isn't it? Old fans will remember August of 1959 when this magazine, having leapt on to the tape scene and with its articles and news, did a fine job of cementing British clubs together. Lone enthusiasts were introduced to societies catering for their needs. Groups were popping up all over the country with a rapidity that suggested that tape-recording was as much a way of British life as beef eating. *ATR* went further and sold the idea of creativity as an outlet of the machine – so much so that even the Americans envied our situation. In the late '50's clubs were bursting at the seams with members, and machines were being poured on to the domestic market in all shapes and sizes. A large percentage of the membership consisted of trades people – with an obvious eye on business. Demonstrations were free, lucrative and plentiful. The trade welcomed the sight of new members and they, in their turn, were happy to be at the forefront of the latest developments. The clubs helped the trade and – there's no question about it – the trade helped the clubs. The tape wagon was loaded, geared and humming with the *British Tape Recording Society* at the wheel. (This society was formed in 1955 based on an American idea with members all over the country taping with each other.)

Backing this situation *ATR* magazine continued (and has continued) to analyse the developments with technical articles and



*'What's the point?'*

reviews with people like David Lazell portraying the social side of tape recording. The importance of club activity was accentuated by Terry Nurse who, in an article in the January 1962 issue of *ATR*, presented the mechanics of a tape society. It would be blatantly short-sighted to believe that everything in the garden remains lovely. A few years ago tape clubs all over the country began to feel the pangs of membership hunger. It's a small consolation to know that most clubs catering for any interest eventually fall under the crunch of stagnation! There were times when even parts of the *ATR* Club News section began to read like an obituary. Whereas in the late '50s average club membership was about fifty strong, it may now be only fifteen and in some cases it's even lower.

Why? What was the reason? More important what is the reason and what about the future? Every tape society has a hard core of fanatics; members who are prepared to devote their lives and the lives of their families to the tape recorder and to the running of their club. This hard core is the irrevocable committee who not only plans the programmes but is expected to produce them as well. Around the edge of all societies is the surface of lingerers – too abundant in quantity for comfort. This group is cemented together by one cherished idea. 'We've paid our subs; now what are we getting out of the club?' This sort of person rarely considers what he can put into the club and forgets that the committee officers have also forked out their subscriptions and could,

if so desired, adopt a similar attitude! In such a case, 'crash' goes another club!

In the days when the tape recorder was a novelty, the conventional idea of entertaining the members was all right. Owing to the available material and the birth of kindred enthusiasm, tape accessories sales representatives for instance could fill an evening. Time changes and the tape world along with it. Members are more informed and can, with respect dispense with sales representatives and their demonstrations. When the novelty was fresh, quizzes, competitions and musical requests could fill gaps. It's doubtful if they have the same pulling power today. Well, what has a 'pulling power'? Perhaps the first question should be: 'What is being pulled?' To those who reply 'new members', I would suggest, with some fear of repercussion, that this line is out of date!

Going back five years to an excellent article by Terry Nurse, I'm sure he won't object if I crib and quote one line of his. '... the sense of *belonging*, make membership of a local club a *must*'. If any club lacks this 'sense', its members will fall away like autumn leaves from trees. The point to be made here is: the novelty of the tape recorder is over and gone. People who own machines and who do not belong to a club, and who will find out that such a club exists in their neighbourhood, will go along to a meeting *if they want to*. The club, if it is a good one, will receive them and make them at home. New members will fit in with the club. The club will fail if it tries to fit in with potential members! Too many



clubs try to run beginners' courses to attract new members. As an idea this is virtuous but if the club continues to run these courses non-stop, the old members will become bored and it will be 'goodbye' to them. Who is more important to a club, an old member who can subscribe to the programmes or the new member who only wants to know how to turn the knobs on his particular machine? Not so very long ago a man bounced into one of our meetings – which we had put aside to discuss the sound effects of our latest programme – and said that he was interested in joining our society. 'Oh whoopee!' said we, 'you have just come in at the right time; we are discussing sound effects!' He wasn't interested in sound effects, tape slide shows, creative recording, voice reproduction, or even the technical side of a machine. He hadn't even bought a tape recorder. He wanted our advice on the best make for reproducing concerts from the radio. He left with assorted opinions on the better make of recorder and we didn't invite him to return! Did we lose a member? No! We kept our old members, who produced a programme that was given to the old people's homes and various other institutions.

I have said before that the success of a tape society depends on how the members are employed in the various and numerous duties that are involved in the making of a programme. It is this sense of belonging which is all-important. Not all members are extroverts. Some will lead about all over the place doing things, others will sit back and do nothing unless asked. Some people like to be asked because then they know that what they are doing is wanted by the rest of the club. Gradually, as the society develops, each member will find his niche and will know that whenever a programme is arranged his part in the production will be expected. The smaller the membership, the more important this sense of belonging becomes. The larger the membership, the easier it is for the more shy member to become a nonentity – unless the club is gifted with social-minded officers.

The formality of a club's organization is, of course, important. The larger the membership, the wider the choice of committee members and the larger the committee can become. In the earlier days of the club to which I belong, the committee consisted of a Chairman, a Vice-Chairman, a Secretary, a Minutes Secretary, a Treasurer, a PRO, a Press writer and five ordinary committee members. Fortunately or unfortunately, whichever the case may be, we haven't sufficient members on the books to conform to this giant system! But this is not the sign of the rot! On the contrary, the society is now more active than it was in the earlier days when the average meeting 'held thirty-five members. Of course with a smaller membership the choice of committee is limited and one may say that the club is lumbered with whoever the members can get to do the work. However, if a club exists with only half a dozen members you can be sure that that half dozen is devoted to the craft and the club is not lumbered. Each officer is, of course, a responsible person. The Chairman has to be a person of discipline and tact who can, for instance, stop the others chatting when something has to be discussed without creating a full-scale row. The Treasurer should be a person who can handle money and who likes keeping books. The Secretary – well, let's face it – the club



'We've paid our subs. What are we getting out of the club?'



'He doesn't have to be Hitler-minded!'

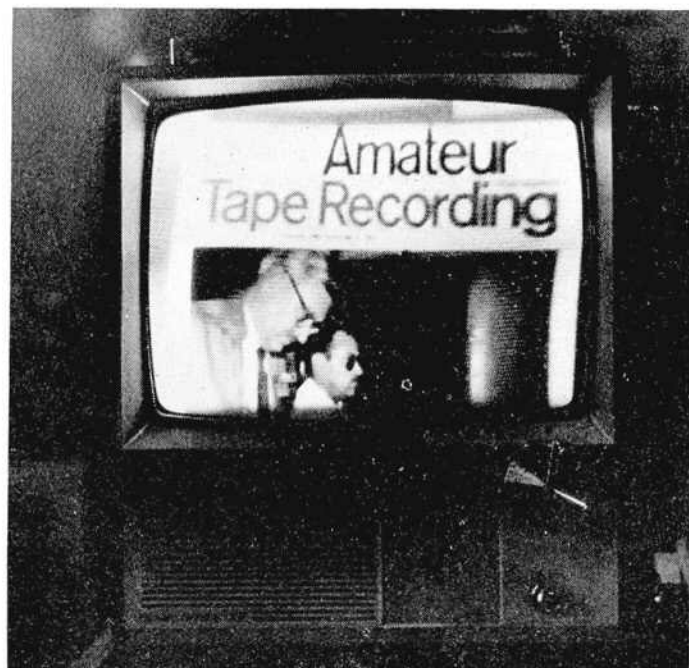
hinges on this person. This doesn't mean to say that he has to be Hitler-minded. I have no doubt that most clubs have, at sometime or the other, suffered the worry of the reigning secretary threatening to throw in his books and leaving the society in the lurch. This has happened and it has brought a few clubs to the edge of ruin. It would not be short of the truth to say that the Club News obituaries have been the result of this kind of event especially when there has been no one left to take on the job. People who take on the position of secretary and then abdicate are not to be admired no matter what the conditions are! The last and equally important position is that of *public relations*. If it is possible to appoint someone other than the secretary to do this job, then it should be done – no matter how small the society is. The PRO is the person who brings the productions of the society to the notice of the public. He arranges

the showings of tape slide shows, visits and demonstrations and is also the liaison officer. A good PRO is an asset to any group. It is through the PRO that new members come. The local tape society is a club which specializes in the craft of tape (this is an obvious statement but it is worth bearing in mind at all times) and it is to this society that people will come for advice. Even as I write this I have received a telephone call from two psychical researchers who, hearing about our society's recent investigations into a local ghost story have requested to see our results and talk about further developments. Societies with small memberships *do* flourish and are probably more active and professional than they were in the days of the *crowds*. The enthusiasm is keen and, as a result, their productions are worthy of audiences and it is from these that potential members will come because they will feel that they can give something as well as take.

# A VIDEO SHOW

Report on the first British  
tape club to video record an  
all-amateur television  
production sponsored by ATR

by F. C. Judd



*The Video Show would not have been complete without a commercial! This 'still' of an ATR front cover was displayed on screen with an accompaniment of electronic music.*

It was well after midnight when four enthusiastic members of the Walthamstow and District Tape Recording Society, three members of a local amateur dramatics society and I finally agreed that our one and only rehearsal of the first all-amateur television show would have to suffice. Would it be all right on the night, we wondered? Well if it wasn't, an audience composed of hardened tape recording and cine enthusiasts would soon be telling us otherwise.

The reason for only one rehearsal was due to the intervening Christmas holiday and the fact that the Sony TCV2000 video equipment was on loan for a very limited period. However, any misgivings we might have had about the actual performance in front of an audience and the video camera were well and truly overshadowed by sheer enthusiasm.

## The Show Goes On!

Friday, 6 January, 7 pm, I arrived at the Walthamstow Club headquarters with the car loaded to the roof with the video and sound equipment. The arrangement and connection of the video tape recorder, sound mixers and microphones and amplifiers had been carefully pre-planned and by the time the audience began to arrive, video and sound were both operational. There were no 'technical' problems.

The 'audience', members of the Walthamstow and District Tape Recording Society, the Ilford Tape Recording Club, the Walthamstow Cine Club, the Ilford Cine Club and the local press, totalled more than 50 and a few minutes after 8 pm we were ready to make a little history in magnetic recording. After an introduction by the 'floor manager' Les Bridge (member WDTR Soc) and a short explanation by me on the 'technicalities' the word was given for - *lights, camera, on video and up sound!* A thirty-minute all-amateur television show was, for the first time, being video taped by recording enthusiasts. Although, like the director of a professional TV production, I had originally planned the



*Some of the audience who were also included on the tv screen during a panning camera shot at the end of the show.*

whole operation, everything was now well and truly in the hands of Les Bridge and his colleagues and, of course, the artistes. I could only stand and watch the birth of a new era in tape recording for amateurs.

## On the Technical Side

The layout of the equipment, the location of lights, microphones and camera relative to the stage and the audience is shown in Fig. 1. Three microphones were used on stage, together with a fourth 'roving' microphone for announcements by the floor manager. These were fed into a six-channel mixer which in turn was coupled directly to a high level audio input on the Sony TCV2000 video recorder. Sound effects, some 30 in all, including the introduction music and music links, were pre-recorded and replayed from a Tandberg model 6 tape recorder coupled into the sound mixer. An extra output from the mixer was also taken to a 10 watt amplifier and loudspeaker so that the audience could hear the sound effects and music links as well as the amplified voices of the artistes. This

is similar to the sound distribution used for audience participation in professional TV shows. Some sound effects and music accompaniments to songs were produced live. The vision recording had, of course, to be carried out with a single video camera fed directly to the video recorder and simultaneously to the TV monitor screen. The audience could therefore see the live and screened version of the show whilst it was being recorded. The lighting requirements were not critical but we found it more important to have the set and artistes evenly lit than brilliantly lit. Care must be taken to avoid heavy contrasts between light and shadow.

## The Video Team

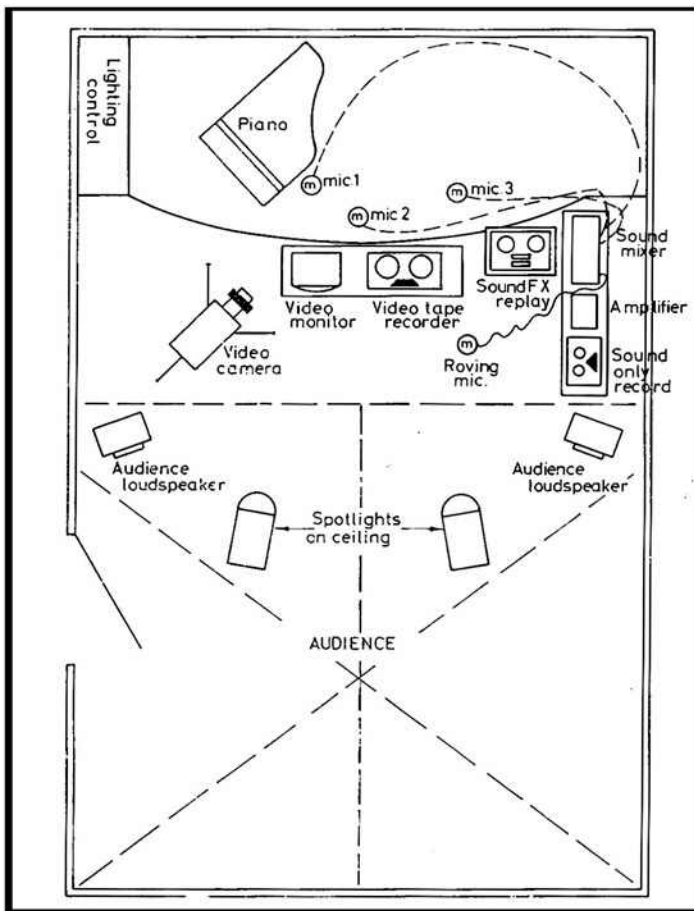
Following the pattern of professional television production (see *ATR*, February issue) a team had been formed to carry out various tasks; for example, Les Bridge of the Walthamstow club was allocated the job of *floor manager*. He was therefore responsible for the entire production from the moment the tape began to run. The video recorder was





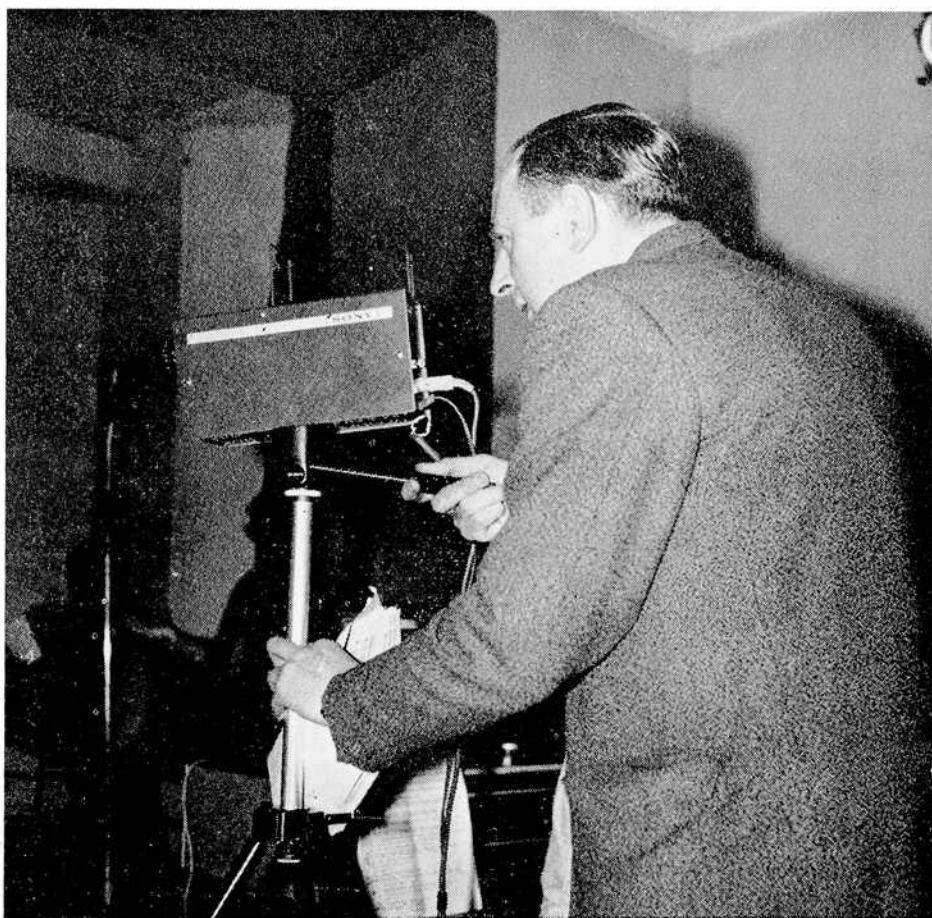
The technical team with the Sony video recorder and sound mixing equipment. Centre – Alec Lucas (sound effects). Right lower – Les Bridge (floor manager) inspects the monitor. Right upper – Jack Watson (Secretary, WDTR Society).

Fig. 1 (diagram). Right, layout of the video recording and sound equipment used at the Walthamstow and District Tape Recording Society.



under the control of Maurice Dudley, his part being to maintain adequate vision and sound recording level and at the same time monitor the screened version of the show. Ken Perks learned to become a video camera operator almost overnight and Alec Lucas found that coming in with the sound effects 'on cue' isn't so easy as it looks. Title boards, audience applause cards and cartoons were handled by Cyril Tucker. Don Cooper, a blind member of the club made a sound-only recording of the whole production from an audio link with the main sound channel. I must not forget the artistes, Peter Walker, Margaret Hilton and John Ratcliff, for without them the show could hardly have gone on. The entire script and title boards, etc, were produced by Peter Walker, himself an ATR reader and tape recording enthusiast. Finally thanks must go to Mrs Barbara Tucker who, as Press Officer of the Walthamstow and District Tape Recording Society, can turn out some really excellent coffee. We needed it. Jack Watson, Secretary of the Society, is, I think, still wondering what happened. He said in a letter to me (quote): 'I have never seen a more interesting and unusual demonstration at our club and I have been a member for seven years. I have never seen quite so many people in our club either.'

So there you have a simple unvarnished report on the first all-amateur but nevertheless creative video recording session. I know that the Walthamstow and District Tape Recording Society will join me in extending our thanks to Debenhams Limited, the UK distributors, for the loan of the Sony TCV2000 video recorder and its ancillary equipment. All who have seen video record-



Camera operator Ken Perks lines up the Sony video camera.



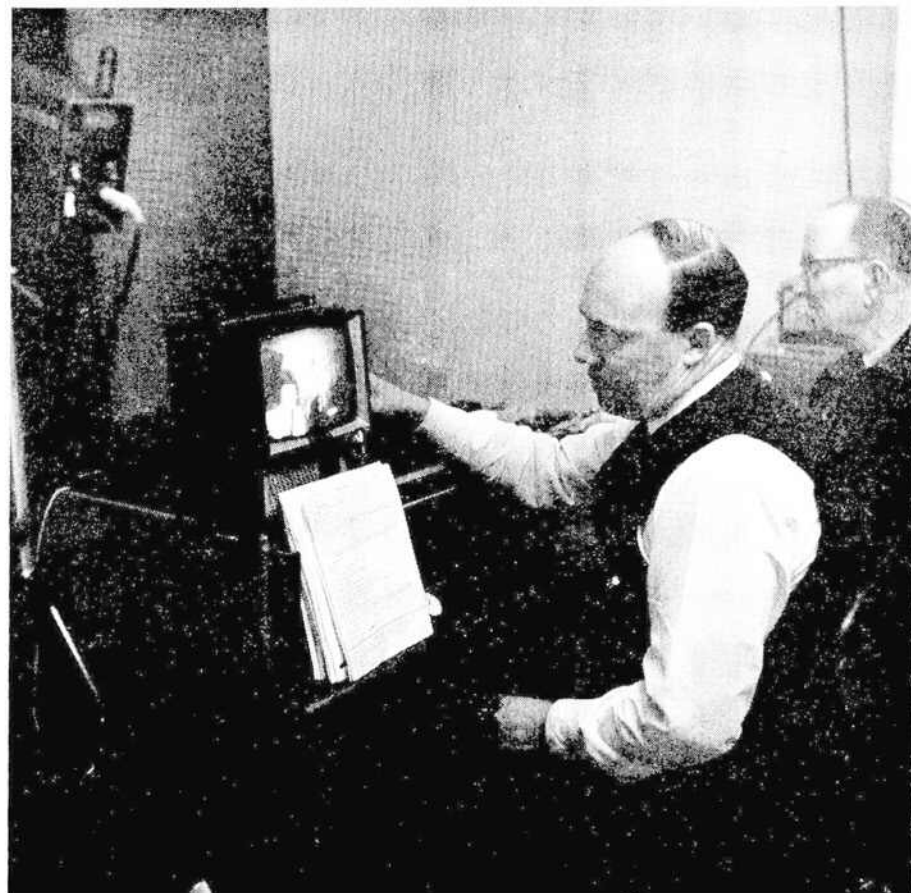
# A VIDEO SHOW

*Continued*

ings of themselves during the time I have had the equipment on loan have expressed surprise concerning the excellent clarity of both vision and sound reproduction. Next month I will outline other facets of creative video recording with equipment like the Sony TCV2000, telecine for instance, and editing and the use of title boards.

## **Sony Videocorder Distribution**

The Sony Series 2000 Videocorder is now being marketed in the UK, and first deliveries



*Maurice Dudley adjusts the contrast and brilliance on the monitor screen. Note the script and the stop-watch.*

from the Tokyo factory have already been received. A network of Sony centres is being set up throughout the country to distribute for Sony UK. These centres are, in most cases, covering a part or whole of their

county, and will be solely responsible for the servicing of installations in their area. Special arrangements have been made for supplying VTR's through these centres to Sony domestic dealers.

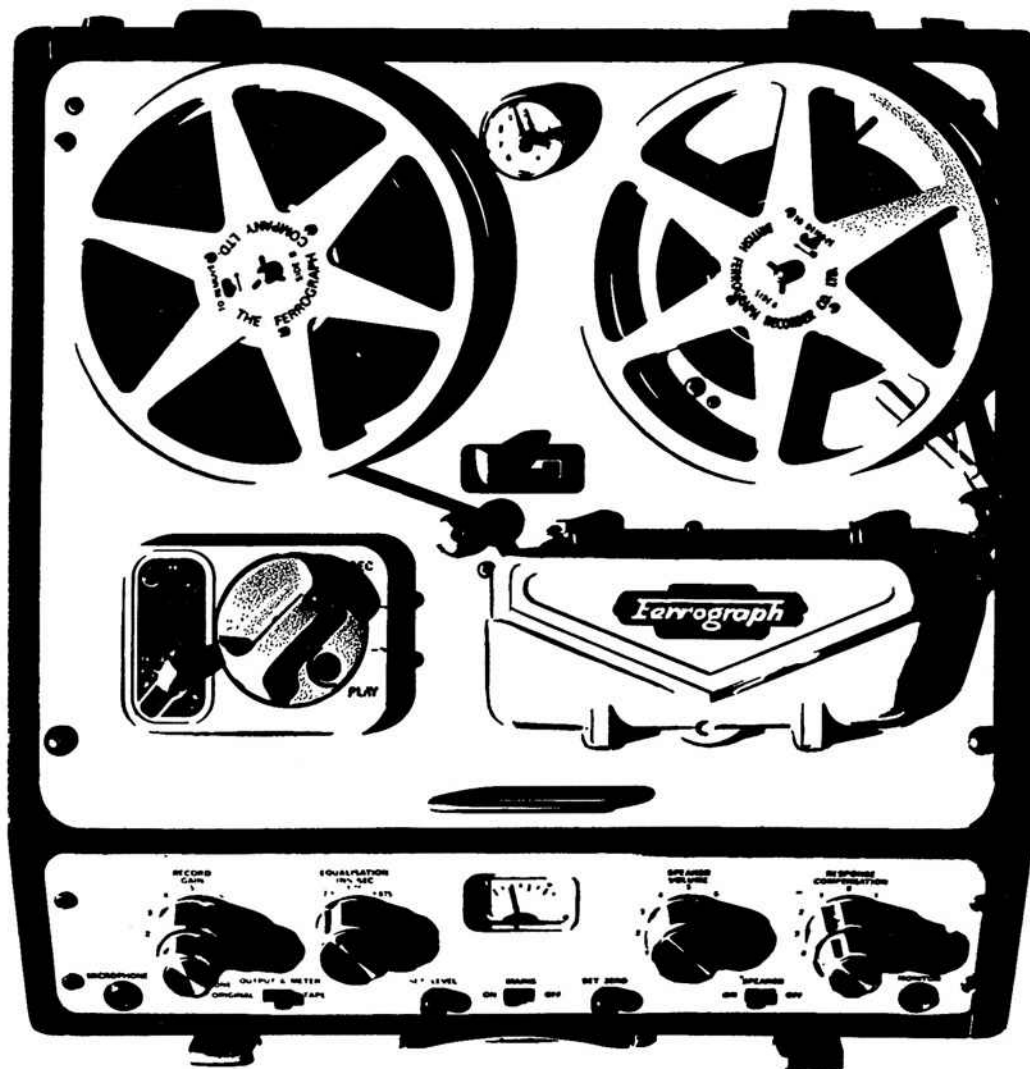


*The artistes on stage. Left to right, John Ratcliff (piano), Margaret Hilton and Peter Walker. Note the title board on the left and reproduction on the monitor screen.*



*Right, the show goes on. Photo clearly shows the clarity of the monitor screen.*

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AT9



# 1066 AND A TAPE RECORDER

by Daphne V. Ayles



I'm an innocent abroad in the world of tape recorders. Although I've thoroughly enjoyed the use of one for ten years, I could by no stretch of imagination be described as an expert. After all, propping the machine in front of wireless or television, or plugging it into a record player, doesn't require much skill. I have never had to bother about the right sort of tape either, because I just went back to the shop where I bought the machine, smiled sweetly at the manager, and asked for a new tape. After sorting out the length of playing time required, he invariably produced the right kind.

All good things come to an end, however, and a nine-hundred-year-old battle sparked off the fuse. After organizing a tape recorded version of Harold versus William, I've come to the conclusion there's more to history and tape recording than I thought. It all began last January when programme schedules were drawn up. I'm a vulture for culture, and the club members sighed with relief when I suggested commemorating the 'glorious fourteenth of October'. They probably feared I would suggest burning down the premises to celebrate the Great Fire of London! Suggesting it was one thing, putting the wheels in motion was another. An illustrated lecture would, I felt, reduce even the most historically conscious club member to surreptitious clock-watching and cat-naps. To act it in modern dress seemed incongruous, and remembering the panic caused by Orson Welles' broadcast *War of the Worlds*, distinctly dangerous. The obvious solution was the taped interview technique and the fact that I knew even less about interviewing than tape recording techniques did not deter me in the slightest. It seemed simple to take the events leading up to Hastings and send down a mythical interviewing team to question the principal characters and the man in the street. An additional advantage was that such a programme could be prepared well in advance.

I was over the first hurdle easily enough. I am a member of our church Drama Group and we were between plays at the time. A tape recording session appealed to them as an enchanting novelty. They thought it would be 'fun'. The next hurdle was the script. I thought I knew at least the basic details, but half an hour's reading was enough to prove just how little I did know. I spent hours poring over maps and encyclopaedias. Equally reliable sources came up with distinctly different versions. Eventually I drafted what I hoped would be classed as a literate script. The final stencilled result was dished out to the cast who had been chosen purely on the strength of their voices.

It was then that I nearly met my Waterloo. I sailed into the shop, beaming smile at the ready, only to discover a new manager installed. Someone, incidentally, who had no intention of encouraging me in laziness. I was submerged in a number of concise but, to me, meaningless questions. The number of feet, what inches per second was it, how about the playing time, etc? In the end we worked out my requirements and *Your Guide to*

I left the shop, together with a playing time calculator.

I returned home, sadder if not, as yet, wiser. Reading the 'guide' made me feel like Alice in Wonderland. 'Curiouser and curiouser' I murmured as I turned the pages. Notes on the construction of magnetic tapes, lengths and playing times, tape handling principles, threading, splicing and editing, flashed before my wondering eyes. Only once did I lift up my head with a clear conscience, and that was when I came to the section on 'the care of your machine and your tapes'. I felt that, perhaps, there was still hope for me. On the evening of the recording I carefully carried my machine down to the church in our basket on wheels, lifting it over the kerbs, and at one stage walking in the road rather than bump it over the cobbles. The Group's rehearsal room looked like a Heath Robinson version of the BBC. To save recording the script twice (we had wild hopes, doomed as it turned out, to disappointment, of interesting a commercial station) our stage manager thoughtfully brought his own tape recorder. We discovered that his 'pick-up' was the stronger of the two, so decided he should make the master tape.

To save the cast the horrors of chanting 'ba ba black sheep' as a sound test, I allowed the recorder to run while they were rehearsing. Unaware of this they happily ad libbed. They were so hilariously irreverent that I'm still wondering why William and Harold didn't combine forces and haunt us. Earthy comments, scriptwise, regarding William's parentage brought forth the comment 'he seems to have been a bastard in every sense of the word'.

The actual recording was uneventful. The stage manager, now recording engineer, pressed all the right knobs at the right time. I was stationed at the door to prevent anyone rushing in, the cast removed their shoes to deaden sound, and everyone had a good cough. Once the tape was running they stifled their coughs, sneezes and themselves in their handkerchiefs. 'William' threw in a useful tip: 'Don't all turn the pages over together, it'll rustle like hell.'

The cast coped magnificently. After all, names like *Leofric*, *Godwinson*, *Haradrada* and *Ealdgwyth* are scarcely in the Smith-Jones-Brown category. I never realized before how many different ways there were of pronouncing *Canute*. One unrehearsed incident added to the realism. Our scout troop, whose shrieks and bellows are unequalled by any other troop in the district, rushed by at the precise moment one interviewer informed us that a party of Normans had been hacked to pieces. The sound had to be heard to be believed.

The recording, unfortunately, was not of a high technical quality, but with all its faults it was an interesting experiment. The voices of the cast tended at times to be too precise for such a nation-shaking event. Everyone confessed they found it hard to act without facial expressions and movement, but agreed that relying on vocal expression was a challenge.

As for me, tape recording will never be the same again.



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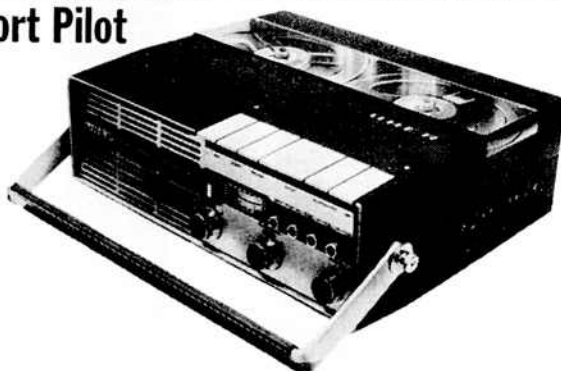
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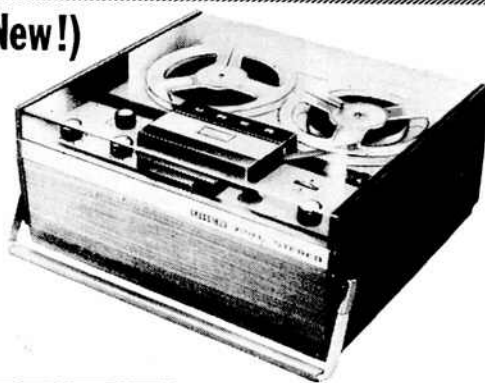
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# tape club news

In this, my first month as Club News Editor, may I offer congratulations to the Rugby TRC, winners of the 1966 *ATR* League Championship. The keen competition indicated a successful year of club activity and, judging from the enthusiastic reports received this month, the year ahead promises to be equally busy.

On behalf of the staff of *ATR* and the many clubs who wrote to express their appreciation, I would like to thank Kim Cook who has so excellently reported Club News for the past three and a half years.

Isabelle Tournor

## Walthamstow

At 7.50 on 6 January at 22 Orford Road, venue of the Walthamstow and District TRS, actors and audience were prepared for *The Video Show*, the first video television recording made by a tape club in Great Britain. At 8.00 Les Bridges, the production controller, introduced the programme and requested response from the audience reaction boards. The actors then gave a 'pre-show warm-up', a succession of quick-fire jokes, and with camera and recording equipment ready to roll, *The Video Show* was on the air! The show progressed through a series of funny lines, humorous sketches and witty ad lib. Sound effects previously recorded by F. C. Judd, Editor of *ATR*, were fed through the video apparatus - occasionally behind cue which added to the audience's amusement as did the pistol shot inadvisably fired inside the grand piano by John Ratcliff producing a reverberated 'Bang' with a 'Twang'. The show was brought to a close with a camera shot of Cyril Tucker, dressed in an oversized overcoat, mangled hat and large woollen scarf, carrying a sign board which read 'The End Has Come'.

After a break for refreshments, the playback of the show was watched on the video monitor unit. Viewing the show twice did not dim the laughter but, in fact, heightened the merriment. Sound effects off cue or over-modulated and musical pistol shots all provided more reason for laughter. Considering the short time which was available for practice, everyone agreed that the production team did a wonderful job. Also to be congratulated are the stars of the show, Margaret Hilton, John Ratcliff and Peter F. Walker. The unanimous verdict on the entire project was 'Marvellous!' To round off the evening, Mr Judd volunteered to answer questions concerning the technicalities of the equipment.

This historic event was shared by over fifty club members and visitors. Among the visitors were members of a local camera club, the Walthamstow Amateur Cine Club and the Redbridge TRS. Also included among guest personalities were the staff from *ATR*: Miss Moira Shippard, Assistant Editor; Miss Isabelle Tournor, Club News Editor; and Mr E. McKeown, Advertisement

## Leeds

At their first club-room meeting, Mr and Mrs Redfearn from Keighley, who are members of Halifax TRC and ex-members of Leeds TRC, showed the club their slides taken in and around Spain. The slides were accompanied with stereo soundtrack which included sound effects of a Spanish organ grinder and windmill.

Two days later the club attended the Friends of Chapel Allerton Hospital Dance and helped raise over £100 towards the cost of new dayrooms at the hospital. Joined by their wives and lady friends, Chris, John, Mike, Joe and Bill proved that they could be as active on a dance floor as in the clubroom! Later, Mr Rowe, Mr Eagle, Mr Newby, Mr Plant and Mr Jones travelled to Doncaster as judges for the Doncaster TRC's competition entitled *Bonfire Night*. After the judging it was learned that the winning entry had been recorded at 1½ ips on a Philips portable. Mr Plant then presented the prize of a tape splicer to the winner.

Members gathered at the Griffen Hotel for a demonstration of the Tandberg 12 arranged by John Peters Audio Department. Mr Daykin demonstrated the capabilities of the machine using Wharfedale Dovedale external speakers. The Euphonics Miniconic was plugged into the Tandberg 12 demonstrating the quality sound which can be reproduced. Also demonstrated that evening was the new Sony Video tape recorder.

The club visited Cinera where a Cinera holiday down the Cresta Run on a bob sleigh, aerobatics in a jet and landing on an aircraft carrier were just a few of the breathtaking things 'experienced' by members.

## Reading

The Abbey Cup is the Reading TRC's annual cup for a slide with tape show. This year's high standard demonstrated how well tape and slide can tell a story, document an exciting event or convey an important message. Using slides like a series of frozen movie sequences, Marjorie Davies matched tape commentary tellingly for putting across her story of two delightful ladies who live together and fall out over Joyce West's attempts to fill the house and garden with her painting and sculpture utensils which spoils Marjorie's attempts at keeping the house and garden tidy!

Second place went to Devra Shiffrin and third prize was awarded to Derek Holt.

The club recommends that any enthusiast who has not attempted to match his tapes with slide visuals should try this fascinating combination which both enhances the impact of tape creations and can enliven and link what may separately be quite an ordinary collection of 35mm slides.



Reading Cine and Tape Recording Society Abbey Cup winners. Left to right: Devra Shiffrin, Derek Holt and Marjorie Davies.

## Friern Barnet

Recently the club had a breathtaking sound-effects tape matched to a hundred colour slides of the Friern Barnet outing to Cosgrove Lodge. The commentary teased many of the members but was received with plenty of mirth. This was followed by an on-the-spot recording with pictures of high performance cars at a hill-climb. One sequence was recorded in the open cockpit of the car with some twenty pictures taken at the bends and trouble spots with clever synchronization of the gear shifts and acceleration sounds. Members sat back exhausted by their vicarious involvement. These two shows were the work of father and son, L. and J. Buszard. In collaboration with North London, the club saw their first demonstration of the VTR by Sony at the invitation of Teletape. This was a very fair demonstration of the medium and just right for the 'well-heeled' amateur.

Friern Barnet's next meeting was aided by news letters which appeared in *ATR*. Through them they were able to borrow the tape *CQ BCL* made by Bob Trotman from the London TRC. Thank you, London! The tape was used as an introduction to a most interesting evening when Frank Inman set up his broadcast amateur station at the club's meeting place. He made many calls, finally contacting a mobile unit and homing this other enthusiast to the meeting place in time for coffee.

The annual party and competition for the cups was a jolly affair and very well attended. A record made by Kenneth Horne and Richard Murdoch as a charity appeal for the blind was played and produced much laughter and enough sixpences to send a worthwhile donation to this good cause. The judge for the competition, ex-member Steve Robinson, had quite a task. He selected the hill-climb tape by J. Buszard as the winner of the Joe Neale (Actuality) Cup and Rod Longhurst as the winner of the Jim Fulton Cup for an entertainment tape. S. Buszard and Tony Stepney were the two runners-up. The cups and other prizes were presented by very attractive and recently wedded Patricia, Mrs Stephen Robinson.

## South Devon

In a meeting entitled *Report 66*, John Pengelly, Peter Cox and John Penty, who travelled from Plymouth, reported on their recording activities of the past twelve months. Included in the programme were recordings of a Cornish mine disaster which have been accepted for inclusion in the BBC's *Today* programme. The stereophonic recording of *Tutti*, which won an award as the club's official entry in the British Amateur Tape Recording Contest, was heard as well as other choral recordings which have been released as LPs.

Bernard Peirce has made seven loudspeaker cabinets which he has donated to the club. It has been decided to sell these at £3 each to raise money for club funds.

In answer to the club's request that tape magazines be made available in the Torquay public library reading rooms, the town's library committee has decided to purchase *ATR*. This idea was suggested by John Parkin at the last AGM as he felt it would provide additional publicity for the club through the inclusion of its activities in Tape Club News.

## Brighton

A new idea entitled *Make A Tape* is under way at the Brighton club. Each month a number of members are chosen and given two weeks to produce a tape of about five minutes' duration. At the end of the month the tape is heard and commented upon by other members of the club. It is hoped that this idea will create more interest in entering tape competitions and will stimulate tape recording activity generally.



Eric Savage proudly exhibited his self-constructed electronic organ at a recent meeting. Built from a kit of parts, it took Eric approximately three weeks to assemble the organ which contains over 5,000 soldered joints, many components including 158 transistors. Despite its apparent complexity, Eric explained the theory behind the noises the organ is capable of producing.

The Brighton club have an interesting schedule planned and those wishing to participate are invited to contact the Secretary, Keith Upton, 47 Kingsley Road, Brighton 5.

#### North London

This club also held its AGM recently and was able to report a successful year. Among achievements noted were membership in the Enfield Arts Council and an increase in club funds and membership. The Chairman, Secretary and Treasurer returned unopposed; Ron Goodwin, John Wilson and Stan Hoefling respectively. Keith Parker, Dave Barker and Den Goodwin were elected as committee members and Keith was made Vice-Chairman. Miss Patricia Allbutt was appointed as Liaison and Catering Officer.

Secretary John Wilson discussed the British Federation of Tape Recording Clubs, pointing out various advantages the club would gain by joining. The club would have access to sound archives, copies of National Contest winners and the copyright licence would also be cheaper. Members were in favour of joining.

#### Rugby

As from the February issue of *Tape Life*, newsletter of the Rugby TRC, stencil typing has been done by Jean Crane, who has taken over from Mike Brown. In a month or two, when Jean has the swing of things, Mike will be relinquishing the Editorship which he has held since the first issue was published in August 1958.

The annual social meeting was held at the

Central Hotel, Rugby, where Bernard and Win Satchell supplied a splendid cold buffet, complemented later in the evening with hot baked potatoes. With a bar extension arranged until 11.15, everyone was looking forward to a lively evening. Among the guests was Mr R. K. Crow, the Borough's Chief Public Health Inspector, who has visited the club twice before to give talks. The club was also pleased to receive members Peter and Rosemary Scott who motored down from Lincoln. The draw, promoted by John Bannister and Bill Long, was a great success, adding £24 to the club funds.

On 23 March, a talk will be given by Graham Harris, Secretary of the Warwick and Leamington TRS and regular contributor to *ATR*. The meeting will be held at 8 pm at the Central Hotel, Church Street, Rugby.

#### Great Yarmouth

In September last year members of the Great Yarmouth and District TRS sent letters to relatives of the old people in homes in Great Yarmouth and Gorleston asking for a message on tape and a request for a piece of music to follow the message. Replies were received from as far away as Australia and Aden and members set about preparing a tape of an hour's duration for each of the homes. The introduction to the programme was by Frank Ifield, who so kindly and readily made a tape for the club while appearing in Great Yarmouth. On arrival at the homes, the members were greeted with smiles of anticipation which soon changed to tears of happiness as the old ladies heard the voices of their sons and daughters and brothers and sisters. All members put a great deal of work into the preparation and presentation of the tape — well worthwhile when they saw the pleasure that it gave.

At a recent social evening the Society took over the lounge of a sea-front public house

where they met with members of the Norwich Tape Society. An enjoyable evening was had by all and the club look forward to their next social evening, which will be held at the end of April.

#### Thornton Heath

At their annual party, the club had the pleasure of meeting Michael, the blind aeronautical student who they assist in his studies. The team of readers collect their material each week and deliver the finished tapes to Chairman G. M. Webb.

The club is contemplating the purchase of a pair of Goodman's loudspeakers to enable stereo tapes to be heard on club nights.

John Bradley recently demonstrated three of the Sennheiser mics, the MD 211, the MD 411 and the Studio Cardioid MD 421. These mics worked most convincingly with a Philips portable, Fi-Cord, Ferrograph and Revox and, as a result, one MD 211 has already been purchased by a club member.

#### Scarborough

At the first meeting of the recently formed Scarborough Tape Recording Club the following officials were elected: Major C. J. Wilson, Hon Secretary; Mr Frank Fletcher, Hon Treasurer; Mr Harry Hiagh, Hon Librarian and Press Officer. Mr A. Robinson, Miss M. Ruff, Mr R. Tindale, Mr R. Hill and Mr A. Simpson were elected as Committee Members.

As part of their programme the club hopes to be of service to house-bound persons, the blind, hospitals, old persons' homes and clubs and handicapped young and old persons. Requests for recording have already been received from local hospitals and old people's homes. The club would like to contact others who are passing messages for the sick.

Details of membership can be obtained from the Hon Secretary, Major C. J. Wilson, 57 Cross Lane, Scarborough. Telephone Scarborough 1778.

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## TEST REPORT

# LEAK SANDWICH LOUDSPEAKER SYSTEM

by Gordon J. King

The new-look *Amateur Tape Recording*, seen as an increase in the editorial content devoted to hi-fi matters, makes it possible to explore for the first time in these pages some of the more outstanding achievements in the art, although not necessarily new designs. One such achievement in our view is the *Sandwich* loudspeaker by H. J. Leak. The unit itself was evolved before 1958, nearly a decade ago, yet it is still being used in new design enclosures, such as the Leak Mini-Sandwich loudspeaker, and in the larger enclosure speaker system, to which this article refers.

Two of these speakers (see Fig. 1) were sent for appraisal, and they were tested with several amplifiers and programme signals under known domestic conditions. The *Sandwich* unit has been used before by the author, but not as a permanent reproducer in a stereo system under domestic conditions, nor in any way comparatively. Loudspeaker systems are not the easiest of things to test objectively, and subjective testing means that the report must be coloured to some extent by what the reviewer himself thinks or feels! True objective testing means setting the speaker up in an acoustically neutral environment, feeding it with suitable test signals and then measuring the results by way of a calibrated microphone system and high-grade amplifier and indicating instruments.

This sort of testing gets rid of the acoustic 'coupling'—the medium between the radiating speaker and the ears of the listener—and it even substitutes electronics for the ears, and uses the instrument instead of the brain for computations. This is all very well, and can tell much about the scientific aspects of the speaker system as a whole, but—let's face it—a speaker system is about the most 'personal' item of any hi-fi outfit, and as such calls loudly for personal or subjective testing (after, of course, the backroom team and designers have completely satisfied themselves as to its objective behaviour—and there can be no doubt that the Leak designers are justly very proud of the objective performance of their 'sandwich' suitably enclosed). Just how a loudspeaker *sounds* depends greatly on the acoustic characteristics of the room in which it is used and this includes the nature of the furnishings, wall and floor coverings, room dimensions and so forth. Its relative position in the room also has a great influence, remembering that a speaker always appears to give more bass output when sited close to a wall or in a corner of a room. The lowest bass that it will ever reproduce is limited by the largest dimension of the room. A good deal also depends on

how the listener is conditioned to hear the loudspeaker.

Almost any reasonable loudspeaker energized by a hi-fi system carrying low distortion signals will sound 'good' to some listeners, especially those new to hi-fi sounds. Loudspeaker sounds are very relative, too. Months or years of hi-fi listening, of comparing speakers and systems—one against another—brings into play a critical awareness of loudspeaker sounds, and this faculty is considerably sensitized by an intimate knowledge of (i) a particular piece of music i.e., test piece, (ii) the performance of the hi-fi chain itself and (iii) the acoustics of the listening room. Running stereo rather than mono also has a bearing on the subjective conclusions in some instances.

These controlled conditions were introduced when the Leak speakers were tested. The originally used stereo speakers were temporarily abandoned and the two Leaks were set up to replace them. Very little room re-arrangement was called for, only to allow a favourite listening armchair to appear in the best stereo sound field. The first reactions of listeners present were expressed by such terms as 'purity of tone', 'complete lack of coloration', 'very natural bass' and so on. It is likely that similar expressions have already been used by past reviewers to describe the Leak system, but not many hours of listening to favourite pieces of music were needed to conclude that here, indeed, was a loudspeaker of more than marginal outstanding performance. Bass is present but not obtrusive, and there is sometimes a 'feeling' that, perhaps, a bit of bass boost should be applied at the amplifier. But this is soon dispelled when the speakers reproduce bass that is *really present* in the programme signal.

The best position for the pair was found to be about 2 ft from a minor wall, spaced about 7 ft from each other. Angle orientation was necessary to project the best stereo image

into the area occupied by the favourite armchair. Treble is also non-obtrusive. It is not hard or metallic-sounding, and some inherent treble diffusion appears to exist in the design, for one does not need to 'tune-up' to a thin-line treble radiation from the tweeter siting.

Sweeping the system over the entire spectrum with both sine and square wave signals at 5 watts rms indicated nothing but absolute smoothness of response. No resonances, no vibrations, no buzzing—nothing but pure sound (on sine waves, that is!). The air pressure response of the system is given in Fig. 2. This is taken from Leak's literature, for not all speaker makers—let alone reviewers—have facilities for making such tests themselves!

The stereo pair were tested with a stereo amplifier set to deliver 10 watts rms from one

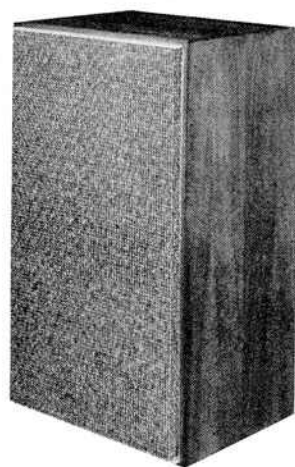


Fig. 1. Appearance of system.

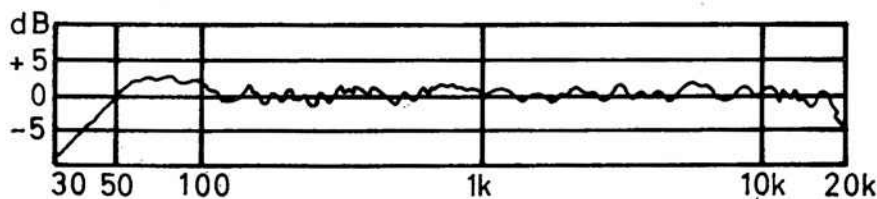


Fig. 2. Frequency response curve.

of my favourite test records—10 watts per channel, that is. The record—which is really excellent for testing speakers, or any hi-fi equipment for that matter—is Toccata in F (Charles Marie Widor) played by Francis Jackson at the organ of York Minster. The stereo version of this disc is AVSE016 on the Alpha label—Audiovision Developments (Oxford) Ltd. The stereo formation Leaks handle the full power of this music without any sign of distress or apparent distortion—the windows and neighbours being the main sufferers!

Although it is often said that a speaker should be heard before purchase, listening to one's selection in a hi-fi shop or demonstration room is by no means the same as listening to that same speaker in one's own home, on one's own equipment. This is really essential, and any readers about now contemplating a speaker change within the medium price range should certainly try to persuade the local hi-fi dealer to run a home demonstration on the Leak.

The two speakers were run under domestic hi-fi conditions for a number of weeks, and as time went by it became increasingly apparent that the sounds produced by the Leaks are sounds that one could really live with. There is total lack of listening fatigue, and at both high and low powers there is no strain between the loudspeakers and the listener. Some speakers work remarkably well at low and medium powers, but give them the full 'gun' and up comes the distortion. This applies to all speakers to some degree; but with an input of 10 watts rms both the second and third harmonic distortion is relatively small in terms of Leak acoustical output, as the curves in Fig. 3 show. These curves were, in fact, plotted by a European broadcasting corporation, and they have subsequently resulted in a number of overseas broadcasting stations adopting the speakers for high quality monitoring.

The Sandwich loudspeaker unit (driver) was developed by the Leak team to match the basic philosophy for the cone of a high quality reproducer to have the conflicting requirements of maximum lightness and stiffness. Ordinary paper cones, although being relatively lightweight, are not particularly stiff. This means that when they are handling signal powers of rising frequency large areas of the cone tend to set up their own modes of vibration which are not under the absolute command of the speech coil itself. These 'uncontrolled' vibrations (called 'cone break-up') have the effect of impairing the overall response characteristics. Peaks and hollows are created in the curve, which detract to some extent from the smoothness of the reproduction, depending upon the precise nature of the cone employed. Typical symptoms are amplitude distortion, intermodulation distortion and overhang effects. The first is heard as coloration in the reproduction at the undulations in the response, the second as intermodulation of sounds of one frequency range by sounds of another frequency range, often causing spurious tones and the third as lack of attack and 'ringing' on short, sharp, transient sounds. Many of these problems can be overcome by paying extra special attention to the loudspeaker cone, as the Leak speaker system clearly demonstrates.

The Leak cone is of 'sandwich' construction, hence the use of this term in describing the

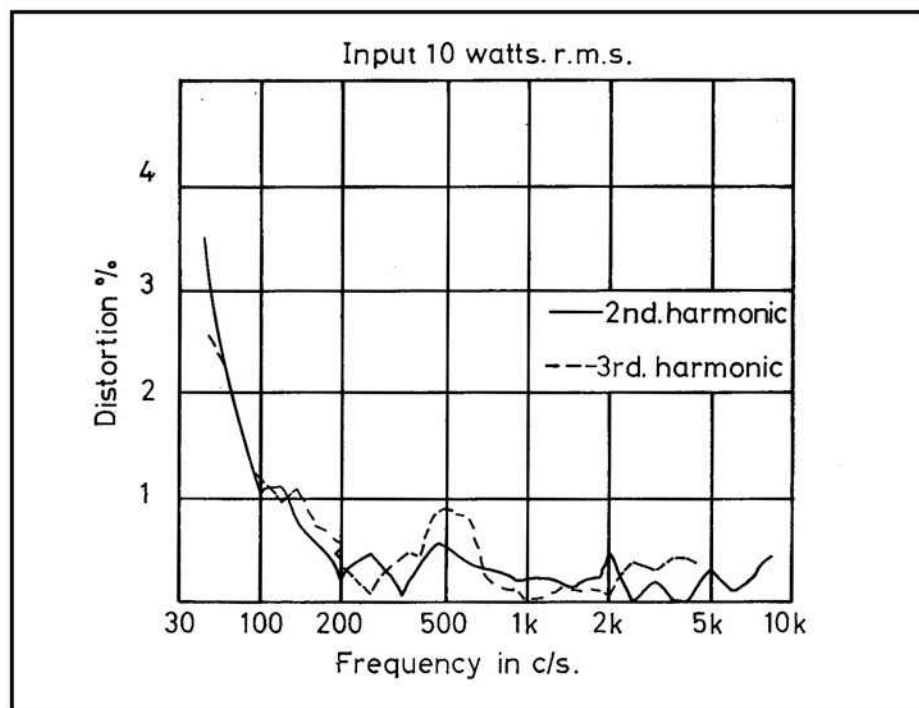


Fig. 3. Distortion curves for 10 watt rms input.

speaker system. It is composed of stiff aluminium skins for the outer surfaces, to handle the surface stresses, while the piston-like rigidity is given by an internal bonding of featherweight expanded plastic—the inside of the sandwich, as it were—which is perfectly adequate for the relatively low internal stresses. The net result is a cone of extreme lightness yet of incredible stiffness, thereby satisfying the basic requirements.

There is no doubt that this cone acts as an almost perfect air piston over at least six octaves. The system as a whole employs two drivers, one for treble frequencies and the other for bass, the input frequencies being divided optimum for flat radiation by a six-element crossover filter. Internal details of the loudspeaker are shown in Fig. 4. The treble unit is at the top and the bass unit half-way down the cabinet. The crossover filter is placed directly behind the bass unit, and the enclosure is occupied by rolls of multicellular mineral wool, which assist in extending the lf response of the system smoothly and in removing cavity resonances. The bass response is also extended by the enclosure being completely sealed and tested against air leakage. The front of the cabinet is covered with a decorative grille cloth, and even this is woven to Leak specifications for maximum acoustic transparency. The treble unit itself is housed within its own compartment to avoid modulation from the lf sounds within the main enclosure, and cavity resonances within this secondary enclosure are damped by the use of foam lining.

A great deal of attention has been given to a large number of small points, and this, coupled with the remarkable sandwich cone technique, leads to a loudspeaker system that has to be lived with to be believed. Your reviewer is certainly going to miss having these speakers around. But perhaps it is time his originals were replaced!

#### Maker's Specifications

Impedance: 15 ohms nominal. Frequency

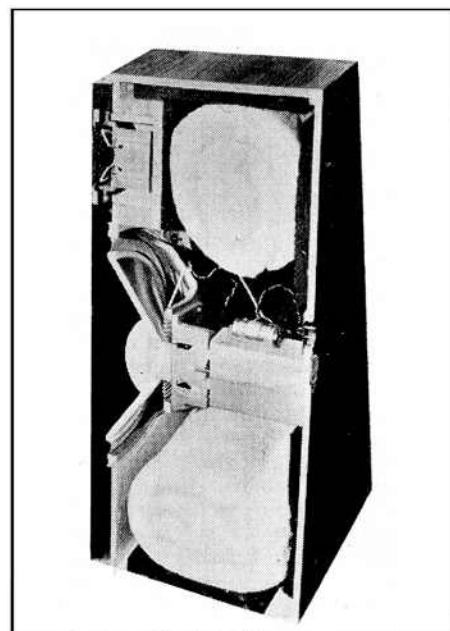
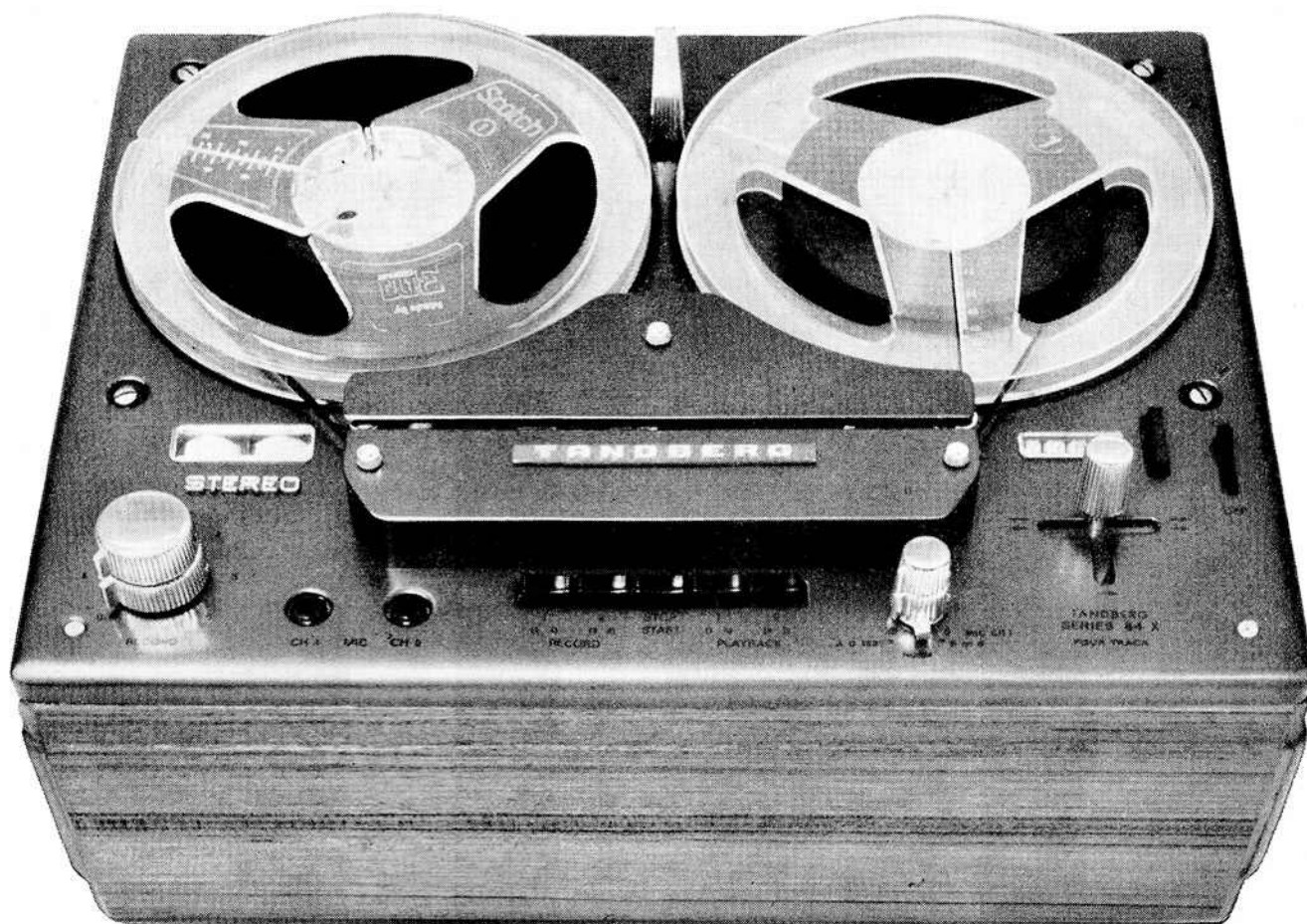


Fig. 4. Cutaway view of sandwich system.

response: This is illustrated in Fig. 2. **Transient response:** Unprecedentedly good due to the 'sandwich' bass and treble cones being hundreds of times stiffer than conventional cones. **Power handling and capacity/distortion:** Greater than with conventional loudspeakers due to absence of break-up. **Sensitivity and power requirements:** Medium to high sensitivity. Based on 10 watt amplifier design but can be used with larger powers. **Crossover frequency:** 900Hz. **Lf resonance:** 19Hz approx. **free air.** 58Hz in system. **Dimensions:** 26 × 15 × 12 inches. **Net weight:** 49.5 lb (without packing). **Finish:** Walnut, sapele, mahogany or teak. Other finishes to order at slightly increased price. **Awards:** Fashion Foundation of America Gold Medal and approved seal of British Council of Industrial Designs. **Price ex-factory:** £39 18s 0d.



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# NOISE AND SIGNAL RANGE

by Gordon J. King

In matters of hi-fi and tape recording we hear quite a lot about noise and dynamic range. Although these are two different things, they are somewhat related to each other, as we shall see. Let us consider a programme signal delivered, say, by a microphone, and let us suppose that the intensity of the sound to which the microphone is responding ranges from the feeble sounds of bird songs, some distance from the microphone, to very much stronger sounds of people talking close to the microphone.

Under these conditions it is unlikely that the microphone itself will overload. That is, its output voltage will be geared linearly to the intensity of the sound waves impinging upon its diaphragm, and one would expect it to deliver a reasonably distortion-free signal even from the comparatively strong sounds of the nearby people talking. The sounds of the distant birds will also create signal, of course, but this will be many thousands of times weaker. The programme signal thus ranges from very weak to very strong, and this is referred to as the *dynamic range* of the programme signal – or microphone signal in this case.

The vast majority of programme signals work within a dynamic range. Even someone speaking in front of a microphone will produce a programme signal ranging from a minimum to a maximum strength. This is the dynamic range again, and in this illustration it is virtually the same signal-wise as it is acoustically. A big symphony orchestra has a very much greater dynamic range from the weak sound intensity of the single triangle to the fantastically greater intensity of the whole orchestra in *fortissimo*. The peak dynamic range of such an orchestra can be as great as 70dB, and this represents a power ratio of 10,000,000 to 1. Little wonder, then, that some tape recorders and amplifiers have a tough time to reproduce such a wide range with fidelity!

The above ratio is that of the sound intensity or acoustic power of the orchestra, and for faithful reproduction the loudspeaker would have to deliver a noise- and distortion-free acoustic power over a similar ratio. This is an impossible task under ordinary domestic conditions, and in practice even the best equipment can barely rise to a dynamic range above 60dB (which is still considerable). Indeed, we often have to make do with a ratio well below this value with less exacting equipment and limited programme signals. This brings us back again to the programme signal aspect of dynamic range. To produce acoustic power at the loudspeaker we have to supply signal voltage to the recorder or amplifier input, and assuming that the system non-linearity is relatively small, which it must be for hi-fi results, the acoustic power ratio is geared directly to the programme signal

voltage ratio. We have to rely on the dynamic range of the programme signal, therefore, and this is determined by the programme controller. Even when we make a recording on magnetic tape we are controlling the dynamic range, as we shall see. On FM radio it is not possible to modulate over a range of much more than 60dB, and disc recording is of a similar order of compression, much more so with popular music.

## Limiting

Dynamic range limiting is demanded for various reasons, but the two chief ones are noise on the one hand and overloading on the other. Programme limiters are used for disc recording to keep the weakest signals out of noise and to prevent the strongest ones breaking down the groove. When we tape record we carefully adjust the recording level control to prevent the recording level indicator from kicking too much into the red zone and so avoid overloading and distortion. We know that too much deflection on the indicator will produce a recording having considerable 'roughness' and bad quality. If the programme signal tends to rise, then we turn down the recording level control.

On the other hand, if the programme signal falls to a very low value we turn up the recording level control to obtain a greater deflection on the indicator. If we fail to do this experience has taught us that when the recording is played back the soft passages will be accompanied by undue background 'hiss' or noise. This action of turning the control up on weak signals and down on strong ones has a

limiting effect on the dynamic range of the programme material. This is manual limiting. There are also automatic programme limiters which are connected either in the microphone circuit or somewhere in the programme amplifier channel, and once the nominal recording level has been established, the limiter takes over the manual operation of adjusting the recording level. Limiting on tape recording, therefore, is necessary to keep the operation within a 'sandwich' of noise and overload, as shown in Fig. 1. The more expensive the equipment, the less the amount of limiting required. This is because the equipment is endowed with (a) a good overload performance and (b) a good noise performance. When we use a microphone for deriving our own programme signals, limiting becomes more important than when the programme signal is from a commercial source, such as a gramophone record or radio programme. This is because limiting has already been applied to these signals. It often happens, though, that the limiting given to a programme signal is based on high quality reproduction. Thus, even when this limited material is applied to less exacting equipment, distortion on high level signals and noise on low level ones can become troublesome due to shortcomings in the reproducing equipment itself. Further limiting may then be necessary for noise- and overload-free reproduction. The dynamic range of an amplifier is increased when the noise it produces is reduced. This is obvious from Fig. 1, for the 'sandwich' is then enlarged by the noise departing more from the overload level.

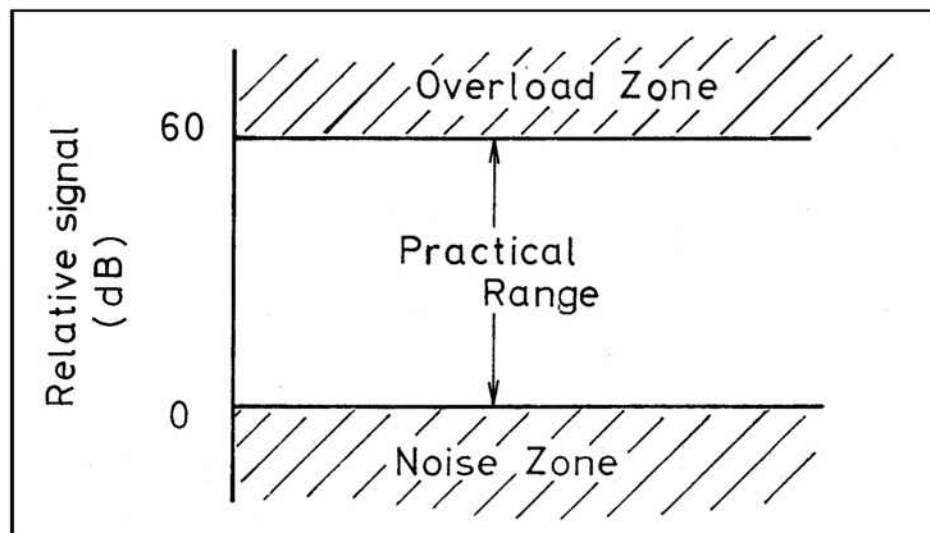


Fig. 1. The dynamic range of a recording/reproducing system is confined within a 'sandwich' of overload and noise, as this diagram shows.

## What is Noise?

This brings us nicely to the subject of noise itself. Just what is noise? Noise is an electrical signal which includes some of the characteristics of the wanted signals and, in audio systems, produces an actual noise output of some kind – usually 'hiss' like the fall of dry, fine sand on to a metal surface. Noise is produced by random fluctuations in the motion of circuit electrons and by the random distribution of electric and magnetic fields. A noise signal by itself appears something like the waveform in Fig 2 (on an oscilloscope), and when modulated upon a higher frequency signal imparts upon that signal ragged edges.

Noise signal can be measured at the output of an amplifier just like wanted signal. Let us suppose that we measure  $100\mu\text{V}$  of noise signal at the output of a 20dB amplifier (one having a voltage gain of ten times), and let us suppose that the input signal to the amplifier (wanted signal) is  $1,000\mu\text{V}$ . Since we get a ten times amplification the output signal will be  $10,000\mu\text{V}$  (or  $10\text{mV}$ ). Thus, we have a ratio between the wanted signal and the noise signal of  $10,000/100$ , which is ten. This means that the signal/noise ratio is ten times or 20dB.

This is not good enough. Unless the noise signal is some 200 times (46dB) below the wanted programme signal the noise will be heard. A signal/noise ratio of 20dB is very poor. Anyway, it illustrates the idea. Sometimes an equivalent noise figure at the amplifier input is used. In the above illustration this would be  $100\mu\text{V}$  of noise signal at the output divided by the gain of the stage which is ten. This means that the equivalent noise voltage at the input is  $10\mu\text{V}$ . To secure the minimum signal/noise ratio of 46dB we would either have to increase the programme signal by 26dB or reduce the noise signal by the same ratio.

Clearly, then, even a stage of very good noise performance will produce some noise at its output, which means that there is always a lowest programme signal level that will make the signal/noise ratio worse than the required 46dB minimum. An amplifier producing very little noise does not normally worry us because the programme signal, even at its weakest, is always 200 times above the noise signal. Trouble can arise, though, when very low level sounds need to be reproduced or recorded, such as the earlier mentioned bird songs, which produce very, very little microphone signal, rarely sufficient to outweigh the noise by 200 times. The above discussion reveals that the lower the noise produced by the amplifier – and the first stages after the low level programme signal are the most important – the lower the level of programme signal that will be accommodated within the operating sandwich in Fig. 1. What, if anything, can be done, to reduce the early stage noise? Noise in the reproducing chain is very closely tied up with the basic design. If the noise is high when the equipment is new, there is not much hope of reducing it. However, if the noise develops over a period of time something in the equipment is responsible. Noise is produced in all circuits, semi-conductors and valves, and good equipment is designed so that the noise output is the smallest possible. To this end, use is made of low-noise valves, low-noise transistors and special low-noise high-stability resistors.

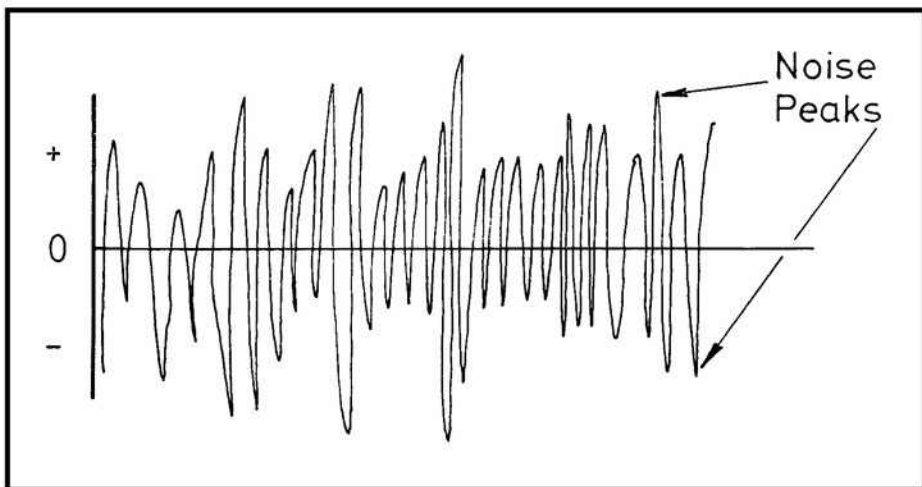


Fig. 2. Representation of a noise signal. This is caused by random fluctuations in the motion of electrons in electrical conductors.

It is not uncommon for a valve or transistor to deteriorate and increase the noise output. High stability resistors are generally less troublesome, but an ordinary resistor somewhere in the circuit could develop noise trouble. An extremely small noise voltage developed in this way can add considerably to the overall noise output, especially if the resistor or other component responsible is right at the front of the amplifier channel. The signal/noise ratio is improved by applying as much as possible of the programme signal to the amplifier input, for it is here that the ratio is given relative to the equivalent noise voltage. This calls for good matching techniques and the smallest possible attenuation between the signal source and the amplifier input. For instance, one could expect a substantial impairment of the signal/noise ratio by connecting, say, a low impedance microphone to the high impedance input of a tape recorder. Even if full tape modulation could be obtained, the recording level control would have to be fully advanced. Even supposing the tape could not be full modulated, an extra high setting of the playback volume control would still be necessary to obtain the required replay power. In both cases the additional amplifier gain would produce more noise signal, since extra gain is required because of the extra low level source signal.

A low impedance microphone gives a smaller output voltage than a comparable high impedance counterpart. Matching by a microphone transformer or transistor impedance converter effectively steps-up the microphone voltage, while at the same time stepping up its impedance so far as the amplifier is concerned. This is only one typical illustration. There are many more of them.

## Overload Level

So much for the noise aspect of the dynamic range, but what about the upper level overload zone shown in the sandwich in Fig. 1? All amplifiers are limited in terms of output signal, and this limit is often related to a specific distortion figure rather than absolute overload or blocking. As the signal delivered by any amplifier rises in level, so also does the distortion content of the signal. However, the design is such that at the required output level the distortion is well within specification. A little above maximum output, some amplifiers run into really violent distortion, while

others can handle an overload with only a gradual rise in distortion. Nevertheless, to keep to within the distortion specifications the output should never be pushed above maximum.

The overload performance of an amplifier is governed by the nature of the circuit and the components employed. The overload level can deteriorate due to falling HT voltage (resulting from a worn HT rectifier, for instance) reduction in emission of a valve or valves and alteration in characteristics of a component. Clearly, such a fault will close the dynamic range sandwich. Conversely, if the noise level rises the original signal/noise ratio would only be preserved by stepping up the lowest level signals, which would again inhibit the dynamic range by bringing the noise zone closer to the overload zone.

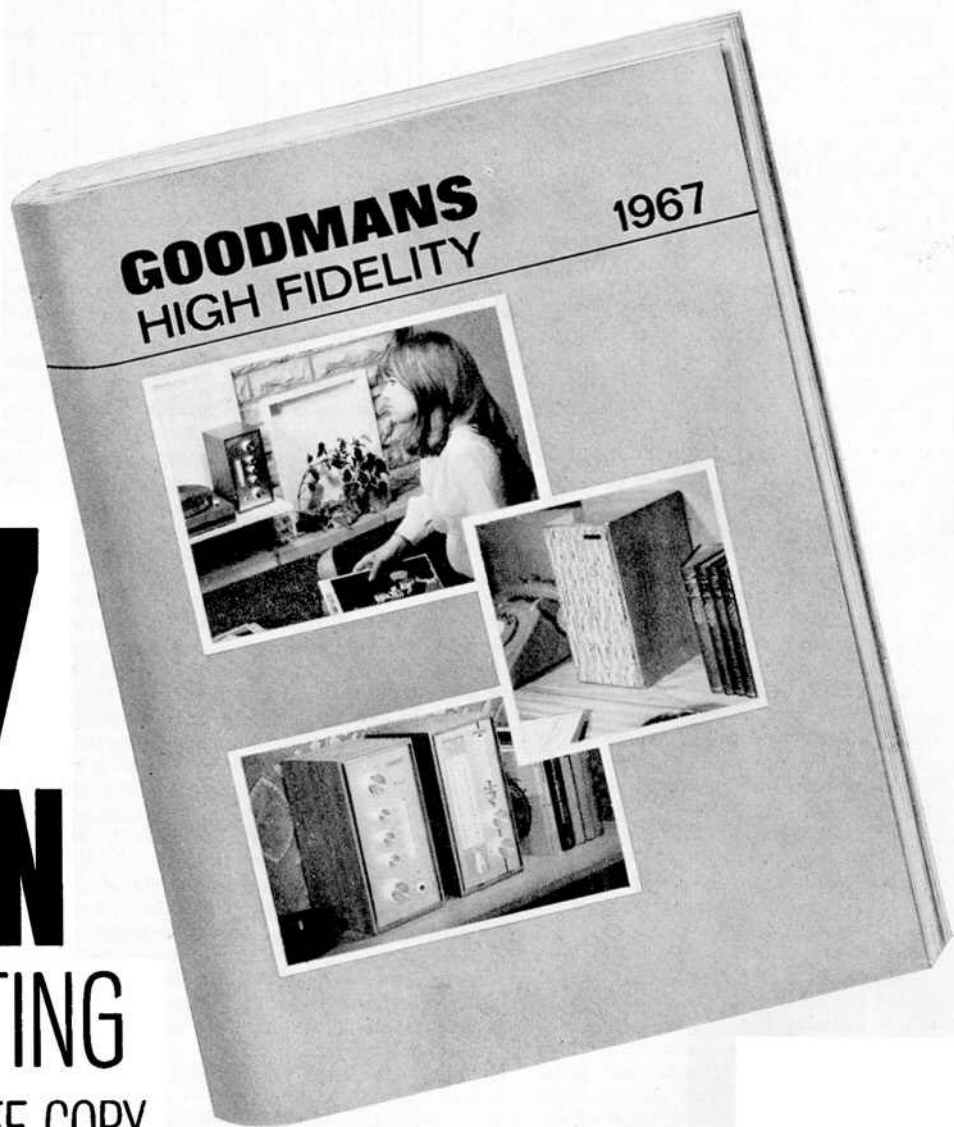
When we reproduce programme signals from radio and disc, the dynamic range – as already intimated – will have been controlled and our equipment should normally be able to handle them without dropping into noise or rising into overload. When we make tape records it becomes necessary for us to apply some limiting as may be demanded by the nature of the equipment and programme material. In some cases we will let our level indicator peak into the red zone, even though we know this causes a rise in distortion at that instant, purely to provide a dynamic characteristic suitable for the nature of the programme material. With the level control set correctly, however, we should rarely have to tolerate this when dubbing from an already compressed programme source.

Noise is the biggest problem and is much in the minds of broadcasting and recording engineers. The maximum signal/noise ratio of any communications system is achieved when the power distribution is constant over the spectrum. Therefore, since the power distribution of average music is far greater at low and middle frequencies than at high frequencies, it is possible to enhance the noise performance by equalization. This is why pre-emphasis is given to the modulation of an FM radio transmission and why disc records are cut with treble boost. The de-emphasis on the reproducing channel restores the quality of the audio while at the same time reducing much of the noise. This subject will be discussed in a future article.



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# A TO Z IN AUDIO AND VIDEO

A fairly large encyclopaedia could be compiled of the terms and definitions associated with sound reproduction and audio and video tape recording, but so far as we know, a work exclusive to these subjects has not yet been published. Technical dictionaries and alphabetical references are available, but these mostly embrace the wider fields of radio and/or television and electronics in general. It is a rather frustrating job compiling such a work because, owing to the rapid rate of development, when the book eventually appears in print it is inevitably somewhat out of date!

However, to keep our readers fully informed we have decided to publish each month a few audio, tape and video terms and definitions in alphabetical order. For those readers new to the subjects it is proposed to include old terms as well as those at present in use.

## Acoustic Curtains

These are made of a rather heavy acoustic damping material often used inside loudspeaker enclosures. A material at one time popular for this application was  $\frac{1}{4}$  inch thick carpet felt. This was arranged in the cabinet to form absorbing partitions (two or three of them) strategically placed across the cabinet to separate the speaker unit from the rear of the cabinet.

The idea behind this is associated with the damping of standing waves within the enclosure. Such damping makes the enclosure appear as a resistance at high frequencies, and while  $\frac{1}{2}$  inch thick damping material lining the actual inside woodwork of the cabinet assists in this respect, at low frequencies the damping becomes progressively less effective owing to it being situated within a very small audio

wavelength of the walls. The use of curtains tends to offer some improvement at the low frequency end of the spectrum.

## Acoustic Feedback

This is when a feedback path exists acoustically between, say, a loudspeaker at the output of an amplifier and a microphone at the input. The effect is that the sound from the loudspeaker is picked up by the microphone, amplified and then fed from the speaker back to the microphone again. A feedback or oscillation then occurs should the feedback loop gain exceed unity, and a very disconcerting howl builds up in the speaker at a frequency governed by the resonance of the feedback loop for maximum loop gain. This is related to the nature of the microphone and the resonant frequency of the speaker system, coupled with the room acoustics between the speaker and microphone.

This often happens when tape recording by switching on the monitor speaker while making a recording. Even if a feedback howl is not sustained, the presence of a feedback path can impair the quality of the recording, in rather the same way as by the switching-in of a resonator. It is for this reason that headphones are more suitable for monitoring the programme signal during a recording session.

Acoustic feedback can also occur from a loudspeaker back to a gramophone pick-up. Here the vibration (acoustic coupling) is generally 'forced' from, say, the speaker enclosure, through the floor boards, through the gram deck and disc and into the pick-up via the stylus. The solution here lies in insulating the gram unit with felt or thick rubber from the table or shelf upon which it is standing. As this feedback is generally 'tuned' towards the lower part

of the audio spectrum, it can often be cleared by cutting the bass response of the amplifier by the bass control, but then, of course, the bass components of the reproduction are also attenuated.

## Acoustic Resistance Unit

This is a unit which is sometimes fitted over the vent of reflex speaker enclosures. One application of such a unit allows the size of a reflex enclosure to be reduced for a given bass response. The unit also reduces spurious resonances while minimizing the magnitude of the upper resonance, which can be a nasty characteristic of some enclosure designs.

## Attack

This is the term describing how well an audio system reproduces a sudden, high intensity, transitory rise in programme signal level. Music is often composed of steep, rapidly occurring wavefronts or *transients*, and if the audio system cuts the higher order harmonics of such signals, the attack to that nature of music is destroyed. This is because the signal demands a fast rise-time in the amplifier, and if this is impaired, the rise time of the signal itself is also inhibited and the attack is lost.

Because the rise-time of an amplifier is related to the response at the treble end of the spectrum, it is often necessary for hi-fi amplifiers to have a high frequency response extending well beyond that required for passing the highest musical frequency. In this way the transitory signal waveform is passed through the amplifier without rounding or distortion.

More next month

## ON TEST—GRUNDIG C100L

Continued from page 19

of course; it is not meant to be. Harmonic distortion is pretty high at full playback output up to about 100Hz, but this falls to about 5% overall at higher frequencies.

To sum up, then, the Grundig C100L is an excellent little battery machine incorporating some of the latest developments – notably the 'electronic drive motor system'. It employs the DCI cassette system, which comprises the Grundig, Telefunken and Uher group. This works at 2 ips as distinct from the  $1\frac{1}{2}$  ips Philips system. The cassettes are not inter-

changeable.

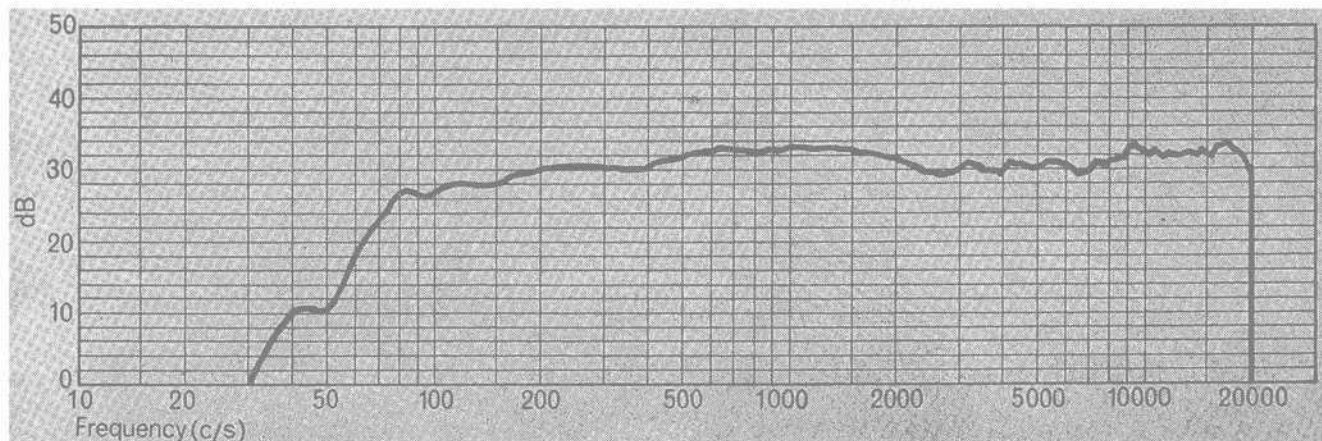
As a field machine it holds many exciting possibilities, and it would represent a good machine to partner a more elaborate domestic-type tape scheme, whereby the 'field tapes' could later be dubbed on to standard tape at standard speed. On the other hand, the machine has potential essentially as a player of cassette tape records, both commercial and home-recorded. It also most certainly would be useful to students for recording lectures and for reporters for obtaining verbatim copy. Its excellent low-noise features would be of great help in these respects.

## Manufacturer's Specifications

**Batteries:** Six U2 cells. **Tape system:** DC International cassette at 2 ips tape speed. **Recording sense:** International half-track. **Wind time:** Approx. 100 secs for DC90 cassette. **Frequency response:** 40 to 10,000Hz (see Fig. 1). **Signal/noise ratio:** 45dB. **Wow and flutter:** Less than  $\pm 0.4\%$ . **Inputs:** Microphone/radio 0.25 to 20mV at 5Kohms. **Outputs:** 2W into internal speaker. 1.5V across 15Kohms 'phones'. 600 mV across 15Kohms. **Speaker:** Elliptical  $6 \times 3\frac{1}{2}$  inches. **Dimensions:**  $11\frac{1}{8} \times 7\frac{1}{2} \times 3\frac{1}{2}$  inches. **Weight:** 7 $\frac{1}{2}$ lb approx. **Microphone:** Supplied with stand.

# Don't buy a speaker

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This is the performance of the Solent, a new speaker by Sonotone, costing only £18 in a modern stylish veneered cabinet. You can easily pay £10 more for speakers which barely equal the performance of the Solent. Clip out this chart. Use it as your yardstick of value when you're shopping for speakers.

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Sensitivity: 98 dB at 12 w. (microphone 6ft).

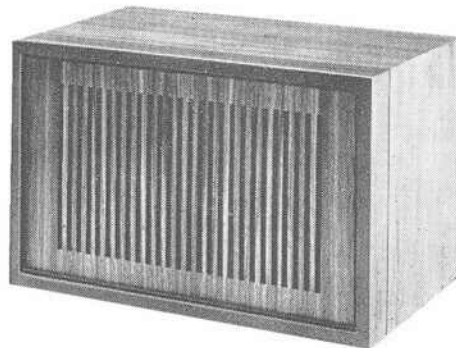
Power Handling: 12 w programme level.

Impedance: 8 ohm system suitable for 8-15 ohm valve or transistor amplifiers.

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## Sonotone Solent £18



(14" × 9" × 8½")



# TAPE RECORD REVIEWS

by Russ Allen

**Stan Getz' Greatest Hits.** Prestige MP 7256. 4-Track Stereo 3½ ips.

This is a collectors' item and it's a great pity we couldn't have had some worthwhile sleeve notes. They do hint that these are recreated 78s, and there is, in fact, a certain amount of acetate hiss but not sufficient to bother the ardent archive digger.

To dig is certainly worth it as Getz is superb. A tenor saxophonist who weaves subtle magic and relaxed, smooth, heady music around each tune, whether it is a moody *What's New* or an up-tempoed *Lady in Red*.

All the tracks are delightful little Getzian gems with a very passable recording quality; better than some originals I've heard. The recorded sound of bass and drums is the only thing that dates this album. Prestige stuff this and thank you.

**Good 'n' Country - Jim Reeves.** RCA Camden CTR 784. 4-Track Stereo 7½ ips.

Ten tracks from the Country and Western man who has gotten himself into the charts. Reeves' big novelty is a fine masculine singing voice of the non-pop type. His songs are what used to be called *cowboy* and the accompaniment is a sophisticated hill-billy group - double bass, electric steel (or Hawaiian) guitar, rhythm guitar, banjo, drums and piano. Sophisticated because, unlike the old days, they play in tune, are properly recorded and are most probably studio musicians assembled specially for the date. Also helping out on some tracks is a female vocal group in and out of echo. It is interesting to note how the steel guitar has taken over the fiddle line and I can only gather that the West done gone got the 'tricity. Must have power points out there in the prairie. Stereo is excellent, as is the recording. It was all taped in RCA Victor's famous Nashville Sound Studio, Nashville, Tennessee.

**Texas Jim Robertson - 'Golden Hits of Country and Western'.** Pickwick P4T423. 4-Track Stereo 7½ ips.

I don't know about Mr Reeves, but Mr Robertson seems to be a genuine cowboy - six foot three and born on his parents' ranch in Batesville, Texas, fifty years ago. A big lad, he was riding and roping cattle on his eleventh birthday, but by the time he was seventeen he'd answered an advertisement for a 'guitar-playing cowboy singer' at a North Carolina radio station. He got the job, NBC heard him, took him to New York and, as they say, he never looked back.

Like Reeves, he has a good masculine voice and sings much the same kind of song. His backing group are a bit less sophisticated and they've got the violin back on lead, with guitar, string bass, piano and drums.

To be really authentic I reckon the line-up should be acoustic guitar, fiddle, washboard and harmonica and for good measure, a blown jug bass. Somewhere I've got some old 78s with just that instrumentation and it sounds fine. Now, if you are wondering about that jug bass, let me explain. The jug was one of those big old earthenware ones with handles like ears - probably once filled with moonshine - and you slung it up on your shoulder. Blowing across the neck produced a lovely windy bass note (as with almost any bottle),

and a good jug blower could produce a really fine bass line. Anyway it must be a dying art as yer jest caint ahear it no more. Pity! Point is, Country and Western just ain't what it used to be, but what it is today is very popular and Jim, good old Jim, be he Reeves or Texas, makes the right sort of noise. C and W fans may purchase either or both with confidence. Dear old EMI have sent me two more of their Studio 2 LPs, and the first one, *Adventure - Ron Goodwin and his Orchestra*, was a very difficult reviewing task. Ron writes a lot of film background music (some of it recorded here), such as 633 *Squadron*, *Those Magnificent Men in their Flying Machines* and *Operation Crossbow*. All are quite magnificent except that after last month's tape *The Sound of Sight*, Ray Martin's truer-than-true micky-take of the screen spectacular, I found it very hard not to develop a broad grin over poor Mr Goodwin's efforts.

Luckily the second track was Ron Binge's *Elizabethan Serenade* and I knew this was for real as I've sawed through it on several occasions myself. Derek Johnson's sleeve notes are informative and friendly. To quote: 'There has always been, and always will be a tremendous demand for Ron's kind of music for it is essentially middle-of-the-road, appealing to all tastes and age groups, etc.' Well, that's what he said and I do know that millions must enjoy it but I'm not very keen on it myself. It certainly doesn't offend, but neither does it thrill me. However, it has its moments. Recording was not quite so sparkling as on the two previous discs I reviewed in this series.

No complaints at all about the stereo quality of the second LP, called simply *Steve Race Two 137*.

Less pretentious than Mr Goodwin's, this is a delightful set of fourteen items, six of which are Race originals, though one of these is but an adaptation. The remaining items include Ravel's *Pavane*, Ron Binge's *Like Old Times*, Rodger's *Dancing on the Ceiling*, etc. Race has revamped most of them, adding Latin rhythms to some which fit splendidly.

*Dancing on the Ceiling* is a fine arrangement with some gorgeous tuba-fattened new chords. Mick Jagger's *Lady Jane*, which I didn't much care for in the Stone's version, has been deliciously gavotted (or something) and an arrangement of the tap dancer's favourite *Goodbye Blues* almost stopped me from remembering what a corny old tune it is. Instrumental balance is good, though the strings sounded a little strangled occasionally, but the stereo spread is exceptionally good without being in the least bit gimmicky. Incidentally, Steve, I didn't really think that picture on the back did you justice. You'd better come and have some done at my studio sometime.

**Stravinsky - Les Noces and Histoire du Soldat.** Supraphon SUA ST 50623 Stereo. 17s 6d.

*Les Noces*, The Wedding, is unusual on two counts. One, it is vocal, having four soloists with the Czech Philharmonic Chorus, with four pianists and the percussion - tympani, bells, xylophone, etc, from the Czech Philharmonic Orchestra conducted by Karel

Ancel. Two, is that, while conceived in 1914, it was not until 1923 that Stravinsky finalized the instrumentation and completed the work. Described as a Russian choreographic scene, it is divided into four tableaux. It is quite typical of the Master, percussive, exciting and with a recurring rhythm reminiscent of a Red Indian tribal dance.

The singing is in Russian and can only be described as magnificent. When I think of all the complaints I've had from readers regarding the scratches and bangs heard on brand-new discs by the major companies, I am amazed at the quality of these Supraphon discs for what is literally half-price. The quality of the stereo is great too.

*Histoire du Soldat*, The Soldier's Tale, is the tragic story of a deserter who cannot escape the Devil.

Musically it is delightful, employing a chamber ensemble of wind instruments, percussion, double bass, violin and conducted by Liber Pšek. It was composed towards the end of 1917.

Parts of the composition are influenced by Stravinsky's interest in American jazz music which he had not actually heard at the time, but had only read the scores. It is extraordinary how he has captured the basic elements, particularly in his scoring for saxophones. The Ragtime section of the three dances is a superb giggle for jazz addicts, being a beautiful parody on early jazz, especially if you have ever heard recordings of The Original Dixieland Jazz Band.

Again I would remark on the clarity of recording and good stereo plus an attractive sleeve with well-written sleeve notes.

**Serge Prokofiev - Symphony-Concerto for Violoncello and Orchestra. Op 125**

Strangely enough, the Prokofiev has something in common with Stravinsky's *Les Noces* in that it took several years to achieve its present form. Originally Prokofiev wrote it in 1933 as his first cello concerto, but it proved unsatisfactory both to the writer and to Rostropovich who first performed it. Therefore it was decided to rewrite it, but it was not until the early 1950s that this was done, the work being almost completely changed. Now it is a work of great beauty. Navarra, a cellist of stature who produces a magnificent tone from his instrument - particularly in the lower register - has enhanced it with this fine performance. His handling of the fiery second movement is truly splendid.

Side two features the same soloist, orchestra and conductor with Ottorino Respighi's *Adagio Con Variazioni* for Violoncello and Orchestra.

Splendid recordings of splendid music on a first-class stereo disc at a price which seems ridiculously low for so high a content. I don't know how they do it, but I'm glad, because the Supraphon catalogue contains a great many very interesting works. Perhaps the only thing that may put some people off will be the unfamiliarity of the names of certain of the artists. I suggest they have no need to worry.

Back now to pre-recorded tapes - all mono twin-track.

continued overleaf 43

## TAPE RECORD REVIEWS

continued

**In Memory of Hank Williams with the Driftin' Cowboys.** MGM TA-MGM C8020. 3½ ips Mono.

We have mentioned the two Jims, Reeves and Texas, and now we have Hank Williams of the same school and, possibly, of even greater fame.

I remember about six years ago playing at a Sergeants' Mess 'do' at an American base near Reading. It was a mighty dull affair with the sergeants and the femmes sitting glumly around, drinking, while we played our little hearts out in an effort to rouse them. Finally a top sergeant came across to us and in a real Southern drawn said, 'Don't yer all know nothin' from Hank Williams?' At that time I'd never heard of him and said so. The poor 'Top' nearly had apoplexy and I learned that Williams was just about on a par with God in the US Forces and certainly around that particular camp. It seemed the sergeant had over a hundred 78 recordings of Hank and still hadn't got them all. This, I reckon, was a feat of stamina but ar reckon mebbe you can sit through sixteen tracks without too much trouble.

Williams's voice has nothing of the quality of the Jims', being woody and nasal, but his diction is good. Thirteen of the tracks are Williams originals, some of which you'll know for sure: *Hey, Good Lookin'*, *Your*

*Cheatin' Heart*, *My Bucket's Got a Hole in It*, etc. The Driftin' Cowboys are another electric steel guitar outfit with fiddle, string bass and drums and, of course, Hank's own acoustic guitar.

I am well aware of the great popularity of Country and Western music but it does get a bit samey and draggy. Anyway the recording is OK, and if you like C/W you'd better not miss Hank's memorable performances.

**The Seekers - Come The Day.** Columbia 3½ ips. 2-Track Mono TA-SX 6093.

My Australian friends again, going from strength to strength, Royal Command Performance and all. They are such a delightfully musical group with Judith Durham's lead voice quite the sweetest in popdom. Listen particularly to her solo on Lennon and McCartney's *Yesterday*.

As a group they combine the very best of the folk singing style with an approach so well rehearsed and musically right as to put them exactly where they are, in a class of their own.

On this tape they are aided and abetted with bits of orchestrated intros, etc, with an especially nice one to *Well, Well, Well* which is a rather super spiritual beautifully sung. Three of my favourite tracks bring to a close Side two, Pete Seeger's *Turn, Turn, Turn* and a song with a great lyric, *Louisiana Man* and finally *California Dreamin'*, which is just gorgeous.

A delightful set by a delightful quartet.

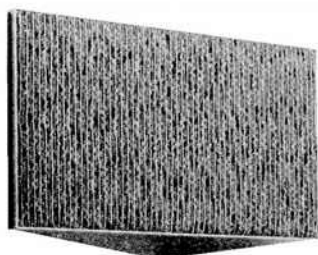
**Hoochie Coochie Man - Jimmy Smith.** Verve 3½ ips Twin-Track Mono TA-VLP9142.

Arranged and conducted by Oliver Nelson, this certainly moves along, with some great drumming by I don't know who because, as is the custom, EMI doesn't consider that tape buyers wish to know what LP buyers can read on their sleeve notes.

I still fervently declare I don't like that electronic organ noise but I do regret that I grudgingly have to admit that Jimmy Smith sure plays a lot of it. In some ways he reminds me of tenorist Tubby Hayes in that he has a lot of technique and uses it all the time. But, dammit, he made my feet tap like crazy and I found myself enjoying the record against my will. It really does go like mad all the way. Somebody sings in a most fascinating gin-croaked voice on the title tune and a couple of other tracks. Nobody says who it is but I presume in my ignorance that it must be Mr Smith himself and, however, I liked it very much.

Maybe it's because I'm writing this on Christmas Day and I'm feeling all benevolent but this really is an exciting album, though I still don't like that strangled plumbing and Mr Smith does play too many notes. Just to be spiteful, I reckon the best track of all is the Oliver Nelson original *Blues and the Abstract Truth* which features the band rather more than the organ.

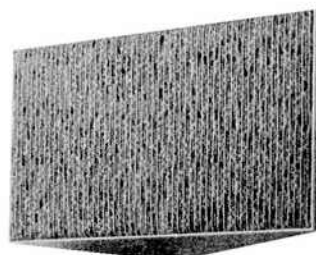
An extremely good set that I know I'm going to play a lot.



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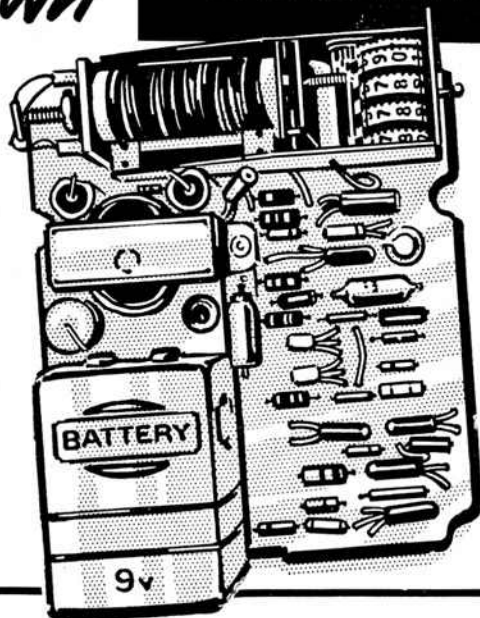
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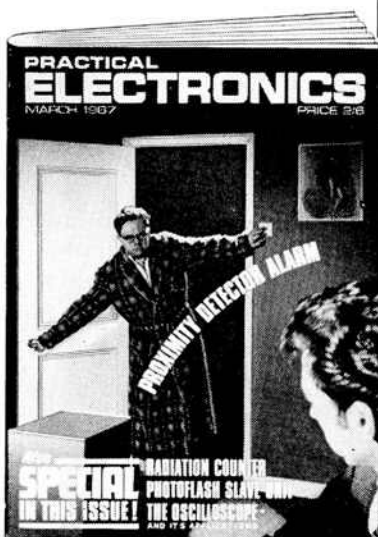
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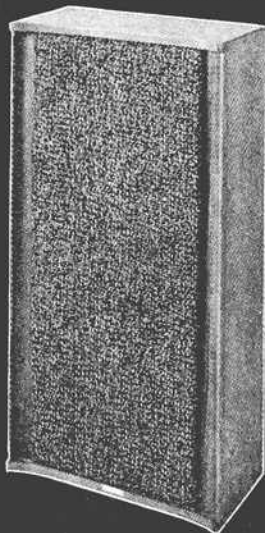
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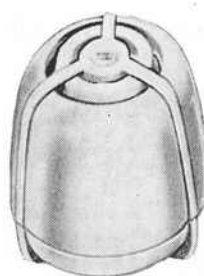
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Date .....

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Please indicate with a tick in the appropriate squares.

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I	J	K	L	M	N	O	P

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Side 2—Clock chime Alarm clock Westminster chime Bow bell

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Side 1—Male and female lions Gibbous Chimpanzees Bell bird  
Rattlesnake Baboon Viper Emperor geese Fish eagles Mountain  
lion (puma) Kookaburra (laughing jackass)  
Side 2—Elephants Mississippi alligator Indian tiger Sea lions  
Male lion In the jungle (a background of typical sounds)

#### C BGX/1—BACKGROUND SOUND EFFECTS Price 7/6

Side 1—Sea (breakers) Wind (howling—eerie) Thunder (light rain)  
Side 2—Rain (heavy shower) Factory sounds (industrial) Traffic  
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Side 2—Spooks Intruder Creaks Fright Dungeon Ghosts Ghouls  
Maniac laughter

#### G MFX/1—AUTHENTIC HIGH-FIDELITY SOUND EFFECTS Price 7/6

Side 1—Lion roaring Twin piston aircraft landing Building and  
debris falling Road drills and compressor Ship's siren Steam train  
leaving station Small steam loco and whistle Cell door, keys and  
locks  
Side 2—Police car and bell, chase Police launch and siren Steam  
goods train and whistle Car door slam, and starter Storm at sea,  
thunder, wind and gulls Tube train, stop, doors and start

#### H MFX/2—AUTHENTIC HIGH-FIDELITY SOUND EFFECTS Price 7/6

Side 1—American police car with siren—arriving American police  
car with siren—departing American police car escort with sirens—  
passing American police motor-cycle patrol with siren—stopping  
Applause (hand clapping) Orchestra tuning up Car crash Glass  
breaking (repeat)  
Side 2—City and Waterloo tube train—arriving City and Waterloo  
tube train—departing Footsteps (continuous track) In subway  
(mixed) In narrow streets (female) On pavement (mixed) Running  
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Side 1—Train departure—main line Train arrival—main line  
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Side 2—Local passenger—arrive and depart Fast goods train—  
passing Central London tube train—arrive and depart Train over  
points and crossing Slow goods train passing—with whistle

#### K MFX/3—HORSES Price 7/6

(10 effects) Trotting Walking Jumping Composite recording of  
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Car skid Car skid and crash  
Side 2—Continental town—street sounds and glockenspiel (clock  
chimes Warning siren Warning bell (all typical continental sounds)

#### P BGX/2—BACKGROUND SOUND EFFECTS Price 7/6

Side 1—London Airport main lounge Passenger flight departure  
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(announcements in English and French)  
Side 2—Train interior (continuous) Children playing Racing Cars  
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Side 1—Automation (theme of rhythm and melody) Perpetua (theme  
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- ★ Tape Recorders
- ★ Hi-Fi Equipment
- ★ Guide to Stands and Demonstration Rooms

#### Other features include:

- ★ Tape Recorders in the Making—Uher
- ★ More on Planning for Video
- ★ Switched on in Munich
- ★ Test Report on a Philips Tape Recorder
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30 March to 2 April, 1967

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Readers wanting tickets should write to  
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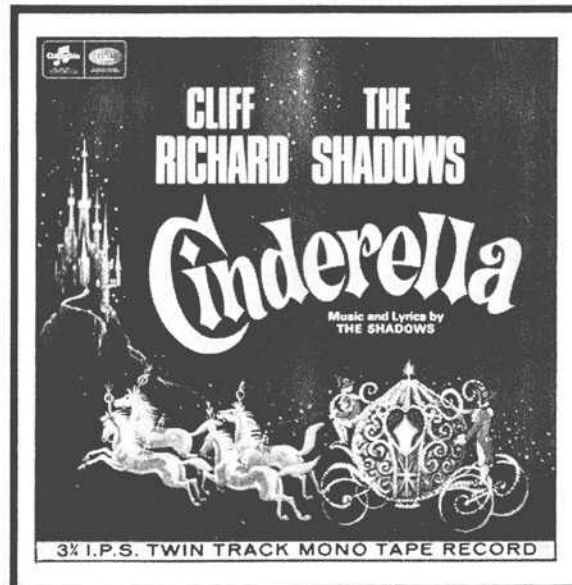
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