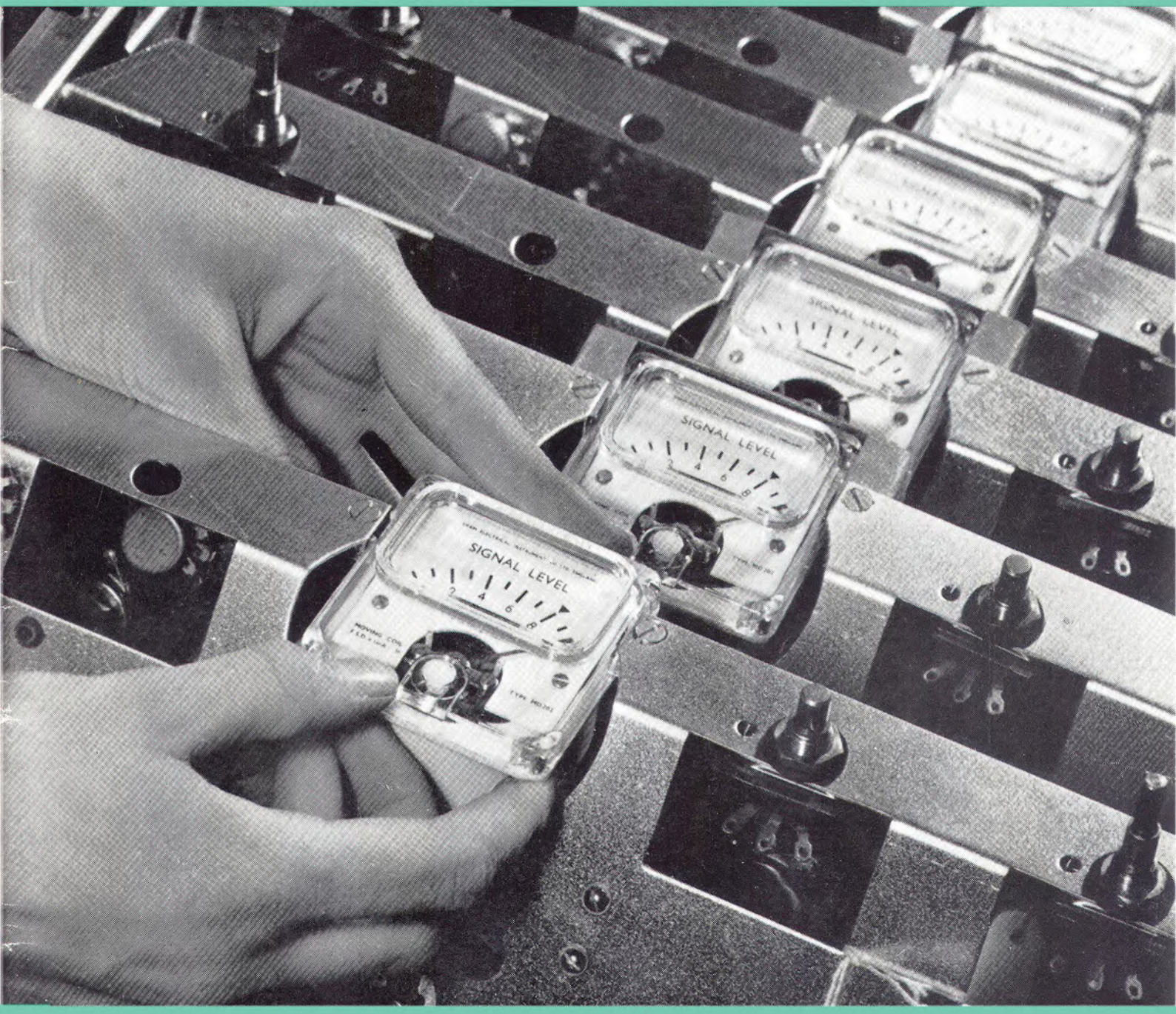
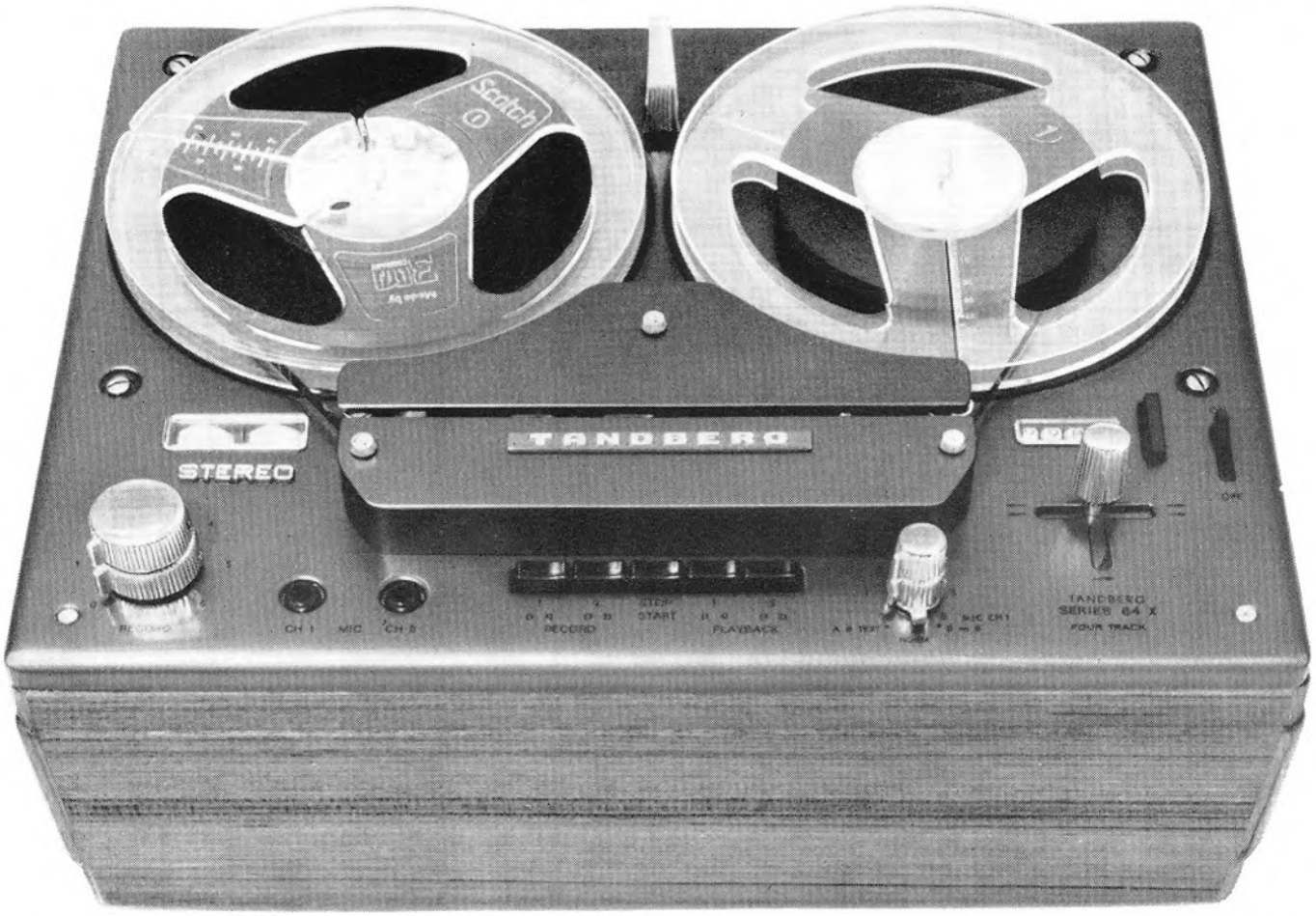
APRIL 1967 TWO SHILLINGS

tape recorder



AUDIO FAIR PREVIEW — MINIFLUX UNIVERSAL TAPE PREAMPLIFIER
COMMENTS OF A COMMENTATOR — GRUNDIG TK340 AND UHER 724L REVIEWS

The outstanding new Tandberg 6x



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(± 2 dB 40-8,000 c/s).

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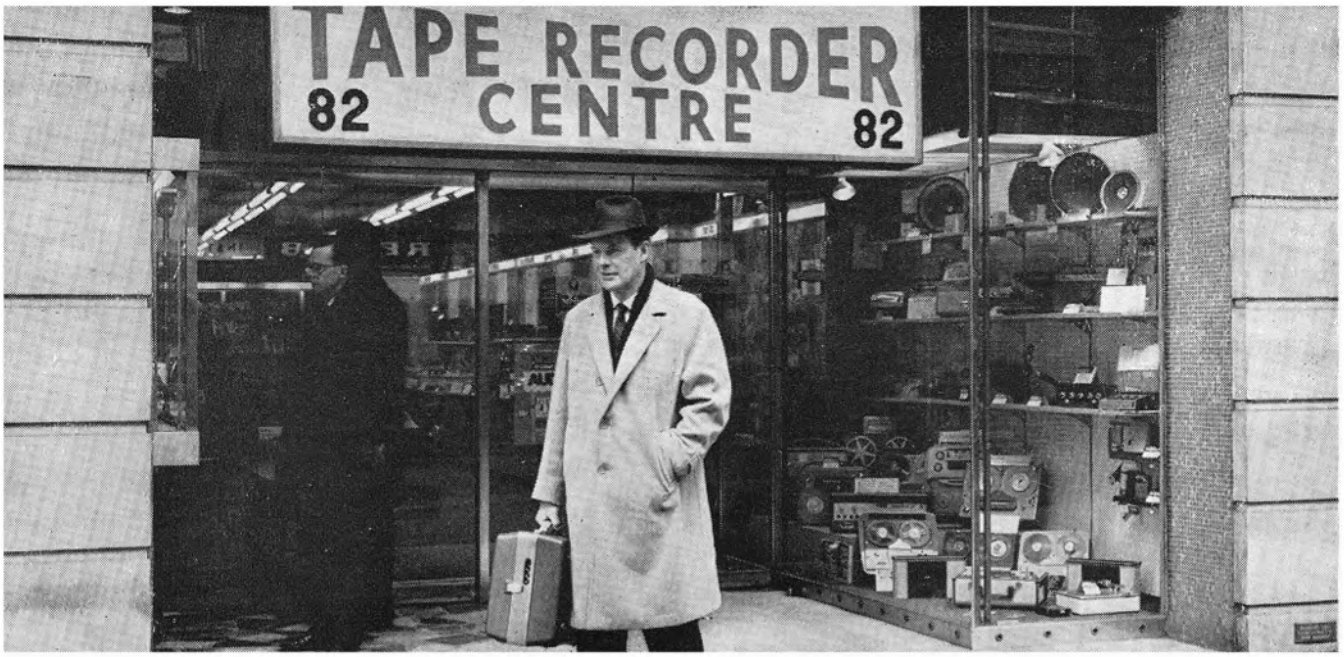

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Philips EL3558	14 14 0	2 9 0	42
Ferguson 3224	15 8 0	2 11 4	44
Wyndsor Vanguard ...	20 13 0	3 8 10	59
Philips EL3556	21 14 0	3 12 4	62
MAINS 2-TRACK			
Ferguson 3220	8 15 0	1 9 2	25
Grundig TK120 ...	10 6 6	1 14 5	29½
Tandberg 823	18 18 0	3 3 0	54
Brenell Mk. 5/3 ...	25 18 0	4 6 4	74
Brenell Mk. 5/3 'M' ...	32 11 0	5 8 6	93
Ferrograph 631	33 5 0	5 10 10	95
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STEREO/MONO			
Philips EL3312	16 16 0	2 16 0	48
Sony TC250A	19 19 0	3 6 0	57
Philips EL3555	26 5 0	4 7 6	75
Akai 1710	27 13 0	4 12 2	79
Sony TC260	33 19 0	5 13 2	97
Tandberg Series 12 ...	36 15 0	6 2 6	105
Truvox PD104	36 15 0	6 2 6	105
Beocord 1500	36 15 0	6 2 6	105
Beocord 2000K De Luxe	43 15 0	7 5 10	125
Revox 736	44 9 0	7 8 2	127
Beocord 2000T De Luxe	45 3 0	7 10 6	129
Akai X-350	66 10 0	11 1 8	190
Akai X-355	83 6 4	13 17 9	239
BATTERY			
Philips EL3301	9 9 0	1 11 6	27
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5¾" 900'	28/-	22/6
7" 1200'	35/-	28/-
LONG PLAY		
3" 210'	9/-	7/3
4" 450'	14/6	11/8
4¼" 600'	21/-	16/10
5" 900'	28/-	22/6
5¾" 1200'	35/-	28/-
7" 1800'	50/-	40/-
8¼" 2400'	72/6	58/-

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4¼" 900' (BASF)	30/-	24/-
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5¾" 1800'	55/6	44/6
7" 2400'	77/6	63/-
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4" 900'	39/-	31/3
4¼ 1200' (BASF)	49/-	39/6
5" 1800'	66/-	52/10
5¾" 2400' (BASF)	90/-	72/-
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SCOTCH

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5¾" 900'	27/6	22/-
7" 1200'	35/-	28/-
LONG-PLAY		
3" 300'	9/6	7/6
4" 450'	14/6	11/8
5" 900'	27/6	22/-
5¾" 1200'	34/6	27/6
7" 1800'	49/-	39/-
8¼" 2400'	72/6	57/6
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5" 1200'	41/9	33/6
5¾" 1800'	55/-	44/-
7" 2400'	76/6	61/-
TRIPLE-PLAY		
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4" 900'	38/6	30/6
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GS 15	900' S/P 5¾" reel	28/-	17/-	49/-	93/-

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900' on 4" reel	39/-	20/6	60/-	117/-
1800' on 5" reel	66/-	34/-	101/-	198/-
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Don't forget our other ACCESSORY BARGAINS!

Tape Head Demagnetiser, essential for any enthusiast! Ready for immediate use. Fully guaranteed. Worth 50/- ... **Only 27/6** P. & P. 2/-
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Three reels for **55/6,** six reels for **105/-,** post free.

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April 1967

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tape recorder

APRIL 1967 VOLUME 9 NUMBER 4

INCORPORATING
SOUND AND CINE

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COVER PICTURE

Our cover, this month, has some of the characteristics of a 'What is it?' puzzle photograph. Supplied by the *Sifam Electrical Instrument Co.* of Torquay, it portrays the assembly of *Ferrograph 633* tape recorders, all of which employ Sifam meters.

SUBSCRIPTION RATES

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

WHY DO YOU buy *Tape Recorder*? Is it for the reviews, constructional articles, the servicing pieces, perhaps the plays? Or are you simply endeavouring to keep in touch with general progress in the magnetic recording field? Are you a middle-aged gadget-minded rose-grower in Slough, or a technically-inclined pipe-smoking professional bag piper in Leeds? Is tape recording the burning hobby of your life or are you simply an industrial spy looking for something more compact than an *EMI L4* to conceal in an inside pocket? Perhaps you thirst after technical knowledge for its own sake?

In order to cater as best we can for our readers, we find it necessary to keep in touch with their likes and dislikes. Our large post bag is a great help here, but from time to time it is necessary to search elsewhere for such information. 'Elsewhere' in this case implies the Questionnaire to be found on page 169. A few moments of your time in completing and posting this (no stamp needed) will provide us with a representative picture of our readership, from which we may mould the future shape of *Tape Recorder*.

There have been several market surveys of this type conducted in tape recording circles—by manufacturers and fellow-publishers—but only rarely have the results been made available to those who provided the initial data. For our part, we propose to publish those findings likely to be of interest to readers, the report appearing in the June issue. We hope this will remove the element of personal detachment surrounding the majority of market surveys.

An early Easter means an early Audio Fair this year, and we look forward to meeting readers and contributors at our booth and in Room 152 in the Hotel Russell. The number of new recorders expected to be introduced this year is rather below the figure we have come to expect, one reason being that none of the normally prolific Japanese manufacturers have superseded their current ranges.

No suggestion has been put forward to date that *Sony* will be demonstrating either of their video recorders, and no mention made of the *Akai* cross-field video recorder in Pullin demonstrations. The apparent delay in getting the various domestic VTR's off the ground suggests, to us, that the teething troubles in mass producing such machines are more formidable than was anticipated. With laser techniques finding practical applications in conventional and three-dimensional television systems, we are inclined to prophecy a change-over from magnetic to optical recording at some time in the future. Lasers have already been employed with success in data storage, photo-sensitive film being scanned by a modulated light beam. Replace the film with transparent plastic tape, increase the laser strength to a level that will melt a portion of the tape, incorporate a lateral scanning system—*a là Zenith*—and there is your VTR. Nothing to wear out, optical editing and projection, and a choice of optical or magnetic-stripe sound. In common with Arthur C. Clarke, and the celebrated orbiting communications relay system, we are inclined to patent the idea!

But here we verge on science-fiction, and in the meantime we must cultivate our iron-oxide age hobby. One potentially potent cultivator is the British Amateur Tape Recording Contest, the administration of which recently passed from the hands of the equipment manufacturers to those of the word assemblers. The Editors of several prominent audio journals now comprise a committee, under the chairmanship of Mr. C. Rex-Hassan. Since the chairman is deeply involved in organising the Audio Fair, it seemed particularly apt that the next annual contest should be initiated formally at the Hotel Russell. And this is precisely the send-off to be given to the contest this year.

It is to be hoped that the reorganisation, which seems at last to have placed the Contest firmly on its feet, will result in a greatly increased number of entries.

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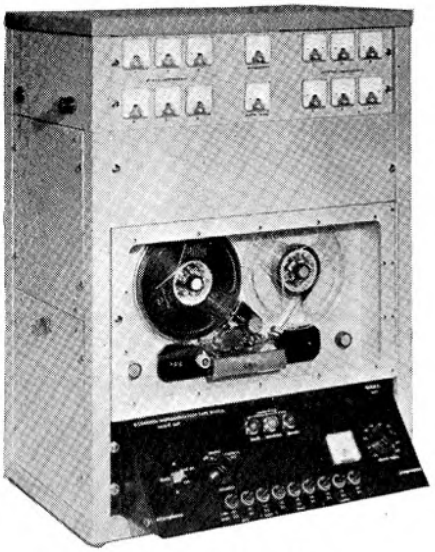


POLLUTION ANALYSES

THE problems of water pollution and contamination are being studied by the Ministry of Technology's Water Pollution Research Laboratory with the aid of a multi-channel tape recorder. Radiation detection equipment installed in a 27ft. catamaran detects and records pulses created by a potassium bromide solution, the latter being added to sewage entering an outfall sewer for a period of some two hours before measurement. Four scintillation counters, located at various depths beneath the catamaran, feed data to separate tracks of *Scotch* tape, two further tracks being provided to note boat position and general information. The tapes are then analysed at the Stevenage laboratory and transferred to diagram displays.

AKAI PRICE REDUCTIONS

PRICES of four tape recorders and two loudspeakers have been reduced by *Akai*. Since RPM has been removed from the range, the new prices are 'recommendations' only. The *Akai X-300* has been reduced 5gn. to £194 5s. Models *M-8*, *X-4* and *910* are now respectively £131 5s., £123 18s. and £59 17s.—reductions of 11gn., 13gn. and 5gn. Akai *SW-130* speakers are now £30, and the *SS-30* £13, original prices being £33 15s. and £14 5s. respectively.

'ELECTRONIC MUSIC REVIEW'

A QUARTERLY magazine newly introduced in the USA is *Electronic Music Review*, devoted "to matters of interest to electronic composers, engineers, performers and listeners". It is published by the *Independent Electronic Music Center, Trumansburg, New York, 14886*, from whom a complimentary copy of the first issue is available on request.

NEXT MONTH

TO BE PUBLISHED on Friday 14th April, the May *Tape Recorder* will carry an article by three members of the South Devon Tape Recording Club, describing the recording of An Amateur Stereo Spectacular. Potential BATRC competitors may find inspiration here, while the rest of us bury our heads in Tape Drive Systems, as outlined by Vivian Capel.

AUSTRALIAN TAPE RECORDER

RECENTLY announced by the *Rola Division* of the *Plessey Components Group*, the *707* is believed to be the first transistor studio tape recorder ever produced by 'down-under' industry. A solenoid-controlled horizontal tape deck is incorporated, with provision for full remote control. Designed to meet the needs of the *Australian Broadcasting Commission*, the 707 features continuously-variable spooling which, with free access to the heads, is claimed to render it particularly suited to editing. The transistor electronics include a replay monitor amplifier feeding a 12in. Rola dual-cone internal loudspeaker.

AMATEUR TAPE CONTEST

REFORMED for 1967, the *British Amateur Tape Recording Contest* has a new organising committee and is formulating plans to be launched at the Audio Fair. Essentially, the committee comprises Editors and Technical Editors of the three tape magazines and other audio publications, with Mr. C. Rex-Hassan as Chairman, Miss Brenda Marriott as Vice-Chairman and Treasurer, and Mr. John Bradley as Secretary. Entries for the 1967 event may be submitted right up until 31st. December, the judging to take place early in 1968, followed by prize-giving at next year's Audio Fair.

There has been a complete revision of entry categories which, with other administrative changes, should make for a very lively and successful event. An invitation has been sent to manufacturers in the tape recording field to become patrons of the Contest, and it is hoped to use Room 344 and a table at position No. 66 on the ground floor of the Hotel Russell during the Audio Fair—and in collaboration with the Federation of British Tape Recording Clubs—to distribute entry forms and answer questions about the 1967 Contest. We shall be publishing our own version of the form, with supporting information, next month.

Seven entry categories are planned : Speech and Drama, Documentary, Music, Sound Snap-Shot, Technical Experiment, Schools (three age groups) and a Set Subject ; this year the latter will be 'Tape letter to someone overseas'. Entries may be in mono or stereo, with special extra prizes for : (a) the best stereo tape in any section, (b) the most humorous tape in any section, and (c) the best all round tape—the 'Tape of the Year'. Until further announcements, any correspondence in connection with the Contest should be sent to : **BATRC, 42 Manchester St., London W.1.**

NOISE REDUCTION

ALTHOUGH every element in a sound reproducing chain contributes electrical noise of one sort or another, by far the major noise problem with modern equipment is caused by tape hiss.

At the BKSTS on January 25th **Dr. R. M.** Dolby described his new audio noise reducing system now being used by *Decca* which, although eliminating all forms of noise generated in the stages which are between the 'black boxes', will be of most benefit in reducing hiss.

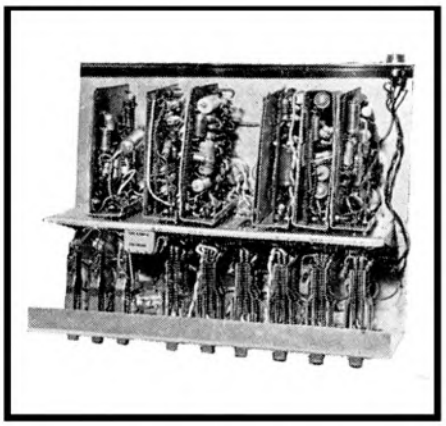
Tape hiss is generated by the oxide particles comprising the tape coating, and together with the signal produces intermodulation effects as well as background noise. This effect could be clearly heard with single tone bursts recorded at the 2% distortion level, as could another defect of the medium—print-through. **Dr.** Dolby demonstrated this by playing some fully modulated tapes of a solo clarinet, and both pre-echo and post-echos were quite distinct—this is an effect that readers could easily reproduce for themselves with possibly surprising results.

The solution to these problems lies in the improvement of the tape itself. Manufacturers are working on the problem continually, but the low-noise tapes so far available work by permitting peak (and average) recording levels to be increased rather than by reducing the residual hiss, and there seems little prospect of any dramatic breakthroughs in this direction. Another method of increasing the signal-to-noise ratio is to widen the track ; readers probably know that doubling the track-width gives a 3dB bonus. However, professionals commonly use ¼in. tape and to obtain a worthwhile improvement (say 10dB) by this means would entail the use of 5in. tape !

Turning to the problems of electronic noise-reduction methods, Dr. Dolby outlined the problems facing the designer—together with some of the phenomena of hearing that he could utilize in its operation.

A demonstration was given of the device, using live musicians and with recordings (made on a *Leevers Rich* machine) being A-B compared with both live and noise-reduced signals. The lecture was concluded with a replay of some Decca master tapes that had been made with the Dolby system. The equipment was operated by David Robinson (also of *Dolby Laboratories*) who describes the system in the *1967 Audio Annual*.

A HIGH QUALITY MIXING UNIT



THE outputs from each of the five microphone amplifiers are mixed, via 4.7K isolating resistors, into the low impedance input of the group amplifier which raises the mixed signal to a level at which it can be used to feed the high-level or 'Gram' inputs of tape recorders, via the main group fader.

The input to the group amplifier is at low impedance to reduce interaction between amplifiers—the signal output from one channel should not vary significantly as others are faded up or down. The low impedance input also reduces cross-talk from one amplifier to another, so that a relatively 'clean' signal is present at each amplifier output to feed to the 'clean-feed' socket; signal from one amplifier appearing at the output of another has been successively attenuated in the ratio of the isolating resistor to the input impedance of the group amplifier and then of the isolating resistor to the output impedance of the first amplifier—an added advantage of the low impedance outputs of the microphone amplifiers.

The group amplifier used in this mixer is a simple one, consisting of another single DC feedback transistor pair (**fig. 1**). The transistors used were a low-noise *Texas* type, a *T1XA02*, for the first transistor, and a *Newmarket NKT 142* for the output. An *NKT 216* or *226* would be equally suitable for the first transistor and an *NKT 218* for the second. There is both DC and AC feedback from the emitter of the second transistor, via R_7, and additional AC feedback via R_8. The DC feedback stabilises the circuit for all reasonable temperature variations, in spite of the absence of a resistor in the emitter circuit of the first transistor.

The first transistor is run at a collector current of approximately 1.2mA, and the output transistor at approximately 1.6mA.

The AC feedback reduces the input impedance of the group amplifier and reduces any non-linearity distortion in the first stage, as well as ensuring a more than adequate frequency response for this stage. The second stage contributes a small amount of voltage gain and should have very good linearity due to the feedback from the undecoupled emitter resistor. If more gain is required from this stage, part of the emitter resistor may be decoupled as suggested in the diagram. The value of R_8 may also be increased to provide more gain, but the effect of increasing the input impedance of the amplifier should be borne in mind before this is carried too far. A low impedance output to the clean feed selector switch is also available from the emitter of the second transistor, providing a feed for monitoring that is independent in level of the main fader.

The main group fader is fed (via C3) from the collector of the NKT 142. This provides a controlled output at a maximum of about 4K, at an adequate level to feed most recorders; the output impedance is low enough to allow feeds of several feet of coaxial cable without risk of treble loss, hum, noise pickup or microphony in the leads. The prototype provides two feeds or outputs in addition to the clean feed output; more could be accommodated without difficulty if required. Although the output impedance is low, the mixer should not be fed into too low an input impedance, to avoid loading the output severely.

If the mixer is to feed low impedance inputs, a buffer emitter-follower stage could be put on the output, and in this case it might be worthwhile adding a transformer to enable the mixer to feed 600-ohm balanced inputs as found on some recorders, particularly professional types, GPO lines and some forms of PA amplifiers. This modification was not considered for the author's mixer, although it could easily be added either as an additional module or as an external add-on unit should it ever be required.

Outputs of the amplifiers are all at low impedance, and are therefore suitable points from which to take signal for clean feed with nothing more elaborate than an isolating resistor to avoid 'killing' the signal in the event of a short on the clean feed output, and to attenuate any clicks or extraneous signal which may be fed back through the output from monitoring equipment, etc., to which the feed is being supplied. 10K isolating resistors are used with the (attenuated) output across 600 ohms (**fig. 2**), to provide a low impedance low-level feed to the external equipment, which can equally be a monitoring amplifier (with preamplifier) or the 600-ohm or high impedance microphone inputs of another mixer. The use of large isolating resistors also means that if a standard 2-contact jack plug is inserted in the clean feed socket instead of a 3-contact plug, the amplifier connected in the mixer to the 'ring' terminal of the socket will not be shorted out by the barrel of the plug. In an emergency, therefore, a single clean feed can be taken from this socket quite safely using a two-contact jack plug and single, screened cable.

The BBC microphone amplifier that has already been described is a very useful and reliable design, and takes care of most of the problems that arise when one tries to design a microphone amplifier, with the possible exception of cost, which is rather high, although the amplifier represents very good value for money in terms of available quality. It will handle very low level signals without contributing too much noise; on the other hand, it will take quite a hefty input before distortion becomes a problem. It is also stable over a wide range of temperatures, probably wider than the range it is likely to encounter with normal amateur use. The performance is largely independent of transistor characteristics (except transistor noise) within quite a range, which simplifies construction when one does not have an inexhaustible source of transistors on tap.

One of the more expensive parts of the amplifier is the input transformer, which in spite of the feedback used needs to be a good (and therefore fairly expensive) type to realise the full potential of the amplifier. For some applications some reduction in quality would not be noticeable. Many amateur microphones, for instance, do not have a flat response to the useful ends of the audio range, but are nevertheless very useful where the range of the microphone is not going to be exceeded too much. For instance, a tenor is unlikely to be required to sing a note below A_2 (100Hz), if as low, so a microphone whose sole purpose is to cover tenors or a tenor soloist need not necessarily be flat to much below this frequency provided the response *falls* from there on reasonably smoothly. Similar arguments apply at the other end of the frequency range, and since many microphones start falling off in response soon after 10kHz anyway, it is not always necessary to extend the amplifier response much above this.

The amplifier to be described was designed with these thoughts, and cost, in mind. It was intended to provide floating inputs for 30/60 ohm and 300/600-ohm microphones using a cheap input transformer and with the rest of the circuitry less complex and less expensive as far as possible, while retaining facilities such as the phase switch and preset gain control that are incorporated in the BBC

PART TWO
MICROPHONE PREAMPLIFICATION

BY JOHN FISHER

FIG. 1

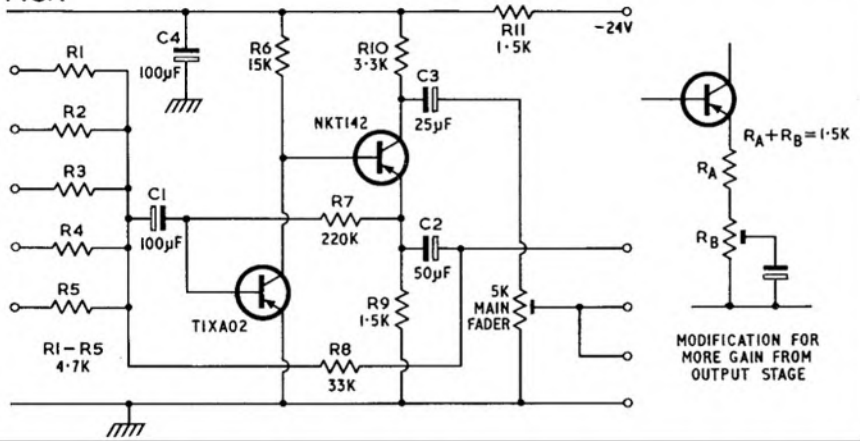


FIG. 2 SHOWING ISOLATED LOW IMPEDANCE CLEAN FEED OUTPUT FROM MIC AMPS

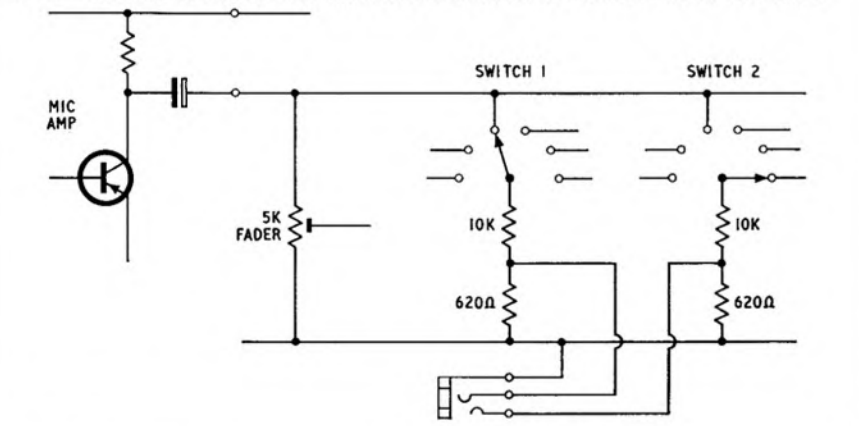
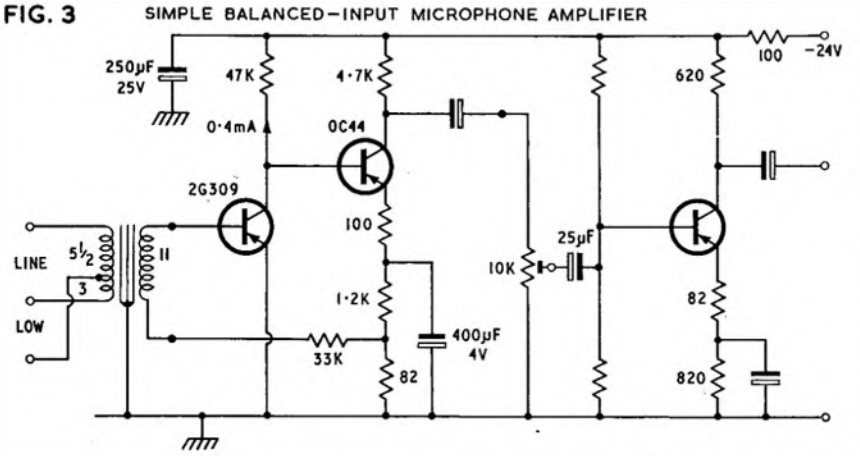


FIG. 3 SIMPLE BALANCED–INPUT MICROPHONE AMPLIFIER



amplifier. The circuit has been somewhat experimental in nature, but the results are quite reasonable within the limits set by economy, and one amplifier to this design has been in the mixer now for a while; no performance measurements have been made, but when used with an inexpensive moving-coil microphone the emerging sound is quite reasonable, which was after all the basis of the design philosophy for this amplifier.

This microphone amplifier again uses what will now be a familiar construction to readers (fig. 3), a DC feedback pair as the first stages, with the preset control and third stage conveniently borrowed direct from the BBC design, both because this makes the modules more easily interchangeable and because the output stage is basically simple anyway as well as reliable. There is no decoupling network around the first stage (as there is in the BBC amplifier) and, as in the group amplifier, there is no resistor in series with the emitter of the first transistor, with no apparent ill effects. The value of the collector resistor may appear a little high considering there is no AC feedback over this stage, but with the lowish level signals the amplifier gets from 'domestic' quality microphones—that generally have a lower output level than their 'professional' counterparts which, as a result of their price and/or size, can afford more efficient magnetic systems for a given frequency response—the non-linearity so caused is not serious. As the transformer to be used was not designed specifically for this circuit or particular loading, I felt it safer to avoid reducing the input impedance as both transformer and microphone are likely to be happy working into a slightly excess impedance. There is a small amount of feedback in the second stage due to the small undecoupled emitter resistor, to improve linearity.

The original transformer of fig. 3 was intended to provide inputs for low and line impedance microphones, but there is no reason why another type with appropriate turns ratio and inductances should not be used to cater for other impedances if these are required. The pin arrangement used on the plug of the prototype module is the same as that of the BBC amplifiers to allow the amplifiers and transformers to be interchanged should this ever be necessary, or desirable, for testing purposes.

The input transformer carries the bias to the base of the first transistor, a Texas 2G309 (this is a high-gain low-noise type with a high cut-off frequency and useful voltage and current ratings). The performance of this type makes it very useful in these microphone circuits. The collector of this transistor is DC coupled to the base of the second transistor, an OC44 (an equivalent such as the NKT 142 could equally be used), selected for high gain to make the small amount of feedback from the undecoupled emitter as effective as possible. The output passes to the standard preset gain control (miniature 10K pot) and from there to the third stage. The 2G309 operates at a collector current of approximately 0.4mA, and the second transistor at a current of about 2.3mA.

The input transformer needs to be something like the Gilson type described earlier, and of course this would work as well as any,

(continued on page 151)

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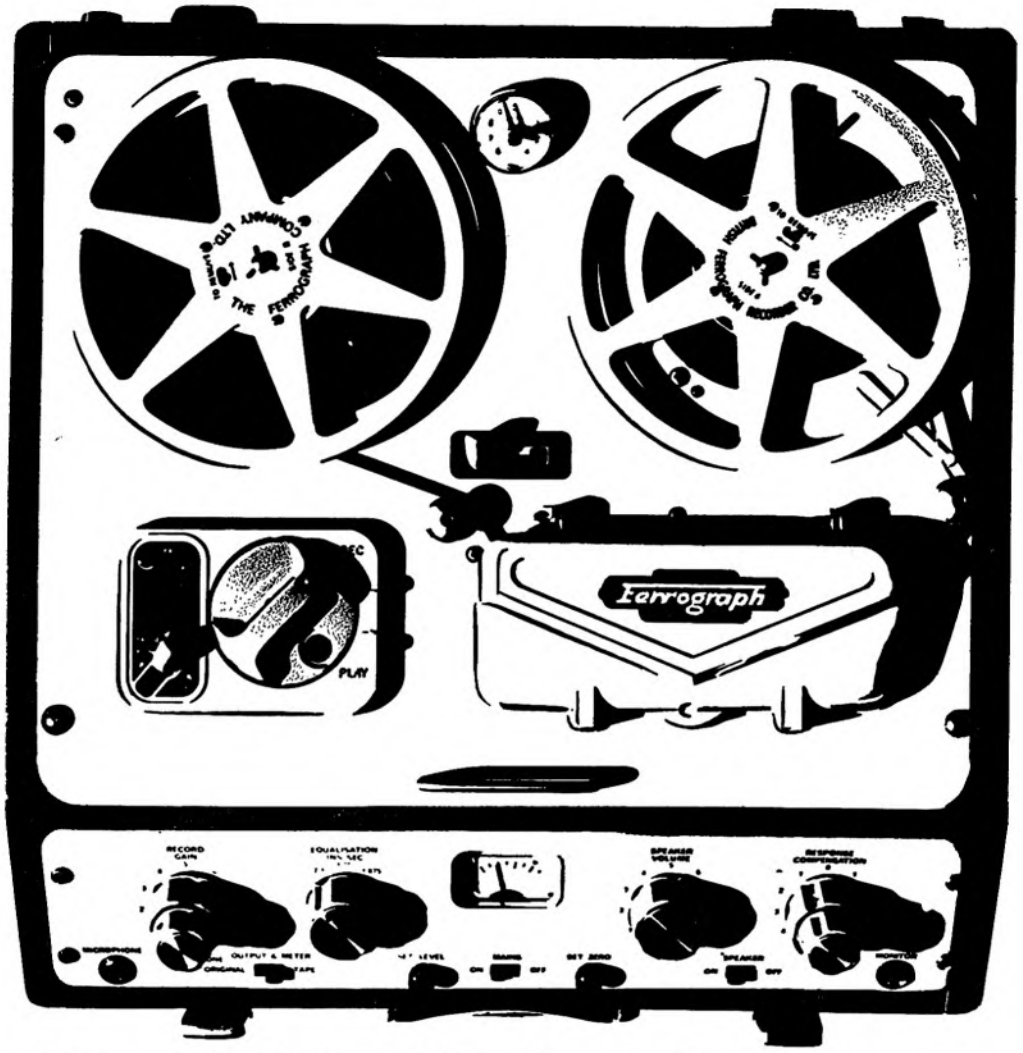

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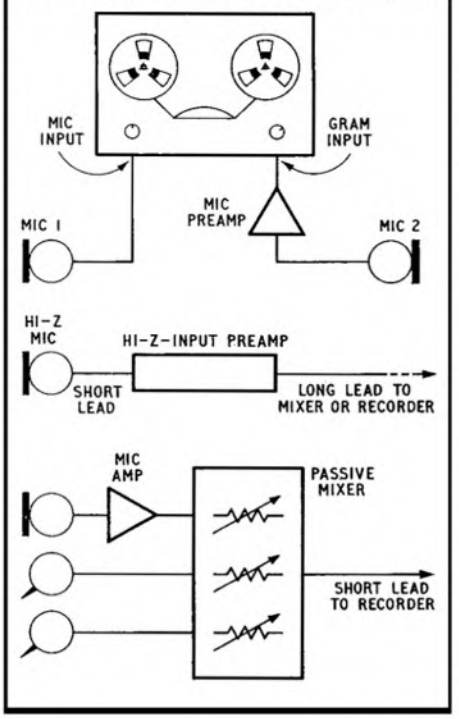
though one might feel more inclined to build the full BBC type if one is spending that much on the transformer; the prototype was required to work on something really cheap, and a 'surplus' one was obtained for a few shillings—it was a neat little potted type with a turns ratio of 3+5½:11 which is of roughly the same order as that in the other amplifier. In fact the transformer turned out to have a response that is sensibly level over the range 100Hz to 20kHz, when correctly fed and terminated—rather fortunate but not to be expected! As the base bias current of the first transistor is very low, the bias can be fed through the transformer without affecting its inductance and response.

It has been suggested that for a really cheap low-impedance input stage one could dispense with the input transformer and obtain the required input impedance—for an unbalanced input—by using a common-base stage or a common-emitter stage with feedback to the base of the input transistor. Indeed, several successful designs have been published and described in this and other magazines, and many more are probably in use; in fact the unbalanced input amplifier previously described has been successfully used with a moving coil microphone in this way. But these amplifiers lack the versatility of transformer input amplifiers, which can accept both balanced and unbalanced inputs with *correct* impedance matching at more than one available impedance more important, they also lack the hum cancelling properties of a properly connected balanced system. One can quite often get away with using an unbalanced feed from a low impedance microphone with no hum or noise problems, and there are a lot of people who do so regularly with no problems; however it is usually on the most important occasions that things go wrong, and generally balanced feeds are reckoned to be a safer if slightly more expensive bet. It would be possible to design a sort of balanced input amplifier using no transformer by utilising a 'differential' amplifier with the input to the two bases directly, but this might run into problems where the induced hum or noise currents were large as it would be possible for one transistor to clip while the other is still conducting, so that the balancing effect is lost (quite apart from the shift of transfer characteristic towards non-linear portions and the resulting harmonic and intermodulation distortions). This method could be made to work with a lot of care and effort, but unless one is keener on circuit design than on recording it is probably safer to leave well alone and stick to the usual method of using a transformer even in this era of transformerless circuits.

Another problem of transformerless circuits is that one loses the easy means of incorporating a phase change switch.

It is of course possible to use this microphone amplifier even if one does not intend building a complete mixer, by building the circuit in a small screened box, possibly as a self-contained unit working off batteries. The amplifier is quite flexible as to supply voltage, and the whole unit will function reasonably with a supply of 12-24V. As the third stage draws most of the current, a very economical microphone preamp could be built using the first two stages only; whether or not one would need the preset control would depend on the sensitivity and dynamic range of the following amplifier. These first two stages could be used with one of the small 9V batteries to form a compact little unit, or of course two batteries could be used to provide an 18V supply. The life of the batteries would be long with such a small drain, but the usual precautions should be taken against leakage and consequent corrosion. With reduced voltage battery supply the 100-ohm dropper resistor can well be omitted, but it might be a useful plan to retain the decoupling capacitor to prevent the performance deteriorating as the internal resistance of the batteries gradually builds up.

FIG. 4 MICROPHONE PREAMP APPLICATIONS



VERSATILE PREAMP

As **fig. 4** shows, a microphone preamp can be very useful, particularly if battery powered, even if one is not building a complete mixer. Several recorders have built-in mixing facilities for a high and low level source (for instance some recorders in the *Philips* range, and the *Brenell Type M*). A microphone preamp allows one to mix two microphones without using a separate mixer by feeding the preamp output into the high level input of the recorder and a microphone direct into the low level input; whether or not the third stage in the preamp is required depends on the sensitivity of the high level stage. Such a preamp can also be used when a good quality microphone having a rather low output has been purchased for use with a tape recorder supplied with a high output low quality microphone—quite often such recorders which are designed with a price in mind utilise cheap, peaky microphones because the extra sensitivity of the microphone means that less gain is required in the recorder, possibly saving one stage of amplification. In such cases there is sometimes just not enough gain available to get a decent recording with the better quality microphone. The microphone preamplifier can be the answer, as with care it can be made to contribute very little noise—less than the recorder microphone amplifier—and the microphone preamp output can be fed instead into the high level input or if necessary via a preset gain control (to avoid overloading the input) into the low level input.

If the recorder is not a very expensive type, the contructor may well find an 'economy' version of this preamp to his liking; owners of more expensive machines such as the Brenell mentioned earlier may prefer to 'go the whole hog' and build a self-contained version of the BBC microphone amplifier, particularly if there is any prospect of subsequently building a fully fledged mixer. If two high impedance microphones are to be mixed, the preamp could be the high impedance input amplifier previously described, although one would normally find it more useful to buy a low or medium impedance amplifier for use with an appropriate preamp so that the microphone lead can be extended.

On the subject of high impedance microphones, if one wishes to extend the lead it is worth investigating the possibility of removing the input transformer, as is possible on some moving-coil types without difficulty, to leave a low impedance output which can be fed down long cables to a transformer (the transformer removed from the microphone would do if enclosed in a screened can or metal box) or a preamp. If this cannot be done easily, one could feed the high impedance microphone into the high input impedance preamp and feed the output at a lower impedance down an extension lead to the recorder or mixer. This brings me on to yet another use of microphone preamps, at the 'wrong' end of the cable: instances have been known where the only way to overcome an obstinate source of noise pick-up in the leads of *low* impedance microphones was to connect a mike preamp close to the microphone and run the output at high level as well as low impedance, to swamp the pick-up. Fortunately one does not usually have to resort to such measures! There might be something to be said, however, for a system which had the microphone amplifiers *at* the microphones and relied on passive input stages to the mixer.

If this seems to have been rather a digression from the subject of the mixer, this brings us back; but it is hoped that it has been worthwhile to point out that the circuits have a wider application than just in integrated mixers. One more suggestion, for those who use one of the passive mixers available cheaply ready-made (by Brenell, *TSL* and others) for mixing high level high impedance signals, is that the use of a preamp would allow a microphone to be mixed in also and increase its usefulness. These passive mixers have the disadvantage, however, that having a high impedance output the cable to the recorder must be kept short to avoid pick-up of hum and noise in the connecting cable.

Next month we shall examine constructional problems of the various circuits that have been mentioned.

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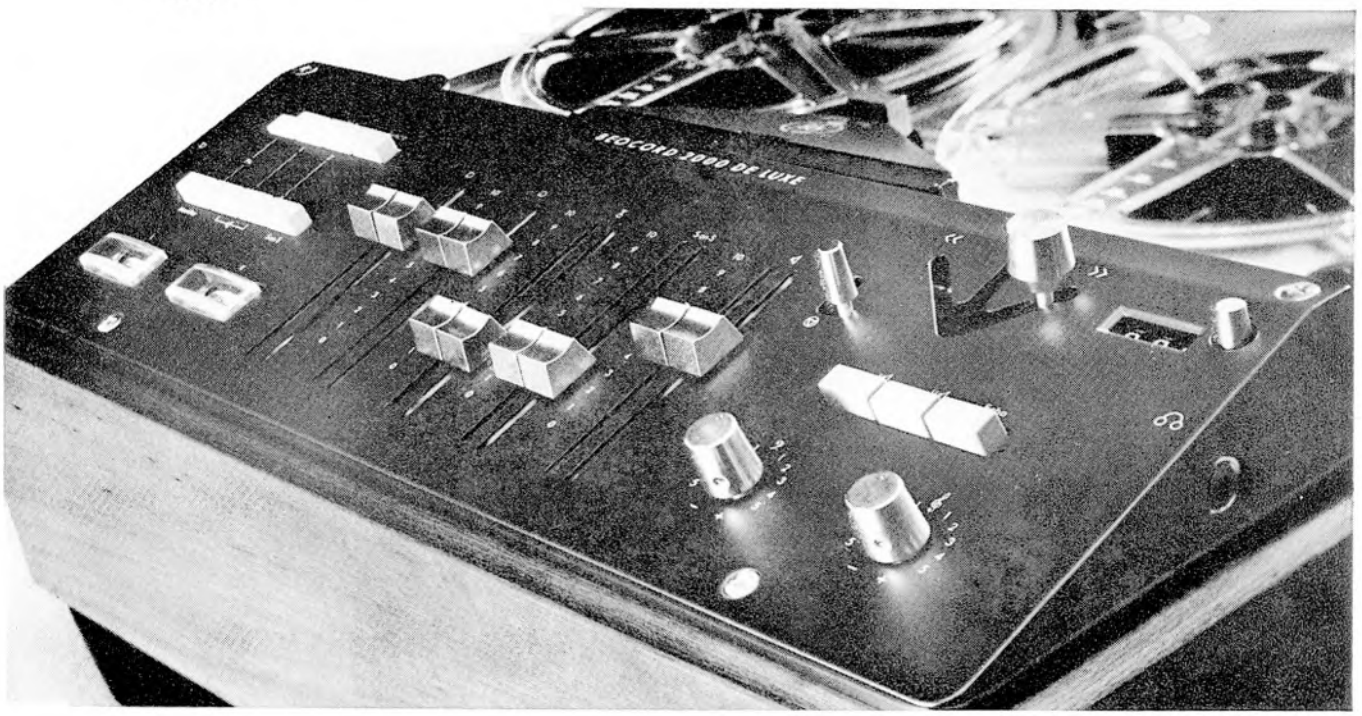

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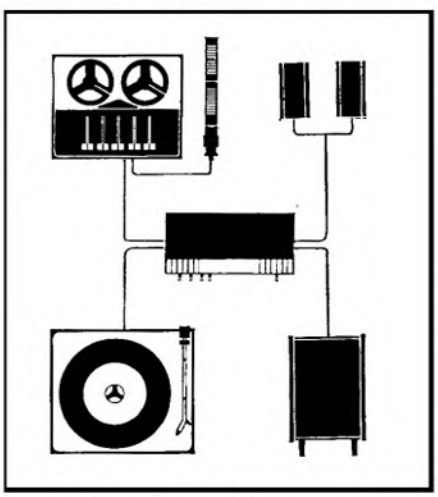

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ANTICIPATED FARE

A PREVIEW OF TAPE RECORDERS AND ACCESSORIES TO BE INTRODUCED AT THE AUDIO FAIR

LIKE the Motor Show, the *International Audio Festival and Fair* is traditionally the occasion when new models—new designs and 'improved' versions of existing designs—are revealed to the public gaze. The public will have rather less to gaze upon this year in the way of new models, *Brenell*, *Ferrograph* and *Revox* jogging along happily with their respective *Mark 5*, *Series 6* and *736* recorders. Even the fourth (bias) head added to the *Tandberg* sits on an unaltered version of that Norwegian deck. But more of this later.

The Audio Fair and Motor Show differ in one important respect: the latter is not normally accompanied, at least to our knowledge, by a string of smaller outside exhibitions. Opposite the Hotel Russell this year will be a display by *Mastertape* (*Magnetic*), who will be welcoming trade and public to view their products at the Morton Hotel.

A little further away at the Grand Hotel, Southampton Row, continuous demonstrations of *Heathkit* products will be given by *Daystrom*. No tickets are required for either of these displays.

A substantial number of additions are being made, this year, to the *AKG* microphone family. Although catering mainly for the professional user, the company have several low-price microphones to offer the amateur. One of the most popular is the *D.109* lavalier microphone which retails at £11.

Although rather dearer at £30, the *D.202* is particularly interesting in being the first microphone ever to feature separate moving-coil units for low and high frequencies. (A full description of its design appeared in the January *Hi-Fi News*.) The microphone is said to retain its 20dB front-to-back characteristic from middle frequencies down to the 15Hz region. The D202 has been on the market for some while, but will be shown alongside some complete newcomers, including the £6 *D.11D* stick cardioid and *D.110* lavalier.

Elaborating on the *K.50* headphones, AKG have developed an improved and more expensive *K.60*, a simplified *K.20* model being introduced at low price with a view to educational applications.

A four-speed transistor stereo recorder—the *X-2000*—is being added to the *Akai* range. Like the *X-355*, this model features cross-field bias and automatic mode-selection.

An automatic tape loading system, ingenious for its simplicity, will be visible in the *Ampex* room, where the *2100* and *1100 Series* will be demonstrated. The three-head 1100 features bi-directional playback, with automatic tape reversal, while the four-head 2100 also records in two directions. Guarantees tend to lose their meaning when a manufacturer offers to pay all service costs, within a given period, *other than* carriage, handling, labour and components; but the 2100 is covered by a one-year warranty that promises absolutely no charge for repair of faults. Pleasantly unequivocal.

For those who admire the basic Ampex but cannot afford the sophisticated reverse mechanisms, the *800* is offered at £127 10s. Silicon transistors, deep-gap heads, dual capstan drive and exceptionally low wow and flutter are features that put the Ampex 800 years ahead—whichever way one reads the technical literature!

Re-designed spool containers and a *Compact Cassette* are being introduced by BASF. The cassette follows the *Philips* design. A "particularly interesting" exhibit is planned, though no details have yet been given.

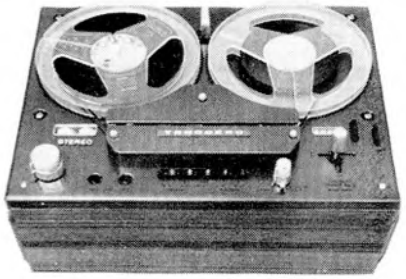
Most manufacturers have so engrossed themselves in designing 3¾, 2, 1⅞ and 15/16 i/s tape transports that they appear to have forgotten the advantages of 15 i/s. The myth has developed, over the last decade, that modern recorders are so near perfect at 7½ i/s that higher tape velocity is no longer warranted. Yet how many of today's under-biased recorders can offer the effortless treble obtainable from even a good disc recording? If any enthusiast believes the difference between 15 and 7½ i/s to be subtle, he would do well to listen to a Brenell. This long-established company stands alone in having incorporated a 15 i/s speed on every recorder it has produced. No new designs are anticipated at the Audio Fair, but the existing range of three mono and two stereo recorders will be demonstrated alongside the *Hi-Fi Tape Link* stereo tape amplifier.

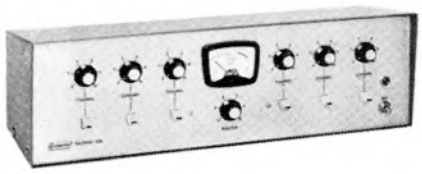
Light-action mechanical controls are a feature of the *TD20*, a deck recently introduced by *BSR*. Just how light, potential buyers can establish for themselves in the BSR room. Speeds are 7½, 3¾ and 1⅞ i/s—as on the *TD10*—selected by a rotary switch on the spool panel.

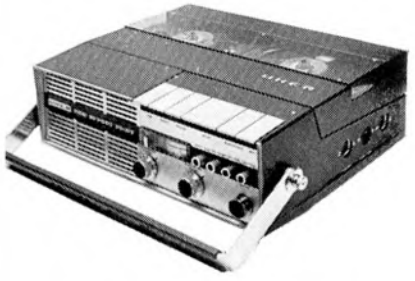
The *British Amateur Tape Recording Contest* has Audio Fair connotations, this year, the 1967 competition being opened formally at the Hotel Russell. Further details will be found on page 147 of this issue.

Canada HA10 headphones are being introduced by *S. G. Brown*, who consider these to be one of the best headsets of their kind available anywhere in the world. Frequency range is 20Hz—20kHz (30Hz—10kHz+3dB), with less than 2% Harmonic distorton and 130dB maximum acoustic output per phone. Ambient noise is 40dB down at 1kHz. The headset is supplied wired for binaural listening, and has a 2W power capacity per phone. Impedance is 8 ohms.

"A comprehensive book of audio circuits of interest to both professional and amateur high fidelity enthusiast" is being compiled by *Ferranti* for the Audio Fair. This will include a re-designed tape recorder, offering improved signal-to-noise ratio over the model demonstrated last year. Ferranti silicon planar transistors are employed throughout the various circuits in the book, which include high-quality preamplifiers and a 30W RMS power amplifier. (*continued on page 155*)







Photographs (from top): **Tandberg 64, Grampian 16/60 Mixer, Akai X-2000, Uher 1000 Report Pilot** and **Grundig TK245.**

Left: **Shure Unisphere** dynamic microphone

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Columbia TC-SCX3257

ANTICIPATED FARE

Apparently the only company who dare supply wow and flutter pen recordings with every one of their current range, *Ferrograph* will again be demonstrating their *Series 6* recorders. Centre-piece of the display will be the *632H*—a stereo tape unit with 1W single-channel monitor amplifier and speaker. Speeds are 15, 7½ and 3¾ i/s and the price is £138 12s. A standard version, with 1⅞ i/s replacing the 15 i/s speed, is available at £132 6s.

Microphones, reverberation units, a windshield, a parabolic reflector, and a range of active and passive mixers will be displayed by *Grampian*. Very active indeed, the versatile *16/6* mixer incorporates six channels, with independent switches and rotary gain controls, plus a master fader and output level meter. The less elaborate four-channel *18/4* mixer/control unit will also be displayed.

A ¼-track stereo recorder with manual and automatic gain control has been added to the *Grundig* range, and will be displayed alongside a mains-powered *DCI* cassette machine. The stereo *TK245* operates at 7½ and 3¾ i/s and has most of the features of the larger *TK340*, including off-tape monitoring. Also being exhibited is the *TK220*, a ½-track mono machine with 7in. spool capacity. Like the TK245, it has manual and automatic gain control.

Insert the product of an American manufacturer in the conception of a Dutch designer and you have, for what it is worth, a *Scotch* version of the *Philips C60* cassette. Low dropout, good frequency response and above-average tape life are claimed for the tape employed. Also on the *3M* display will be *Dynarange* tape, said by 3M to have been recommended by Ferrograph, Tandberg and Akai for use on their equipment. A self-threading reel operating on centrifugal-force principles is to be shown.

Mono and stereo recordings made "under domestic conditions" with low-to-medium-price recorders will be played by *Sennheiser*. The recently-introduced *MD411* triple-impedance microphone will be demonstrated in this fashion.

A new series of *Unisphere* microphones have been introduced by *Shure*, based on the *Unidyne* cardioid dynamic range. A wire-mesh spherical shield is claimed to give excellent protection from wind and breath noise, rendering the series particularly suited to close-speech.

Demonstrations of *Sony* equipment will commence at fifteen minutes to each hour, machines to watch for being the Sony *250* and its 'big brother', the *350A*. Both are preamps-only stereo tape units, with headphone monitoring facilities, the 250 having a combined record/playback head at £59 17s. while the 350A offers A-B monitoring at £78 15s.

STC will be both recording and replaying tapes, using three microphones representing the low, middle and high-price ranges. The subjects will be piano pieces played by two members of the Trinity College of Music.

Cross-field bias receives the backing of no less a company than Tandberg, who have added a fourth head to their highly-reputed Series 6 range. The ¼-track *64X*, to be followed in due course by a ½-track *62X*, has a claimed frequency response of 30Hz—20 kHz ±2dB, and 62dB signal-to-noise ratio. Multiplex filters cease to be optional on the new marque, being fitted to the inputs of all 64X models. The filters can be bypassed by feeding through auxiliary inputs.

The *British Kinematograph, Sound and Television Society* have prepared a series of demonstration recordings made by Terence Long on a *Philips Pro 20* at 15 i/s and copied on to ½-track *Revox 736's* at 7½ i/s. The tapes are being made available to exhibitors and simulate the quality that can be attained under domestic conditions. If the exercise makes its point, we can expect the wares of many manufacturers to be demonstrated alongside 736's. Revox are exhibiting in Room 118 and the BKSTS in Room 343.

With the *Bradmatic* out of the running, a substantial gap has been left in the field of semi-professional tape decks. A company endeavouring to cater for the advanced amateur and for industry is *Tape Recorder Developments*. The *TRD 1* was announced some twelve months ago, and we are informed that 75% of the first year's production has been exported. The basic deck is solenoid-controlled and costs £80 17s. Various speed configurations are offered, the standard model being 15, 7½, 3¾ and 1⅞ i/s, 30 i/s being offered at the expense of 1⅞ i/s or 1$\frac{15}{16}$ in place of 15 i/s. A ¼-track version employing ½ in. tape is to be demonstrated through a silicon-transistor tape amplifier.

Truvox have a sound design in the *PD100* mechanism and are sticking to it. While the deck remains as before, however, the electronics are now complimented by silicon transistors, an improvement reflected throughout the *Series 100* range. The £115 10s. stereo tape units and, "time allowing", the £49 7s. *Series 40*, will be demonstrated.

A full-track 7½ i/s four-head version of the *4000L* battery recorder will be shown by *Uher*. The *1000 Report Pilot* permits precise synchronisation of sound and film. Pilot oscillator, rumble filter and A-B monitoring facilities are incorporated, along with a switchable photo-electric automatic gain control. This machine was first shown at a trade exhibition last autumn but no price has yet been announced. Other models on display will be the Uher range of mains stereo recorders.

Potential export markets will be prosecuted actively by *Wilmex* and *Williman* throughout the Audio Fair, the products of various manufacturers being displayed for the benefit of overseas trade visitors.

The Audio Fair will be open to ticket holders from 4 to 9 p.m. on Thursday 30th March, 11 a.m. to 9 p.m. on Friday and Saturday, and 11 a.m. to 8 p.m. on Sunday 2nd April. Access to the Hotel Russell is most conveniently gained by Underground, at the Piccadilly Line station Russell Square. A somewhat rickety-looking lift meets the surface within sight of the Hotel.

Tickets for the Fair are obtainable free from most audio dealers but, in cases of difficulty, may be requested from our Croydon office. A stamped addressed envelope must accompany all requests for tickets, and it is important that these are not combined with matters requiring separate attention.

TRADE NAME	BOOTH	EXHIB. ROOM
Acos	43	449
Agfa-Gevaert	40	—
Akai	—	319
AKG	14	302
Allan, Richard	—	48
Amateur Tape Recording	39	—
Ampex	—	536
Arena	7	215
Armstrong	45	538
Audio & Design	64	121
Audio & Record Review	—	155
Audio Technica	26	318
Bang & Olufsen	54	322
BASF	33	234
Beyer	65	313
BKSTS	—	343
Braun	63	312
Brenell	30	304
Brown	46	317
BSR	70	218
Celestion	5	204
Connoisseur	71	145
Decca	—	236
Design Furniture	—	104
Elcom	56	249
EMI	32	147
Fairchild	52	220
Fane	21	213
Ferguson	20	222
Ferranti	59	120
Ferrograph	38	134
Fi-Cord	66	311
Fisher	—	115
Garrard	48	247
Goldring	41	334
Goodmans	49	434
The Gramophone,	—	153
Grampian	58	151
Grundig	19	534
Hi-Fi News/Tape Recorder	35	152
High Fidelity	60	—
HMV	27	—
Jordan Watts	25	221
KEF	31	442
Leak	34	348
Linear	19a	—
Lowther	—	404
Lugton	—	246
Lustraphone	15	342
MB Mikrofonbau	37	217
Miniconic	17	—
Mullard	—	211
Ortofon	8	117
Parmeko	51	219
Philips Hi Fi	10	337
Philips Tape Recorders	11	336
Pioneer	—	111
Quad	67	504
Radford	—	448
Radionette	36	—
Rank Wharfedale	72	502
Record Housing	62	140
Records and Recording	50	—
Rectavox	13	349
Revox-Studer	42	118
Rogers	61	402
Sansui	73	314
Sonotone	22	321
Scotch	23	242
Sennheiser	29	114
Shure	44	447
SME	57	—
Sony	74	112
STC	—	202
Stereosound	9	214
Tandberg	18	212
Tannoy	68	547
Tape Recorder Developments	69	315
Tape Recorder Spares	69	315
Tape Recording Magazine	—	154
Telefunken	16	542
Thorens-Franz	28	—
Truvox	12	248
Uher	47	122
Vortexion	—	149
Whiteley	6	237
Williman	—	244
Wilmex	—	346
Wireless World/Electrical and Electronic Trader	55	—

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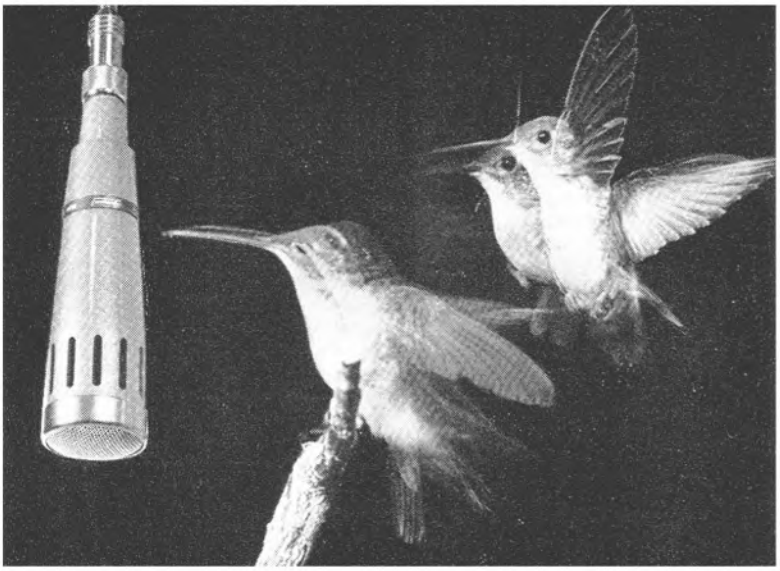

in the field

PART 1 SINGING TO THE BIRD

BY PHILIP RADFORD

MOST of us associate springtime with the singing of wild birds. Poets of all eras have written on the subject and now interested naturalists use portable tape-recorders to record the sounds. Cock birds, usually more brightly coloured than the hens, acquire their best plumage at the start of the breeding season as daylight increases. Biologists tell us that birds' endocrine or ductless glands increase their activity at this time and male birds get attached to a particular territory. It is at this stage that song develops; it serves to attract and keep a mate and to maintain the territory. The pair will, in the main, feed and raise their brood in that area.

Man has long known that bird-song lures and excites other birds of the same species. Thus, Axel Munthe wrote sadly of the netting and capture of birds on Capri. These were birds passing on spring migration and drawn by the singing of blinded decoy birds. Happily the practice is now illegal, but probably the playback of suitable bird-song recordings would be as effective a decoy.

That a male song-bird resents any other similar bird singing in its established territory can be observed readily by a recordist. A cock Chaffinch, for example, is a common and ardent singer during April and May. Playback of its song within its territorial boundaries in the nesting season usually brings the bird in rapid flight to a nearby vantage-point. His slate-blue crest is raised in annoyance and the pink breast made prominent. Song is rattled out and repeated in vigorous cascades. The response fades after a few minutes and the bird either loses interest or alarms at the presence of a human intruder. Further playback usually restarts the song. Should a similar recording be played in autumn or winter no Chaffinch pays any attention.

There is great variety in the character of bird-song. The Chaffinch song mentioned is a musical and rattling utterance; it contrasts completely with the continued churring notes of Nightjar or Grasshopper Warbler to which I will refer later. However, they are all territorial songs which originate in the cock bird's vocal apparatus. In view of the importance of this apparatus to the recordist, perhaps it would be advisable to consider briefly how birds produce their sounds, and their physical nature.

Birds differ from humans in that song is produced in the syrinx. This is a bony box situated at the lower end of the trachea or wind-pipe and at the junction of the two main bronchial tubes. Inside the syrinx there is a free semi-lunar membrane; also, and probably more important, there are two pairs of tympanic membranes, external and internal. The tensions of the tympanic membranes may be altered by the actions of muscles. Vibrations are set up in these membranes by air exhaled from the bird's air-sacs. The trachea and its column of air above the syrinx has a resonant effect, this can be modified by muscles acting externally.

By comparison, sound production in man comes from the larynx. This box is at the top of the trachea; it contains two vocal-cords (or folds) which vibrate as air passes over them during speech. Their tensions can be altered by muscle action and resonating-chambers are provided by the mouth, throat and nose cavities. The sizes of the resonating hollows are modified by tongue and lip movements.

The sound-waves caused by membrane vibrations in the bird's syrinx, then, are those which the bird recordist wants to get fixed on his magnetic tape. Having done so, playback converts the tape's magnetic currents to sound energy. This is effected by the playback head; the energy is transmitted to the playback amplifier and hence to the loudspeaker which results in the production of sound-waves which are radiated to the listener. I suggest that a recordist with some understanding of the theories of bird-song, both biological and physical, is likely to get better recordings in the field. Certainly interest is increased.

Now the sound-waves of bird-song can be analysed further by the use of the sound spectrograph. This instrument allows a measurement of the frequency of sound in kiloHertz plotted against time in seconds. The resulting 'graph' is called a sound spectrogram and at present is used mainly in research into the nature of bird and other natural sounds.

Studies of sound spectrograms show the variability of sounds which can be made by birds. Thus, it has been demonstrated that two or even more notes can be produced by some birds at the same time. In this country the sound spectrograph has proved that a singing Reed Warbler may emit two sound frequencies simultaneously. Also, evidence given by sound spectrograms has shown how inexact is the representation of bird sounds by human words. For instance, the call of the Chiffchaff cannot really be expressed as "chiff-chaff, chiff-chaff". Similarly, a Great Tit does not really say "teacher, teacher". And so it is with most birds which are said to 'talk', such as Budgerigars. Yet, uncommonly, some birds can imitate human speech. Examination of spectrograms of some Indian Hill Mynahs has shown similar sound patterns to that of man.

A territorial song which has always fascinated bird-watchers is that of the Grasshopper Warbler. This is a small, inconspicuous and streaked brown bird. It usually arrives in this country in April or May. When singing it is often hidden in undergrowth; it can run, mouse-like, at surprising speed through dense bush or herbage. The male's song is an enigmatic, mechanical reeling. Gilbert White, in the 18th century, described the song. He told how country people would laugh when it was said that the sound was made by a

(continued on page 161)

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3 + 3W ,, AMPLIFIER S-33	£13 7 6	£18 18 0
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COMMENTS OF A COMMENTATOR

an interview with Keith Macklin

BY JOHN ASHCROFT

KEITH Macklin is well known, particularly to Northern BBC viewers and listeners, for broadcasts ranging from sports commentaries and topical TV magazines to the Home Service half-hour of hospital record-requests, *Just What the Patient Ordered*. This interview was arranged on behalf of the Merseyside Tape Recording Society, but the results deserved wider circulation. The views expressed are of course Mr. Macklin's own, and are not necessarily statements of official policy; but they might provoke second thoughts among those amateur recordists who frequently claim that "the BBC just doesn't want to know . . ."

J.A. Starting with a personal question, Keith . . . did you have the traditional shock on first hearing your own voice from a tape?

K.M. Oh yes! I thought, like everyone else, "Is that *me*?" Because you hear your own voice in some way distorted by the bones of the head, you never know quite what you sound like. I'd thought I had a rather baritone voice, and I found it was more . . . well, somewhere between baritone and tenor.

J.A. But your voice—on the air, over the 'phone, or heard 'live'—always sounds pleasant, casual, and relaxed. Have you always had this advantage, or is it to some extent a style that's been developed, consciously or otherwise, during your BBC work?

K.M. Broadcasting is like everything else: you must work at it to do it successfully. People early on told me I had a pleasant voice, but I used to listen to tapes of my Rugby League commentaries and when the match got exciting I used to go up almost to falsetto, which isn't very pleasant. So, over the years, I've cultivated the habit (if this doesn't sound too prissy and pompous) of taking the breath with which you form words further back into the throat, which produces a deeper sound.

But otherwise my voice is my own . . . I'm talking to you, now, the way I talk to my friends, to my wife and kiddies at home—I'm not putting anything on. And if, as you say—and thank you for saying it!—I have a pleasant manner, this is purely and simply because temperamentally I'm an easy-going, casual, happy-go-lucky cuss who can't be anything else.

J.A. Despite your experience in radio and TV, do you ever feel nervous at the start of a live broadcast?

K.M. It rather depends on the broadcast and the degree of responsibility involved. I don't mean that all broadcasts don't have a degree of responsibility, but take for instance the Rugby League Cup Final at Wembley. I do a sound commentary. I enjoy the game, I think I can say with all due modesty that I know the game sufficiently, and short of collapsing or having a heart attack nothing could really go wrong. But if . . . this is highly unlikely . . . if I were thrown into a Coronation, or a State Opening of Parliament, where there's an immense degree of responsibility and one has to retain some sort of establishment status, I think I'd be rather nervous before that!

J.A. Turning to tape topics . . . I believe even the BBC considers 7½ i/s adequate for most purposes nowadays?

K.M. Oh yes; I've been using various types of tape recorders since I first broadcast for the BBC nine or ten years ago, and I've never recorded at other than 7½—oh, we did use fifteen once, but it was by accident and I was mildly ticked off for it. Engineers, reporters and editors work to 7½ nowadays.

J.A. In field recording, there's always the risk of recording *over* something else—which, according to Finagle's Laws, is bound to be irreplaceable. And the best equipment can go on the blink, usually at the worst possible time. Have you had any bad moments from such causes?

K.M. Often! I think I've had every disaster that can befall anyone doing tape recording. I've come back with what I thought was a good interview, and one track on the tape has been in complete conflict with the other. As you know, English played backwards sounds like Polish, and I've had someone talking Polish conflicting with me talking in English, and it's a terrible mess. (*Presumably turning the tape over and absent-mindedly trying to record a second track on a no-erase single-track portable such as the earlier professional E.M.I.!* —J.A.) I've had the recorder running too fast, so that you get a slow drunken slurring; I've had it running too slow, so that you get the Pinky and Perky effect . . . as I say, I've had *everything* happen to me, and there's nothing more embarrassing than saying to your interviewee "That was a very good interview, let's play a bit of it back," and out comes a garbled high-pitched twittering noise!

And I had one terrible moment some years ago, after interviewing a foreign Prime Minister on Lime Street Station. This I think was clumsiness on my part; I can't have wound the spool too well, and the tape slowly wound itself underneath and tangled and twisted and tore, and a fifteen minute interview must have been recorded at varying speeds, I imagine, from 2½ to 150. I had to go and find this very decent gentlemen and say: "I'm terribly sorry but I've made a pig's ear of the recording—would you mind doing the interview again?"

J.A. With modern equipment, many amateurs can make recordings which, technically at least, might be suitable for certain broadcast purposes. Do you think amateurs will ever be able to submit their own recordings to topical magazine programmes, rather as freelance writers send articles to newspapers and printed magazines?

K.M. Certainly. This is true even now, and many amateurs don't realise this. But there are a lot of snags. An amateur could send in a recording which was technically perfect, no extraneous noise, right gain and everything but this is not the important thing when submitting to a news and current affairs organisation such as the BBC.

First and foremost, the subject must be interesting, and it must be professionally treated. An amateur could come across a first-class story . . . the town hall burning down, or a smash-and-grab robbery . . . and record an interview on the spot, but if he was such a complete amateur that the interview was clumsy and inept, it would not be accepted. Of equal importance to being *there*, and having the equipment, is some knowledge of how to conduct an interview and get the right answers—in other words, as well as technical ability you need journalistic ability.

J.A. But surely, if an amateur came across something possibly historic, a real 'sound scoop' if I can use the term, the BBC would rather have a bad recording than *none*?

K.M. Well, yes! I'm trying to think what might happen . . . the BBC has offices around the country and can get to most places very quickly . . . but supposing there was a terrible crash (Heaven forbid!) at the local airport, and one of your chaps happened to be around and interviewed a survivor, I should imagine something like this could get on. Unless the person was too shocked to speak, he'd almost certainly say something dramatic and emotional and moving, and probably the BBC would take the survivor's replies and dub over a reporter's questions.

J.A. All around the country, individuals and clubs are compiling local 'sound archives.' Obviously they can't compete with the abilities and facilities of the BBC staff, but do you think this is a worthwhile activity?

K.M. It *is*. Local people can contribute archives of priceless value to their community, and I'm sure city and county librarians would be delighted to give every support. The BBC, being a national body, can't identify itself with any town or city or region. Archives are wonderful things—to hear sounds and voices

(*continued on page 161*)

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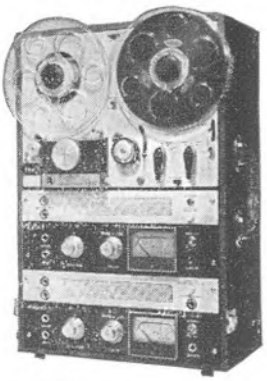

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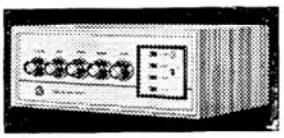

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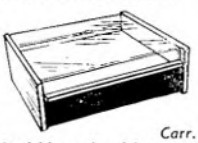

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from the past, I personally find fascinating, and local people would obviously sooner have local sounds and voices than something national.

J.A. If, in the course of such work, an amateur or club recorded something that might be of general interest, would there be any point in offering a copy to the BBC for programme or archive use

K.M. I think so. Your questions have a certain diffidence about them, as if the BBC puts up a great brick wall labelled "Trespassers will be sat on." This is not the case ! If anyone, of any age, shape, nationality or denomination, gets hold of something really interesting, he's perfectly at liberty to write to a BBC producer, or Controller of Programmes, and ask for it to be considered—and if it really is of outstanding value, there's a jolly good chance that it *will* be considered.

J.A. But with the Sound Archives, particularly, the problem nowadays is not so much collection as *selection*.

K.M. Oh yes. Over the years, thousands upon thousands, in fact millions, of feet of tape are recorded on one subject or another, and selection is the hardest thing. Obviously you're going to keep the sound of the Archbishop of Canterbury at the Queen's Coronation, and possibly throw away an impressionist imitating a frog.

But selection is certainly the hardest thing, and I should imagine that of every hour or more of recording only ten or fifteen minutes will ever be kept, and not then for posterity—possibly for twenty or thirty years, before it is replaced in turn by fresher 'archives'.

J.A. The spread of amateur recording has made the public more familiar with microphones and techniques than ever before . . . but, to many people, a microphone is still a diabolically disconcerting thing to have popped under one's nose. Can you give any simple, basic practical advice to amateurs on how to put people at ease and conduct an interview, especially on location ? I know it's a tall order on the spur of the moment . . .

K.M. It *is* a tall order ! There are so many different techniques. Some people don't mind being interviewed ; others panic—they turn pale, and run. I find that stopping someone for a moment and explaining who I am and what I want helps to put him more at ease. The 'snatch' interview isn't always successful—three out of four flop. If you rush into the street and grab hold of somebody and ask him : "What do you think of the Selective Employment Tax ?" he'll look at you blankly and say : "Eh ?" and "Who are *you* ?"

I think the thing to do is stop someone, politely, and say : "I'm sorry to trouble you, but we're such and such a club, we're making recordings about such and such a topic, and we'd like to ask your opinion of so-and-so . . . would you mind helping us, please ?" You'll find that nine out of ten people give you a straight answer—they'll say "Sorry, I've got a train to catch," or "No thanks", or "Certainly, provided it doesn't take too long." The 'snatch' interview is wrong ! I think politeness, putting people at their ease—oh, and when you go out, don't approach people with a microphone in your hand !

Go up to them first without a microphone, and get their cooperation, and *then* produce the microphone. Equipment can frighten people . . . they wonder if it's BBC, ITV, your own Society, or whatever. So do it politely, and talk to them first, and put your case to them simply and clearly.

J.A. For outside work, do you enjoy the freedom and comparative mobility that can be gained using a radio-mike ?

Yes, I've used radio-mikes and I like them. Some years ago, for instance, at the Rugby League Cup Final at Wembley, I did 'live' interviews with the two captains on the field just before kick-off . . . and there's a certain thrill using radio-mikes, because they're associated with 'live' outside-broadcasting which is the most exciting of all work.

J.A. And you're not hampered by lugging a machine and flex about with you . . .

K.M. Yes, and someone else is operating all the controls. The thing I hate about recording is all the knobs and switches that have to be pushed and so on : I'd rather someone else did that, because quite frankly I'm not a technician.

J.A. Have you a recorder at home, or would that be a busman's holiday ?

K.M. I have a *Fi-Cord* but I don't often play it for pleasure. My eldest child, Heather, who's four, likes me to put it on so she can twitter into it and hear her own voice ; but I get so used to recording professionally that quite honestly it's like a man who makes sausages for a living going home and his wife putting sausages in front of him.

J.A. I see your point ! And thanks very much, Keith, for giving such an entertaining interview.

K.M. It's a pleasure—I only hope none of it makes me sound too much of an egotist, which is something I detest . . . and I hope your members find something of interest in it.

(They certainly *did*—**J.A.**)

IN THE FIELD CONTINUED

bird; also he pointed out the difficulty of localising the position of the singing bird. While the song resembles the sound of a fisherman's reel, the sound spectrogram has demonstrated that the song has about thirty triple sound pulses per second.

This strange ventriloquial churr maintains the Grasshopper Warbler's territory in the same way as the musical song of the Chaffinch. I had a demonstration of this last May when I recorded a singing Grasshopper Warbler on a heath. The bird was reeling from undergrowth at a distance of about 18 yards; it remained unseen as twilight developed. On playback of the recording it responded by vigorous reeling for about ten seconds. Then it flew rapidly towards the tape-recorder and myself, reeling continuously and passing within a yard. For a bird not often seen in the open, I was amazed that it should sing so strongly in flight. It flew to a hedge about eight yards behind me, only stopping the song on reaching it. After a few seconds it flew back to the original singing area, again reeling during flight and with the intensity increasing as it neared the tape-recorder. The process was then repeated.

It was evident that the bird was singing in flight as a response to a song similar to its own, in this instance its recorded voice. However, it can probably be assumed it would have behaved in the same way at that time if a male of its own species had sung in the territory. Quite how this small bird could continue a loud reeling song while in active flight is a puzzle to me.

A week later I taped a very different type of song, given by a Yellowhammer. He repeated the familiar "little bit of bread and no cheese" rhythm from a perch on the top of an elder bush. On playback, the attitude of this brightly coloured and confident bird changed. Like the Grasshopper Warbler, he resented any other similar song within the boundaries of his territory. Who would dare to sing on his land, near his hen and nest? He swooped towards the revolving tape-spools, then settled on an adjacent tree. Several bursts of song were uttered and he descended to a clump of brambles, displaying his rich rufous rump and white outer tail-feathers. Alarm notes were given from this cover before the bird flew up to his original elder bush to sing the same cadence with even more vigour.

A bird resembling the Grasshopper Warbler in having a song which could be produced by mechanical means is the Nightjar. Also, both birds are spring migrants and come to breed in this country. The Nightjar's song, well-known to any bird-watcher, is made at night and is a vibrant churr which may last for several minutes without an interval. Usually the male Nightjar sings perched on the branch of a tree; playback of its song stimulates it to increased amplitude of sound and often it moves closer to the tape-recorder. I have never heard it churring during flight as with the Grasshopper Warbler, but it has a curious courtship flight associated with wing-clapping ; wings are clapped, I believe, above and below the body. Noises of this wing-clapping can make a tape of great interest to the naturalist or the student of sound-recording. Playback of wing-clapping has evoked no response from Nightjars that I have observed, although I have only tried it on one occasion. Possibly the volume of sound was insufficient to give effective stimulation.

It seems clear, however, that in springtime male birds dislike the sound of any similar song in their home area. Presumably, if they do not behave in an aggressive way another cock will usurp the territory. One may imagine that a female will have a poor opinion of a mate who does not respond to intrusion by another male by attempts to evict him.

To an enquiring naturalist, the use of a portable tape-recorder is invaluable to study birds' reactions during the breeding season. It is a new method of investigation and can show the variation of response to playback at different phases of the breeding cycle. Also, the influence of changing climatic conditions and the time of the day can be noted. Such observations are of great value to an ornithologist.

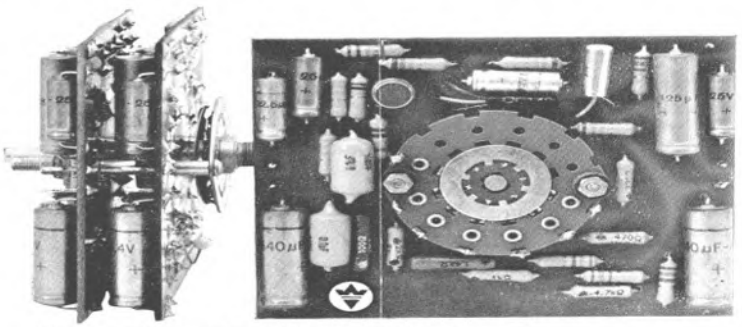
Playback of the same songs by the comfort of one's fireside during winter storms is pleasing and evocative. Humans rather than birds may be expected to react here: bird-song of the spring to come is anticipated and tape-recorders prepared for action.

THE MINIFLUX UNIVERSAL TAPE AMPLIFIER *

A SURVEY of manufactured high quality preamplifiers, both valve and transistor, indicates a complete lack of interest by designers in providing correct tape head input facilities. Nearly all the preamplifiers that have been examined provide a single medium-sensitivity input marked TAPE. Some of the circuits include an equalisation characteristic corresponding to 100μS for 7½ i/s (this time-constant has now been out of date for several years) whilst other circuits appear to rely on their tone controls to obtain a degree of variable equalisation which in practice can never be achieved with certainty.

It is clear that there is a requirement for a high quality universal tape preamplifier which is capable of equalising correctly all past and present recording characteristics for the standard tape speeds. This article will describe a suitable circuit which was basically designed in 1964 for industrial applications and has since then, apart from changes in transistor types, provided very reliable service under professional use in studios. Each design step will be examined and briefly discussed.

The table shows the variety of past and present standard equalisation time-constants used for tape speeds from 1⅞ i/s up to 15 i/s. From this it can be seen that unless the origin of a 7½ i/s pre-recorded tape is known it may require equalisation according to 100μS, 70μS or 50μS, with or without a low frequency roll-off at 3180μS and unless the reproducing equipment is capable of providing such a range of time-constants one is unable to know whether the reproduced recording is being given its correct interpretation. In addition to the set equalisation standards, a further high frequency correction will also be necessary. Such correction, which is located near the upper frequency limit of each curve, is unspecified and is dependent mainly upon the replay head's gap length. The curves A to G in **fig. 1** (see also *Ref. 1*) shows the unequalised replay responses obtained from the indicated standard test-tapes. The curves have been normalized about the low frequency scale and were obtained from a master replay head having known characteristics and a gap length of three microns. The curves indicate that according to modern replay head designs the degree of top lift for full compensation is relatively small and can be met in practice by tuning the head to resonate at a frequency just beyond the frequency limit. This has the advantage not only of increasing the head output EMF, but also provides an early decoupling for HF bias when the replay circuit is in simultaneous monitoring operation during recording.



Tape preamplifier mounted on Miniflux printed circuit board.
Note ganged arrangement of stereo version.

Turning now to circuit design, the combination of a magnetic head feeding into a transistor gives rise to certain problems which, unless thoroughly investigated and solved, can result in a very poor amplifier signal-to-noise performance. However, it can be categorically stated that, provided certain circuit conditions are optimised, the combination can give far better results than the best thermionic valve circuit. The term 'amplifier signal-to-noise ratio' is intended to mean the difference in level between that obtained from a recorded tape signal at maximum modulation level (usually indicated OdB on the VU-meter) and the noise of the system when the tape is stopped; thus this term excludes the 'dynamic' or 'operating' signal-to-noise ratio which compares a previously recorded signal level with the noise level obtained when the tape is subjected to an erase operation followed by the unmodulated bias field of the recording head (i.e. as is obtained during a silent passage in recording). Such operating signal-to-noise ratios are totally dependent on the quality of the recording and the tape and are therefore outside the scope of preamplifier design. All that one can do in the replay circuit is to ensure that the amplifier's signal-to-noise ratio is as high as possible.

In a preamplifier almost all the noise is attributable to the input stage, and the first transistor's noise behaviour has to be controlled carefully to ensure the best possible final signal-to-noise ratio of the entire playback chain.

The typical noise spectrum of a germanium transistor is shown in **fig. 2.** The level portion, extending from just about 1kHz to nearly 1mHz, shows an even distribution of 'white' noise, which if measured at a spot frequency within these confines will indicate a noise factor (N.F.) of about 5dB. With increasing frequency the N.F. increases with the fall-off of transistor gain, but since this is outside the audio band it can be neglected. At the other end below 1kHz there is an increase in noise component that is inversely proportional to frequency and which is commonly referred to as LF noise. Now, bearing in mind that the equalising characteristics of the preamplifier will require a gain increase of up to 40dB at 30Hz, it is obvious that unless the rising $\frac{1}{F}$ noiseis not controlled there will be considerable difficulty in maintaining an adequate signal-to-noise ratio.

Fig. 3 shows that the $\frac{1}{F}$ noise region can be severely controlled by the transistor's collector current (Ic) and it is seen that a change of Ic from 1mA to 200μA has not only greatly reduced the N.F. at low frequencies but has also lowered the frequency of the starting point from about 6kHz to about 150Hz, and furthermore the 'white' noise portion at the higher audio frequencies shows a welcome overall lowering of about 1dB.

It is true that the noise at very low frequencies of about 20Hz and below may be outside the audio range, but its presence in a system may not only give rise to intermodulation effects but also makes serious measurement

*This article is contributed as a "Technical Communication" by *Miniflux Electronics Ltd.*, 8 *Hale Lane, London, N.W.*7, owners of the *Miniflux* trade mark. The 88 x 100 mm. printed circuit board is available from this address.

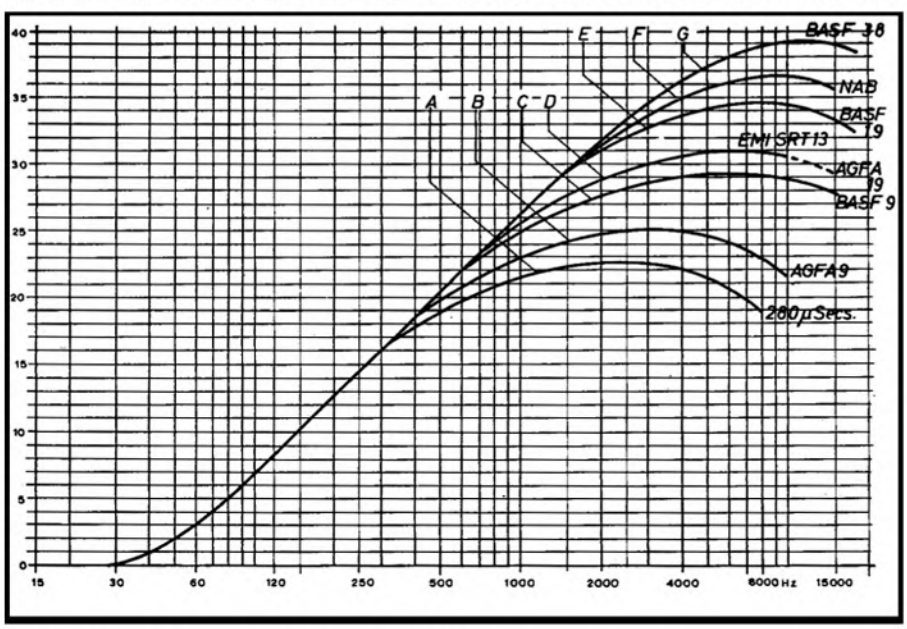


Fig. 1 Unequalised output from Standard Test Tapes.

THE MINIFLUX UNIVERSAL TAPE AMPLIFIER

inaccurate. It has been noted that excursions of instrument pointers will indicate random erratic movements of over ±6dB, making it impossible to read a definite magnitude. It has also been noted that there appears to be some small, unexplained, settling down of the excursions after the transistor has been in operation for some hours.

In addition to adjusting the collector current for lowest N.F., the noise spectrum is also influenced by the value of the source resistance offered to the transistor's input terminals. The curves shown in **fig. 3** are for an optimum source resistance (Rs) of 600 ohms, and whilst this can be varied up or down over a range of, say, 500 ohms to 1K without seriously affecting the N.F., it would be possible to degrade the Ic=200μA noise curve to the extent of that given by Ic=1mA either by drastically increasing *or* decreasing the value of Rs.

Most manufacturers' data on transistor noise is ambiguously presented and not adequately defined to give a designer a true picture of the transistor's LF noise behaviour and its dependence on Ic and Rs at different frequencies. For example, in **fig. 2** any manufacturer could give a N.F. value of 3dB for a given Ic and Rs value if measured at a spot frequency anywhere between f1 and f2. Alternatively, a wide-band average N.F. value of about 10dB could be given for the same device, yet this would conceal a N.F. of more than 18dB on a spot measurement taken at 100Hz.

The particular problem in relation to magnetic head circuits is that in this case the source resistance is not purely ohmic but can be represented by an inductance which displays a variable impedance over the required frequency range, and it is therefore necessary to investigate separately the transistor's noise performance when connected to a magnetic head.

To study this problem a typical low-noise germanium transistor was connected as a common-emitter input stage operating with an Ic of 200μA, and was fed with a 1kHz signal via a variable inductance source, i.e. a number of magnetic heads covering the range 10mH to 1H. By arranging the signal input to be fed as constant current to a low inductance record type head having a long gap length (10μ) *vis-a-vis* each replay head, so as to provide mutual coupling (as in **B fig. 6**) the correct replay head EMF relationship for changes in inductance was maintained throughout the head range.

A reference level of 4mV RMS was set as the equivalent output voltage obtained from a 1H head. This value is about 8 or 10dB below that which would be obtained from such a head using half-track operation from a 1kHz signal recorded at maximum level. The output from the transistor test stage was fed to a low-noise amplifier incorporating a 70μS equalising response, and the output from this was noted on a valve voltmeter which could be optionally switched from a broad-band measurement to a weighted condition according to the Standard ASA 'A' curve.

The results shown in **fig. 4** indicate that in the weighted condition a head of 20mH gives the most favourable signal-to-noise ratio of about 58dB. It is interesting to note that this supports the author's prediction made in 1960 (see Ref. 2), although the reasoning used then was quite different.

In the unweighted condition it is seen that a head inductance of about 100mH appears to give the best signal-to-noise ratio of about 50dB. However, it is noted that a 20mH head is now degraded to 38dB, whereas in the weighted condition a change from 20mH to 100mH shows a degradation of only about 2dB. In practice a 100mH will have more than twice the output of a 20mH and the higher inductance value is usually used in conjunction with germanium transistors.

It must be remembered that the indicated signal-to-noise ratios are based on a very low signal level and that in fact one should have to add at least 10dB to this figure to obtain a more practical value.

In cases where a transistor input stage is not followed by tape equalisation characteristics—for example, where the responses are flat as for use with a microphone—it will be quite in order to increase the input transistor's Ic to about twice the test value in order to obtain increased gain. The resultant increases in $\frac{1}{F}$ noise would not be subjected to the increased amplification due to tape equalisation and could still therefore remain below an objectionable level.

The inclusion of a low frequency roll-off of 3180μS, as called for in some of the standard equalisation curves, greatly assists in suppressing $\frac{1}{F}$ and flicker noise and its application in some circuits having particularly noisy transistors has resulted in an acceptable improvement in amplifier signal-to-noise ratio.

The circuit for the Universal preamplifier is shown in **fig. 5.** The transistors J1, J2 and J3 are connected as a DC-coupled triplet with overall separate DC and AC feedback. By introducing an *n-p-n* transistor between two *p-n-p* types the necessity for interstage decoupling is removed and a very high degree of stability is maintained over wide variations in supply voltage and temperature. The overall signal feedback includes frequency discriminating capacitor C4; the various equalising time-constants are obtained by varying the value of series feedback resistor R10. Any intermediate time-constant values may be simply calculated since it has been arranged for 10μS to equal 100 ohms. The input of J1 is provided with signal feedback taken from the emitter through C3 and R4 to the base input. This increases the input

(*continued overleaf*)

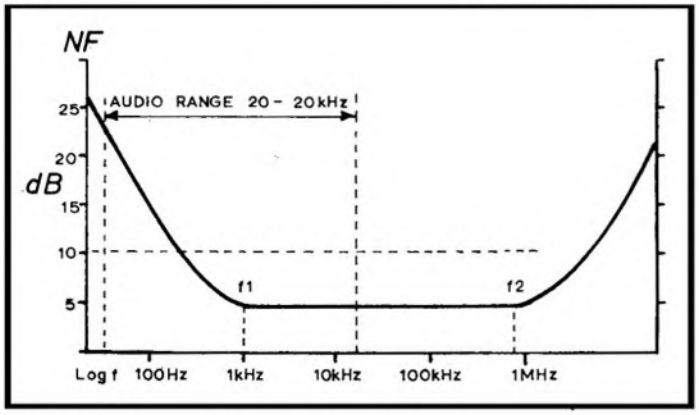


Fig. 2 Noise spectrum of germanium transistor.

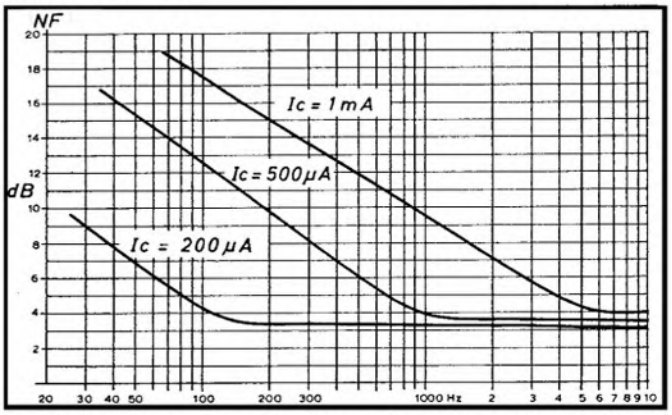


Fig. 3 Transistor audio noise spectrum for optimum source resistance Rs=600 ohms with Ic as parameter.

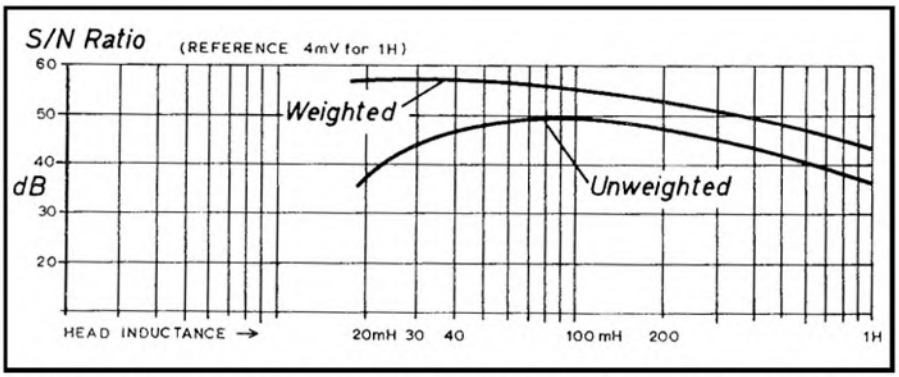
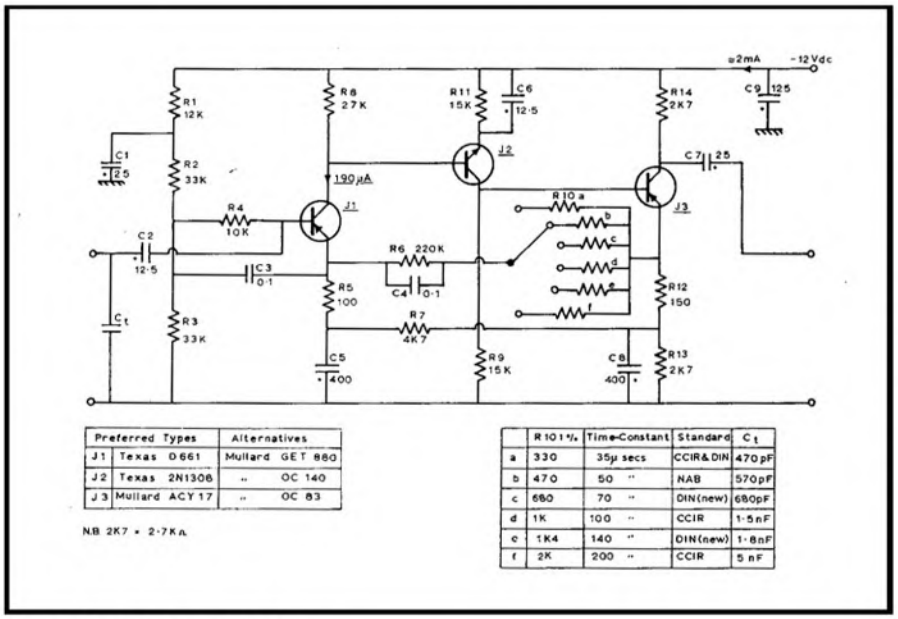


Fig. 4 Signal to noise ratio of germanium transistor input stage for differing head inductance values.



Preferred Types		Alternatives	
J1	Texas	D661	Mullard GET 880
J2	Texas	2N1306	" OC 140
J3	Mullard	ACY17	" OC 83

	R10 ±%	Time-Constant	Standard	Ct
a	330	35μ secs	CCIR & DIN	470pF
b	470	50 "	NAB	570pF
c	680	70 "	DIN(new)	680pF
d	1K	100 "	CCIR	1·5nF
e	1K4	140 "	DIN(new)	1·8nF
f	2K	200 "	CCIR	5 nF

Fig. 5 Complete preamplifier circuit.

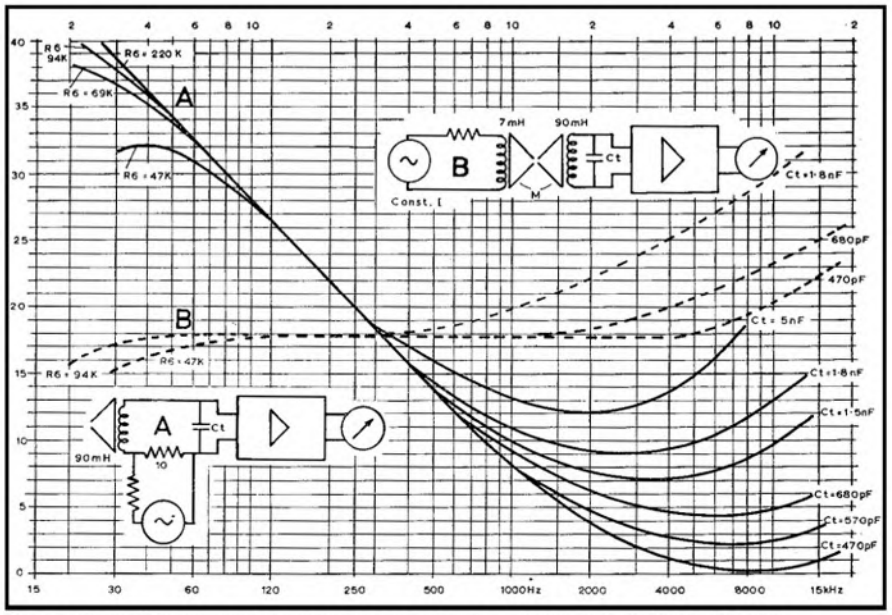


Fig. 6 Preamplifier response curves from constant voltage generator including head tuning.

impedance of J1 to input signals and also increases the effective Q of the head tuning provided by Ct. Although the higher AF signal input impedance is increased far beyond the lumped DC resistance of the base bias circuit, this has not altered the optimum source resistance value required for low-noise operation, nor for that matter the previously assessed optimum head inductance; for this reason it is necessary for the base coupling capacitor C2 to remain high in value so that its series reactance at low frequencies does not add to the optimised source resistance.

No output control is shown since this may depend on the following power amplifying stages. If it is followed by a simple valve input circuit, a **10K** trimmer potentiometer can be included and set to give a convenient output level. If the circuit is to feed into another transistor stage, care should be taken to ensure that the inclusion of a volume control does not upset the base biasing network of the next stage. A further coupling capacitor can be used to isolate the DC base bias circuits.

The response curves of the preamplifier are given in **fig. 6.** The conditions for the results shown in curves **A** were obtained by feeding a constant voltage input signal in series with a magnetic head (*Miniflux* ½-track type *WN-3T*, 90mH). Values for the head tuning capacitors Ct—which should be of the low-loss type—are shown; these, together with head lead capacitance (about 50pF), resulted in the desired top lift for the given equalisation characteristics. At the low frequency end, curves are shown for varying values of R6. It will be shown that in certain circumstances the inclusion of a low frequency roll-off such as called for in the NAB and new CCIR Standards will not only be beneficial for suppressing flicker noise but will also, in certain circumstances, improve the linearity of the operational playback response.

To simulate operational results which exclude tape and head gap losses, a test set-up indicated in **B** can be used. A long gap record head (10μ) having an inductance of 7mH is arranged to be fed by constant current from a signal generator. The gap of the record head is positioned against the normal replay head to provide mutual coupling which induces a voltage generating flux that obeys the 6dB per octave law of induction. The resultant curves **B** shown by broken lines allow a useful assessment to be made of tape and gap scanning losses and a comparison with operational curves will indicate the linearity of recorded tape surface flux beyond the turnover frequency.

The operation response curves obtained from standard test-tapes with the preamplifier are given in **fig. 7.** In the curves relating to the type WN3-T, head there is clearly shown a particular undulation at about 250Hz amounting to ±2dB. As the tape speed increases the undulations move up in frequency due to the increased recorded wavelength for a given low frequency. This is known to be due to the finite pole length in contact with the tape and may be regarded as a form of 'pole tip resonance'. Since it is essential to have some pole contact for the head to operate at normal tape speeds the effect cannot be entirely removed, but the pole shape and contact area can be designed to present an integrating effect to the long wave flux pick-up which reduces this

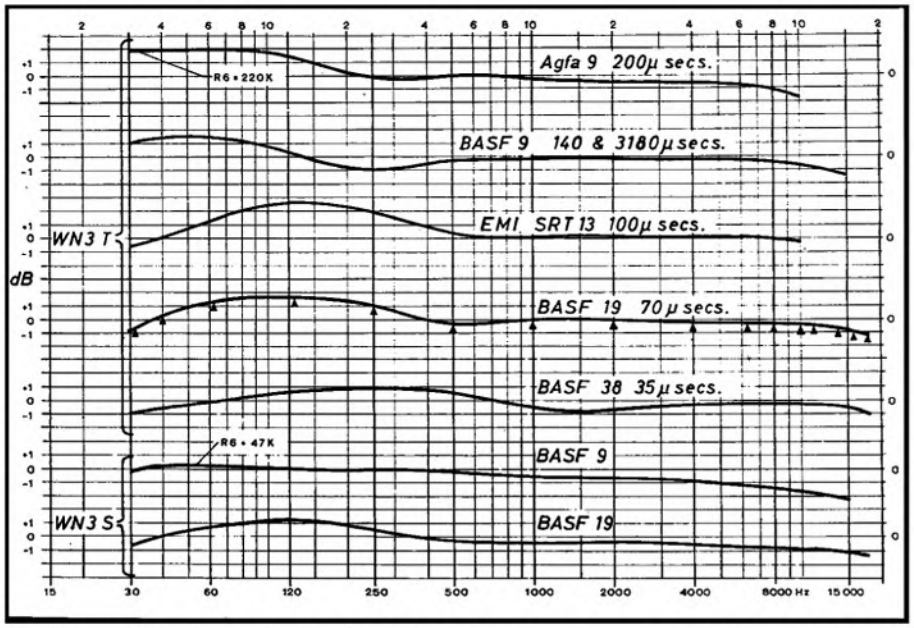


Fig. 7 Preamplifier response for given Standard Test Tapes from *Miniflux Type WN3-T* and *WN3-S* heads.

TAPE EQUALISATION TABLE

TAPE SPEED AND AUTHORITY	TIME-CONSTANT	TURNOVER FREQUENCY	CURVE
CCIR			
15 i/s	35 μSecs.	4.5kHz.	G
7½ i/s (old)	100 μSecs.	1.58kHz.	D
7½ i/s (new)	70 μSecs.	2.27kHz.	E
3¾ i/s (old)	200 μSecs.	790Hz.	B
3¾ i/s (new)	3180+140 μSecs.	50Hz+1.13kHz.	C
NAB			
15 i/s	3180+50 μSecs.	50Hz+3.2kHz.	F
7½ i/s	3180+50 μSecs.	50Hz+3.2kHz.	F
3¾ i/s (new)	3180+90 μSecs.	50Hz+1.7kHz.	—
1⅞ i/s (new)	3180+90 μSecs.	50Hz+1.7kHz.	—
DIN			
15 i/s	35 μSecs.	4.5kHz.	G
7½ i/s (new)	70 μSecs.	2.27kHz.	E
3¾ i/s (new)	3180+120 μSecs.	50Hz+1.32kHz.	—
1⅞ i/s (new)	1590+120 μSecs.	100Hz+1.32kHz.	—
1⅞ i/s (old)	280 μSecs.	565Hz.	A

effect. This has been done in the case of the Miniflux *Series S* heads which include specially dimensioned subsidiary pole tips alongside the main poles arranged so that their flux pick-up produces an undulation in opposite phase to the main pole tips. The improved result as shown in the *WN3-S* versions of **fig. 7,** in which the response of the *BASF Test-Tape 9* (3¾ i/s) shows an overall response of about ±1dB. The test-tape measurement intervals which are as indicated on the WN3-T curve for *BASF 19* are of necessity widely separated and cannot give a true picture of 'pole tip resonance'. It is therefore essential to take careful low frequency measurements at very close intervals to give a full picture of this effect. In **fig. 8** a comparison is made of the WN3-T and W3N-S type heads with a type **B** head which uses a conventional ring type long-pole construction. It will be seen that the overall effect is the choice of a single large undulation compared to a multiple of smaller undulations and, as illustrated in **fig. 7,** the single large undulation can be severely reduced by the inclusion of a low frequency roll-off, which in the case of BASF 9 is provided by making R6=47K.

Preamplifier test results are as follows:
Supply Voltage 12V DC
Supply Current≏2.15mA
Input impedance at 100Hz=9K
Input impedance at 10kHz=18K
Output impedance=2.7K constant

Typical operational equalised output from ½-track head type WN3-T in conjunction with a 7½ i/s tape speed recorded at maximum modulation (tape magnetization 32mM/mm) =1V RMS.

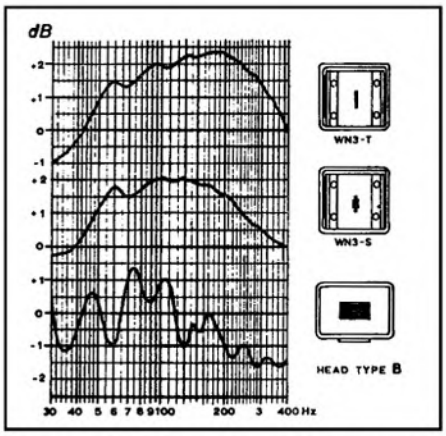


Fig. 8 Close interval equalised low frequency response curves for differing pole constructions

Maximum open-circuit output voltage= 2V RMS at lkHz

Amplifier signal-to-noise ratio:
−66dB related to 2V RMS output } with R6=47K
−70dB weighted according to 40 phon ear filter } J1=D661

Distortion excluding tape :
30Hz=0.28% (total
1kHz=0.074% distortion) } at 1V RMS output across 1M
10kHz=0.13% „

The entire preamplifier is constructed on a printed circuit card measuring 88 x 100 mm. and as seen from the illustration in **fig. 9** the card is conveniently mounted between switch spacers. For multi-channel operation a number of preamplifier cards may be stacked and secured together between a ganged switch assembly. In practice it is possible to reproduce identical preamplifiers (±0.1dB) by using 1% high stab. resistors throughout the circuit together with careful selection of matched capacitors C4. The dimensions of the P/C card are such that it will conveniently fit into an *Eddystone* diecast screening box *Catalogue No. 650*. If the base of the box is drilled to take the switch's spindle lock screw, the card can be secured therein with the locking nut.

It is stressed that the above notes are only applicable to germanium transistors, which type now enjoy comparatively low prices and reasonably close performance parameters. The silicon planar transistors, whilst being more expensive, do show enhanced performance figures, particularly in gain and in noise parameters. The gain of a silicon planar transistor appears to be well maintained at very low collector currents of about 25μA and some manufacturers claim certain *p-n-p* types to be virtually noiseless in the audio band. Preliminary investigations of such transistors for use in magnetic recording replay preamplifiers show that optimised head inductance values may be considerably increased and result in improved signal-to-noise performance. However, on present day prices the cost of such very low noise planar transistors is about three or four times that of the type used in the circuit described.

Ref. 1 Miniflux Tech. Data *Tape Recorder* page 119, April 1964.
Ref. 2 Tape Heads and Transistors *Hi-Fi News* page 732, March 1960.

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Tape speed: 7½″ and 3¾″ per sec.
Reel size: 7″ or smaller.
Recording system: 4-track stereophonic and monophonic.
Frequency response: 30–18,000 cps at 7½ ips. (50–15,000 cps at 7½ ips ± 3db). 30–13,000 cps at 3¾ ips.
Signal-to-noise ratio: Better than 50 db (at peak recording level).
Wow and flutter: Less than 0.19% at 7½ ips. Less than 0.25% at 3¾ ips.
Erase head: In-line (stacked) quarter track, EF18–2902H.
Record/Playback head: In-line (stacked) quarter track PP30–4202.
Level indication: Two VU meters (calibrated to 0 VU at 12 db below saturation of tape).
Tone control: Two separate controls for bass and treble.
Input: Low impedance microphone inputs —transistorised (will accommodate any microphone from 250 ohm to 1 K ohm impedance). Sensitivity—68 db (0.3 mv) (2). High impedance auxiliary inputs. Sensitivity —16 db (0.12 v) (2).
Output: Low impedance line outputs (2). Output level 0 db (0.775 v). External Speaker jacks (8 ohms) (2). Integrated Record/Playback. Connector (1). Binaural monitor output (1). Output level 0 db (0.775 v)
Operating position: Either horizontal or vertical.
Speaker: 4″ x 8″ dynamic (2).
Power output: 5 watts x 2.
Transistors: 2SB381 (x6), 2SB382 (x2), 2SB383 (x2), 2SC297 (x1), 2SC298 (x4), 2SD64 (x6).
Weight: Approx. 34 lbs. 3 ozs.
Dimensions: 21 5/16″ (W) x 15 7/16″ (D) x 7⅞″ (H).
Accessories: 5″ stereo recorded tape. Empty 7″ reel. Microphone Model F-96 (2). Connection cord. Capstan. Pinch roller. Reel cap. Head cleaning ribbon.

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SOUND & CINE

acting like an actor.....

BY ANTHONY WIGENS

IT is possible to make a sound film with a one-man crew, but it is one heck of an effort. With reinforcements for the last outdoor session before the leaves blew off the trees, I was able to concentrate on quality in the acting for my current film. It pays the director to look after his actors, especially if they are amateurs. Anxious to please, they nevertheless need guidance in the meanings and motivations which lie behind the text. You may be happy with the way a line is spoken, but if the actor hit it right by fluke, and doesn't understand *why* it was right, his confidence is undermined.

We have gone to some trouble to achieve realism in the acting of *The Country Lovers*. The sequence being filmed in the photographs on this page concerned Jess's efforts to kid Kay that he had poisoned himself. I traipsed around the neighbourhood looking for poisonous looking berries, whole plants of which I then planted in my garden.

In one shot, Jess strips the fruit off the plant he has pulled up, and in the next shot he apparently stuffs the berries into his mouth. In fact the script reveals that he is shamming, but I didn't want to ask Jess to sham. I thought that a shot of an actor pretending to be pretending had little chance of realism, especially if he was conscious that the fruit pressed up against his mouth might well be poisonous. So I shopped around the local sweetshops and came back with a bag of goodies called *Cola Chews* which closely resembled the berries.

For the close-up shot of the fruit being pressed to his lips, Jess substituted a handful of the sweets, so that he could actually put them in his mouth—and subsequently spit them out. I hoped to get a good succulent splutter on the sound track.

One thing I didn't reckon with was the humidity in the days between buying the sweets and using them as consumable props. I should have put them in a screw-top jar, but didn't, so they were very sticky and hard to handle. However, we did achieve realism.

Achieving consistent character realism is another matter. While this problem was very much in my mind I read a review of a new book on the theatre. Called simply *Improvisation*, it deals with discovery and creativity in drama. I went straight out and bought a copy.

For anyone closely involved in film-making using actors, or in recording tape dramas, it bulges with ideas. What particularly appealed to me was that, although relevant to any professional acting company, it was also related to the needs of students and schoolchildren—amateurs, in fact.

The dust jacket declares : "The whole book illustrates the way improvisation helps people to draw upon their imaginative resources and to extend their awareness of themselves and others".

Even when you are working with a complete script, there is scope for actors to improvise situations *in character* amongst each other. A performance rehearsed alone is unlikely to be a deeply meaningful one. As the book says : "Drama is the only art form which fully recognises man's gregarious nature".

A group of actors can be helped to adopt the prevailing mood of the script by music, and lighting. But within each character, mood and performance are directly affected by physical presence (whether a character slouches or holds his shoulders back squarely), clothing and accessories (formal or casual, immaculate or tatty), age (the actor playing an older person must *imagine* the tightening of tendons behind the knees, the sagging of the flesh), temperament (sullen or humorous), experience (invent a background for the character, if the script does not provide it), and finally, general attitude and outlook (a combination of all elements, described in short by the book as the character's philosophy).

Simply as preliminaries to a performance, detailed preparation of this kind can only help the actor. But the exercises suggested go further, preceding rehearsals, even preceding the writing of the play.

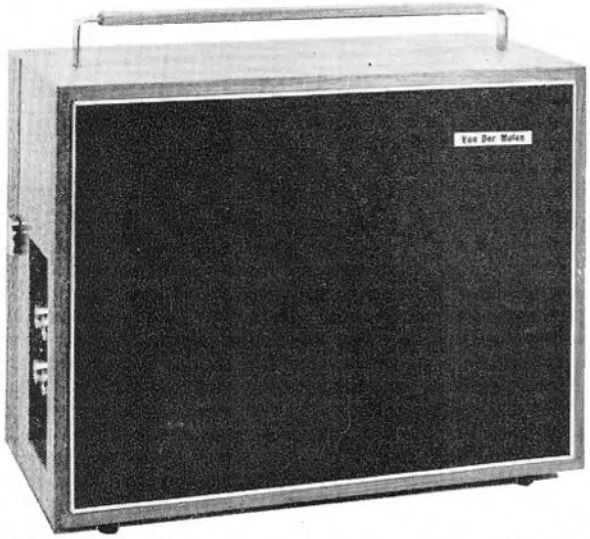
Because the Lord Chamberlain requires a script of a play before he will licence it for public performance, the art of improvisation has not flourished on the stage. I have worked with drama students on a film of pure improvisation and can warn you it is not easy, and certainly cannot be rushed. But we non-professionals need no licence and it is a fascinating area of film work.

The book, *Improvisation* (by John Hodgson & Ernest Richards, Methuen, 36s.), suggests that actors involved on a work-out preceding the real performance, can study grouping as a preliminary. For example, a character who dominates others in the film you are making can be sitting at the top of a short flight of stairs during the improvisation, with others sitting below. This physical domination may then become absorbed by all it affects as they explore their feelings in character, and the attitudes of others towards them.

Improvisation exercises for the *Country Lovers* might include an incident where Jess and Kay meet casually at a dance. There is no such scene in the film, and we can assume that it happened several years previously and both have forgotten the encounter by the time they meet in the film. However, knowing from the script the attitudes of their respective characters, they might perform this improvisation exercise, with dance music to provide the mood and a tape recorder catching their impromptu conversation.

Afterwards, actors and director listen to the tape, discuss reactions and language, analysing, criticising, helping to polish the characters to the benefit of the finished film.

It may sound like perfectionism—I have found that so far there has been too little time for all the theory to be put into practise—but it is a sound approach with amateurs, as with professionals.



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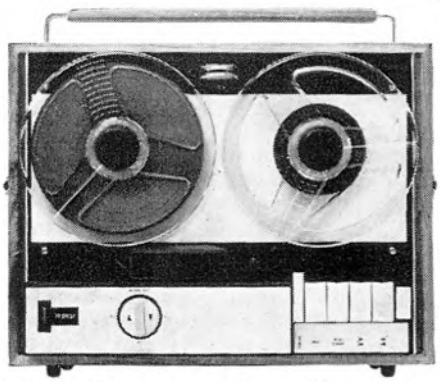

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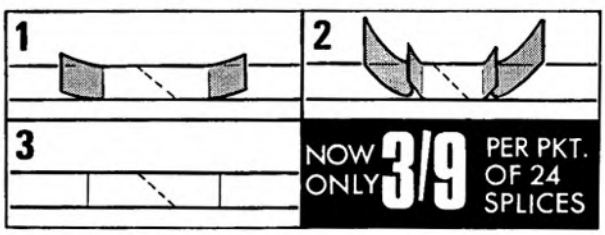

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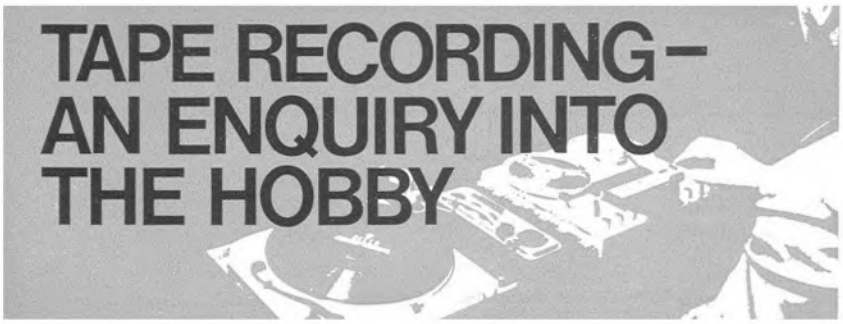
TAPE RECORDING – AN ENQUIRY INTO THE HOBBY



This magazine exists to help those who have battered, worked or wandered their way into the hobby of tape recording. At present, active tapists in Britain seem to be numbered in a few tens of thousands resting on the shoulders of the three million or so who have at one time or another purchased recorders, but who seem never to use them creatively. Despite tape recording competitions, surveys by manufacturers, and editorial assessments of readers' opinion gleaned from letters, we still do not know very much about how and for what reasons people graduate from simple tape recorder ownership to active recording.
Neither are we sure of the factors attracting recordists to magazines such as *Tape Recorder*, or of the exact balance of contents best suited to readers' tastes and interests.

Therefore, to serve the hobby of tape recording in general—including the manufacturers who back it—and to enable us to help our readers in particular, we have compiled the following questionnaire. A large response from readers will be very useful to all concerned—particularly to readers themselves, who stand to gain by influencing editorial policy in directions they think desirable. In due course we hope to publish a summary of those findings likely to be of general interest, and by completing the attached form you will make our conclusions more representative. Your co-operation in this project will be much appreciated.

TAPE RECORDER QUESTIONNAIRE

Please indicate applicable words in bold type by underlining.

1 Name **Mr./Mrs./Miss**

.....
Address

.....

.....

.....

Age group **Under 20/20 to 35/36 to 50/Over 50**

2 Do you possess a tape recorder? **Yes/No**
If so, which model/models?

..... **¼- ¼- full-track**

..... **¼- ¼- full-track**

..... **¼- ¼- full-track**

Do you envisage buying a recorder in the near future? **Yes/No**

3. Do you own a microphone other than that supplied with your recorder? **Yes/No**

4 Do you possess any of the following (please name if possible)?

mixer.....

headphones .....

FM tuner .....

disc reproducer .....

audio amplifier.....

separate loudspeaker .....

5 Do you own any stereo equipment? **Yes/No**

6 Have you ever bought a commercial tape record? **Yes/No**

7 Does the price of recording tape deter you from greater use of your equipment? **Yes/No**

8 Is the main use of your recorder :
Taping from the radio?
Taping from disc?
Tape correspondence?
Live recording in the home?
Live recording on location?

9 Do you belong to a tape correspondence organisation? **Yes/No/Ex-member**

10 Do you belong to a local tape club? **Yes/No/Ex-member**

11 Have you ever built a circuit or device from an article in *Tape Recorder*? **Yes/No**

12 Would you like to see magazine coverage of tape club meetings and activities? **Yes/No**

13 Can you name any aspects of tape recording you consider of interest which you have not seen covered in the magazine?

.....

14 Do you read *Tape Recorder* **almost every month** or **occasionally?**

15 Do you read any other tape magazines? **Yes/No**

16 Do you read our sister publication *Hi Fi News*? **Yes/No/Sometimes**

17 Have you any favourites, or pet hates, amongst the following?

TITLE	MORE SPACE	RETAIN	LESS SPACE
Articles for beginners (*Towards Better Taping*, *ABC of Tape Recording*, *Magnetic Sound Recording*, etc.)			
Book Reviews			
Constructional Articles			
Descriptions of Commercial Equipment (Mellotron, Contronics Cinesound, etc.)			
Equipment Reviews			
Field Trials of Battery Portables			
Humorous Articles (*Personal Bias*, *Cartoon Features*, etc.)			
New Products			
Readers' Letters			
Readers' Problems			
Tape Decks Analysed			
Tape Plays			
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Tape Recorder Service			
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OUR READERS WRITE . . .

. . . about 'sleep-learning'

From: F. Rubin, 55 Belsize Park, London, NW3.

DEAR SIR, As an earlier contributor on the subject, I would like to comment on the article by Mr. J. Mollon concerning sleep-learning, published in the February issue.

Mr. Mollon's article lacks professional insight into the process of hypnopaedia. He seems not to have come across the substantial amount of serious literature that has appeared in the USSR and, to a lesser extent, the USA, as unpublished Masters' theses, kept in the libraries of several universities there. In 1967, scientific literature amounting to more than 150,000 words will be published on various aspects of sleep-learning or hypnopaedia.

I visited the USSR not very long ago, where I arranged to obtain exclusively all data of Russian hypnopaedia that was and is available. It is a pity that Mr. Mollon's article lacks the scientific objectivity which is absolutely necessary when dealing with, and presenting, a new possible technique of learning, i.e. memorisation. EEG recordings taken by Russian scientists show a sustained brain activity during hypnopaedic sessions. In other words, while the tape recorder is on, by the appearance of random alpha waves, an absence of behavioural awakening was observed.

Mr. Mollon has not mentioned the aspects of original learning occurring in hypnopaedic sessions and re-learning (daytime revision) which were pointed out by the Ebbinghaus experiment as a major psychological principle of learning. Further, the aspects of "pre-sleep study" referring to the experiments of Jenkins and Dallenbach and others, also have relevance to the success of hypnopaedic courses. According to experiments conducted by the above, material which is learned just before sleep is better retained. Therefore, the total process of sleep-learning also comes under those principles, which were put down by Jenkins and Dallenbach, E. Van Ormer, E. Graves and others.

Barbiturate sleeping pills also interfere with the "computer clearance programme" of the brain which occurs during REM periods of dreaming. If Mr. Mollon objects for this reason to sleep-learning, then the taking of two million sleeping pills each day in this country should be stopped too!

If Mr. Mollon would read the data that has appeared on hypnopaedia, I presume that he would not conclude that it is expensive humbug, as he did at the end of his article.

Yours faithfully

Mr. Mollon comments:

It is extremely curious that the Russians should now be successful in achieving 'sleep-learning' after so many fruitless attempts by American military departments and the *Rand Corporation*—particularly since Mr. Rubin tells me that there is no necessity for an 'induction' or 'conditioning' procedure as advocated by Mr. Stocker. Sleep-learning, if it occurs, would seem to be an especially volatile phenomenon even under controlled conditions. If there is any effect at all, it is unlikely that it can be readily reproduced in the home by anyone with a tape-recorder.

I will reply to Mr. Rubin's more specific points in order:

(1) In the *Rand* experiments neither recall nor recognition of material played during the night was detected. It is certainly possible that a slight learning effect might be demonstrated by savings in the time required to 're-learn' the original material on waking, but only an experiment such as I suggested in my article would disentangle any such effect from the placebo phenomenon. Mr. Rubin and I are agreed that sleep-learning is certainly no substitute for orthodox study.

(2) The early claims of Jenkins and Dallenbach (1924), Van Ormer (1933) and Graves (1936) that material learnt before retiring is better retained than that learnt before a period of waking activity have not been fully substantiated (Richardson and Gough, *Australian Journal of Psychology*, 1963, *15*, 37-41), but they are, in any case, thoroughly irrelevant to the question of learning *during* sleep.

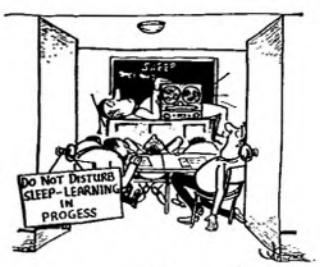
Indeed, the most plausible explanation of the Jenkins-Dallenbach effect is that material learnt before going to bed is not subject to interference by subsequent input. It is the very fact that new material is not learnt during sleep that enables material learnt *before* sleep to be better retained. If one learns one list of words and soon afterwards learns a second, one's later retention of the first will be less than if one had omitted to learn the second. This universal effect is termed by psychologists *retroactive inhibition*. Material learnt before retiring is not subject to retroactive inhibition owing to the suppression of sensory input during sleep.

Further, some very recent research performed in New York by Portnoff and others (*Perceptual and Motor Skills*, 1966, *22*, 751-758) suggests very strongly that the Jenkins-Dallenbach effects depends upon there being an interval between the learning and the actual onset of sleep: sleep *immediately* following learning was shown to prevent consolidation and results in particularly poor retention.

Perhaps Mr. Rubin and I differ only in our definition of 'sleep', but, if sleep-learning is to mean 'learning several minutes before the onset of sleep', then why will not a book and a bed-side lamp suffice?

(3) I am quite aware that barbiturates reduce considerably the proportion of REM, or 'paradoxical', sleep, during which dreaming occurs, (Oswald *et al.*, *British Journal of Psychiatry*, 1963, *107*, 66-78) and, though this effect may certainly be a lesser evil than insomnia, the indiscriminate use of barbiturates has been questioned for this very reason (Newman & Evans, *Nature*, 1965; Levitt, *Psychonomic Science*, 1966)

I certainly look forward to reading Mr. Rubin's forthcoming books on 'hypnopaedia'; but I shall not, for the present, rush out to purchase my sleep-learning kit.



. . . about exports to Denmark

From: Jeremy Williams, Director, Wilmex Ltd., Compton House, Malden Road, New Malden, Surrey.

DEAR SIR, I was interested to read of David Kirk's visit to Denmark, as written up in the February issue of *Tape Recorder*, and in particular the passage dealing with a meeting with a Copenhagen hi-fi dealer. We are concerned with the export of *Ferrograph* tape recorders to that market and therefore some comment by us on the dealer's lack of knowledge about Ferrograph may be of interest to your readers.

We most certainly do export Ferrograph recorders to Denmark—they are used in industry as well as by certain sections of the Government, where a high-quality recorder with enduring properties is required. We also sell Ferrograph recorders to private individuals in conjunction with our local representative.

I therefore feel that the Danish dealer was mis-informed or, possibly due to the language difficulty, he did not really understand the question and was thinking of another brand!

Yours faithfully

. . . about Highgate Acoustics servicing

From: H. G. Martin, Highgate Acoustics, 71-73 Great Portland Street, London, W.1.

DEAR SIR, We refer to page 60 of your February issue (*Tape Recorder Service*) relating to servicing of the *Optacord 408*. In the second paragraph it is stated that we turn up our noses on request for service and that we do not service ourselves but farm out the work.

Neither of these statements is correct and could easily be damaging to the sale of this particular recorder or any others we release. We would therefore request you to give a full statement to that effect, mentioning the following facts:

We have a competent service department with all the necessary measuring instruments to service tape recorders and will have same for video tape recorders. Our engineering staff consists of six service engineers. All our service work is done at the latest within two to three weeks and returned to customers. We have many thousands of tape recorders in circulation and are carrying out constant repairs for all our accredited agents as well

(*continued on page 185*)

field trials OF BATTERY PORTABLES

No. 19 SHARP RD-504

BY DAVID KIRK

NEVER shall I forget the first *Sharp* battery portable that I field tested. Submitted nearly three years ago, the tiny *TRC-1004* was the very embodiment of originality. Non-standard coaxially-mounted spools drove ¼in. tape at 1⅞ i/s. The replay monitor amplifier/speaker unit could be detached from the recorder-proper if the weight (a good few ounces!) proved excessive. The machine was, in fact, so fascinating in design that one almost overlooked the poor quality.

There have been great strides since 1964 in battery recorder design and the new *RD-504* is in many respects quite up-to-date. Nothing could be further removed from the TRC-1004.

First the controls. These are positioned simply and neatly on an attractive black-plastic and chrome cabinet. From left to right of the upward-facing panel are the record/replay gain control, treble cut and lift switch, modulation-meter/battery-voltage-indicator, AC warning lamp, record button and, farthest right, mechanical mode selector.

The gain control incorporates a mains on/off switch but has no effect on the battery power supply.

A rather novel two-part mode selector is employed, play and rewind being selected by twisting the main rotary control clockwise and anti-clockwise respectively. The record button interlocks with the play mechanism and so, too, does the fast-forward lever. One can thus select fast-forward from play or record without first stopping the tape. Switching into this mode from stop involved the twisting of the rotary control and fast-forward lever in one motion.

Most music recordings sounded rather shrill with the treble control at HIGH but were pleasantly balanced at the opposite setting. When the tape itself lacked treble, however, the control proved a worthwhile feature, since it did not amplify tape hiss and governor crackle.

Here lies one of the most significant features of the RD-504. Background noise in general and governor crackle in particular, are very low indeed. Although a DC-powered erase head is employed, HF recording bias really does manage to remove the worst of the erase noise.

No matter how low the background noise, if this is not combined with reasonably low wow and flutter, a recorder is nothing more than a toy. At 3¾ i/s, speed fluctuation was less noticeable than on a favourite Dutch portable of identical price—£27 6s. When I add that the Dutch machine operates only at 1⅞ i/s, this indicates that Sharp have not pulled off a miracle. It does show, however, that more care is being put into the design and assembly of drive mechanisms by at least one Japanese battery-portable manufacturer. The next step, perhaps, is to discontinue the practice of fitting removable capstan sleeves. If things go on the way they have evidently been in Japan, we shall be seeing capstan sleeves on top of capstan sleeves to give a very shaky 3¾ i/s from a basic 1⅛ i/s!

It is worth mentioning that my "favourite Dutch portable" does not take 5in. spools—nor do many other low-to-medium-price portables come to that. This feature may be of only marginal interest to potential outdoor users, but in the domestic sphere—where the mains power supply may make the machine a frequent carrier of radio programmes—the longer recording time would be appreciated.

Conversion from battery to mains operation was a simple matter of inserting the mains lead into the recorder, at one end, and the power supply at the other. This cord is supplied with the machine, as is the microphone—a small plastic-cased moving-coil model of reasonable quality. Incorporated in the microphone casing is a power cut-out switch, connected by way of a small jack socket. The microphone signal passes through a slightly larger jack on the same plug moulding. This renders the microphone unsuited to other recorders, whether fitted with sub-miniature jacks or not. It may be that I have pressed this point too hard recently, but I cannot forget the spectacle of a visiting friend trying to compare a number of Japanese microphones with that supplied with his own.

There is no reason, of course, why a microphone of the *Grampian DP4* or *Fi-Cord TC801* calibre should not be employed with a fundamentally good recorder such as this. The improvement in quality fully justifies the outlay, the only problem, in fact, being the soldering of fat microphone leads to the tiny contacts of a miniature jack plug. In view of the danger of unknowingly pulling the plug from its socket with heavier microphone cable, I would most certainly convert the RD-504 to take GPO Jacks, were I fortunate enough to own it. Such a modification would be made all the easier by the fact that all sockets, other than the AC input, are mounted on a removable plastic plate.

The battery compartment lid warrants some minor criticism. This unscrewed easily with a coin, and battery replacement was simple enough. But re-location of the lid was something of a Chinese (nay, Japanese) Puzzle. Unless positioned *exactly* flush with the cabinet, when the screw is fully home, no contact is made with the cells.

Battery voltage was displayed on the record level meter during playback. Consumption rate was not unduly high and, of course, does not vary substantially with tape speed. The meter was rather smaller than is general on modern portables, and gain-setting out of doors had to be achieved more or less by 'feel'. It is all very well frowning on automatic gain control when taping stereo radio broadcasts in front of a living-room fire, but I would prefer AGC to a microscopic VU-meter when working in the proverbial field. Dubbing from other audio equipment through the radio socket was well within the meter's capabilities, however.

The weight of a battery machine normally only calls for comment when one's arm is almost wrenched from one's shoulder. But light-weight mains/battery recorders are something of a rarity, and the Sharp RD504 deserves some commendation for weighing only 8 lb. In the 'bad old days' of valves I can recall carrying mains transformers that seemed to weigh more than the deck, amplifier and power pack of this machine put together.

It is rare, in this column, to have the opportunity of commenting on the tape supplied with a recorder. Most portables are ¼-track, and the dropout problem does not normally make itself known until the tape begins to wear. Dropout is not the only factor to consider when using a new brand of tape, as was discovered when the Sharp tape, being the nearest to hand at the moment, was placed on a *Revox 736*. A quick copy was made of an air-raid sound-effects disc for the benefit of a cine enthusiast having no gramophone. Later that evening the recording was replayed to him, still on the Revox. A 15-7½ i/s version was employed, admittedly at its slower speed, but the severity of wow on the first reproduced effect—a siren—suggested that a bomb had fallen upon the recorder. Having noticed similar trouble with *Uher 4000L* and *Akai X-4* recorders, however, it seemed likely that so suddenly developing a wow might be caused by badly-sliced tape. When another reel reproduced perfectly, the problem was indeed traced to the tape. Two points can be made here. Firstly, low-price or unidentifiable tape may well be used 2in. computer tape, inaccurately slit. Secondly, since such material performed happily on the RD-504, not all recorders are sensitive to tape width.

Being an exceptionally good little machine, the RD-504 was used for substantially longer periods than some of its less reliable brethren

(*continued on page 185*)

MANUFACTURER'S SPECIFICATION. Half track mains/battery portable. **Tape Speeds:** 3¾ and 1⅞ i/s. **Spool Capacity:** 5in. **Bias:** DC erase and AC record. **Speaker:** 6¾ x 2¾in. elliptical. **Output Power:** 1W. **Batteries:** Six *Ever Ready LPU2* or equivalent. **Dimensions:** 12 x 9¼ x 3¾in. **Weight:** 8lb. **Price** (including dynamic microphone, tape and recording lead): £27 6s. **Distributor: Wholesale Supplies (Swinton) Ltd., 16/18 Worsley Road, Swinton, Manchester.**

tape recorder service

some thorn designs

No 64 BY H. W. HELLYER

SINCE modifying this series of articles in March, 1966, adding a circuit diagram at the cost of detailed mechanical data, a 'thorny problem' has become evident. (*No pun intended, so the author says*!—**Ed.**)

The problem is that several firms market a quantity of similar but slightly different machines under various brand names, or with succeeding marks or numbers. Instead of neatly publishing a circuit and a few columns of text outlining the deck peculiarities, we are faced with the need to spell out the differences between the near-twin models based on groups of common decks. Thus, in heading this article '*Some Thorn Designs*', we allow ourselves to cover a very wide range from the prolific Thorn Group which embraces the *British Radio Corporation* brand names of *Ferguson, HMV, Marconiphone* and *Ultra*.

Owners with one or other of the foregoing should be able to identify their particular machine from the type of deck it employs. The first group, with which we shall concern ourselves this month, are the Ferguson *3200, 3202* and *3204*, which used the *FTD3* and *FTD4* deck, described in some detail in the June 1963 *Tape Recorder*.

Next comes the group of machines based on the single speed *DB21* and the ¼-track, two-speed *DB42* deck. This deck is very similar, with the tab keys placed centrally, but the spool carriers and clutch assemblies give a clue to the deck type. The DB42 has a flatter 'land' on the spool and a more perpendicular centre boss on which the tape reel mounts. Incidentally, premature wear of the flanges of the centre boss is one of the prevalent faults and when requesting a replacement spool it is important to specify the exact model number and whether you need a right-or left-hand spool. There is a slight difference, which we shall consider where appropriate.

Finally, the latest group of machines that we need concern ourselves with, based on the *DC43* deck is a ¼-track, three-speed version with the keys toward the right and several interesting improvements.

Getting back to our brief, the circuit on the adjoining page is that of the basic model, the Ferguson 3200. This is a single speed, 3¾ i/s, ¼-track machine, giving 3W audio output from a fully modulated tape. A crystal microphone permits a sensitivity figure of 1.5mV into 10M ; radio input is also 1.5mV into 22K and the pickup input needs 75mV into a megohm. The radio output gives 500mV at 22K. Apart from the rather high radio input sensitivity, made possible by the microphone switching arrangements which preclude complicated attenuators, all this is much as we have seen before.

As visible in **fig. 1,** the microphone plug operates a switch. This switch is simple and quite effective, until some clumsy 'other chap' inserts the plug wrongly and shatters the hard plastic of the socket. The spring leaves forming the switch—closed when the microphone plug is not inserted—fail to close and the result is a failure of radio and gram input and perhaps a touchy microphone connection. The trouble most often met in the plug is breaking of the bakelite leaf that operates this switch. In an emergency, separate the spring leaves from the inside, use the microphone plug in the normal manner, but rewire one of the special plugs for radio or gram input by connecting between pin-5, common screening, linking pins 4 and 2. Note that the outer of the plug and socket is separately earthed; do not connect the common to this point as hum loops can be formed. Pin 1 is used on later models for part of the remote control switching. Later types of microphone can be employed with the switch inactive. Alternatively, any crystal microphone will serve, and if the special plug is not immediately available, use the radio input socket, linking pins 2 and 4 of the microphone socket and disconnecting R1 and R2, leaving the radio socket as a direct link. Of course, if radio and gram are required as well as microphone, this repair will be ineffective—one will either have to modify the network with an additional switch or do the obvious thing—fit the correct Ferguson plug.

Details of the circuit of **fig. 1** need not occupy us much. The amplifier is quite straightforward and there are no clever tricks to bother us. S1 is the record/play switch, a slide type situated on the main board, i.e. from front to back of the machine and along the right underside of the deck. It is operated by a rocker action which is impelled by a tongue through a slot on the right of the deck. The spring return action is evident at a glance and this is the type of switch whose contact clearance can be seen immediately.

S2, however, needs a little explanation. This is the small slide switch on the top of the deck, just behind the head plate. It serves to mute the amplifier by shunting the output from V2A and also to provide a decay path for the oscillator, when either fast wind or off functions are selected, assisting in head demagnetisation. A small point, but typical of Thorn design thoroughness.

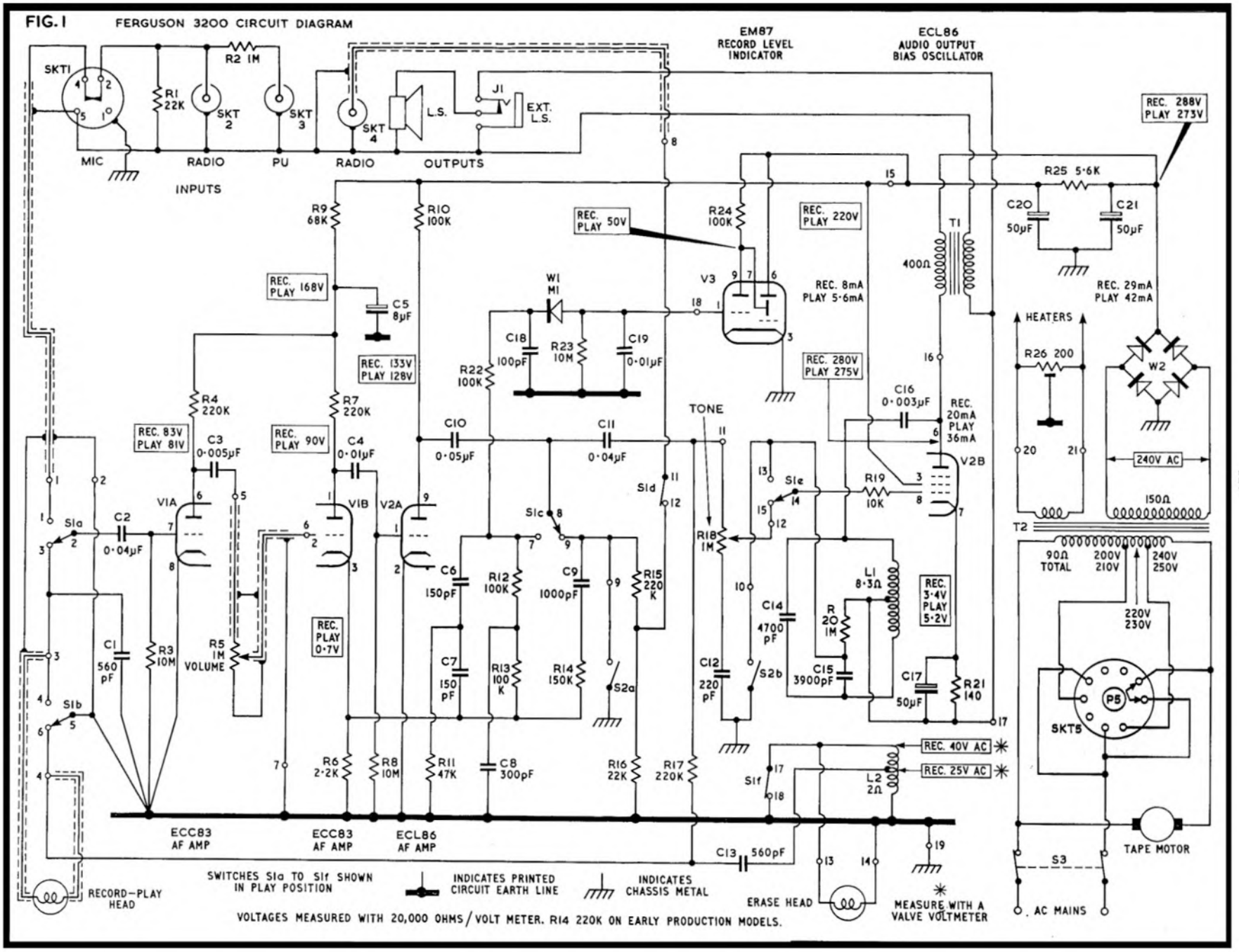
Details of the deck layout, operation and adjustments were covered pretty thoroughly in the June 1963 issue, and it should not be necessary to waste our valuable space on repeats. There is one adjustment, however, that needs a little explanation, as the query has arisen several times in correspondence.

The record-play switch, as stated above, lies along the printed board and is operated by the downward action of the record button on a pivoted 'boomerang', the remote end of which pulls the slide toward the front of the machine for recording. The position of the slide relative to the fixed contacts is, of course, important. The usual trouble is that the machine either does not record properly—one symptom being that the magic-eye appears to indicate a constant overload when record is selected, or, less often, after recording, playback does not always come cleanly; keys and switches have to be juggled. The trouble is that the whole printed board has moved slightly. It is secured by screws in slotted holes to aid the switch adjustment and the trap so easily fallen into is to try adjusting the swing of the lever, or the movement of the record button instead of adjusting the board. The correct position is when the lever arm just touches the baseplate. **Fig. 2** shows the layout, and the two important screws are marked **A** and **B** in this diagram. This is the underside of the ¼-track, two-speed model, the 3202. This model is very similar, having a few important additions quite apart from the changes made necessary by the extra tracking and speed selection. The latter is by stepped motor pulley and a ramped plate bearing the main idler wheel. But the 3202 has an auto-stop and a pause facility, with remote control, not just your simple pinch-wheel hold-off. Both these operations demand solenoid action and additional circuits are incorporated. These circuits are shown in **fig. 3,** and both the solenoid positions and the small sub-assembly board on which the circuit is built appear in **fig. 2.**

It will be noted that the mains transformer has a separate winding supplying a bridge rectifier from which 30V or so DC is available. This voltage is also brought out to pin 3 of the B9G accessory socket on the rear of the machine (inside the lead and microphone pocket). This can be a useful ancillary feed for powering a transistor amplifier, which can greatly extend the use of the machine, especially in conjunction with the output from the unused track of the record/play head, which is brought to pins 8 (inner track) and 9 (outer track) of the same socket.

Returning to our solenoid action, which depends for its clean action on the discharge of the large capacitors and the applied voltage. Note that the correct adjustment in each case is for the normal operation of the circuit with manual selection, adjusting the solenoid to provide its trip or engagement action. Do not attempt to adjust the solenoid mountings or bend the levers, or retention springs until the normal operation is absolutely correct. Another pitfall to beware!

(*continued on page 177*)



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

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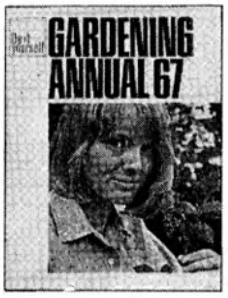

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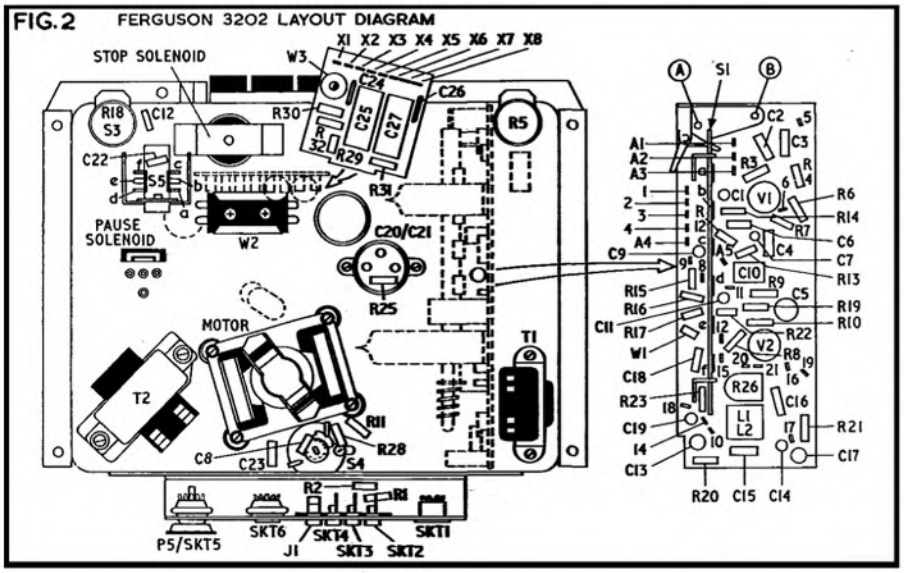
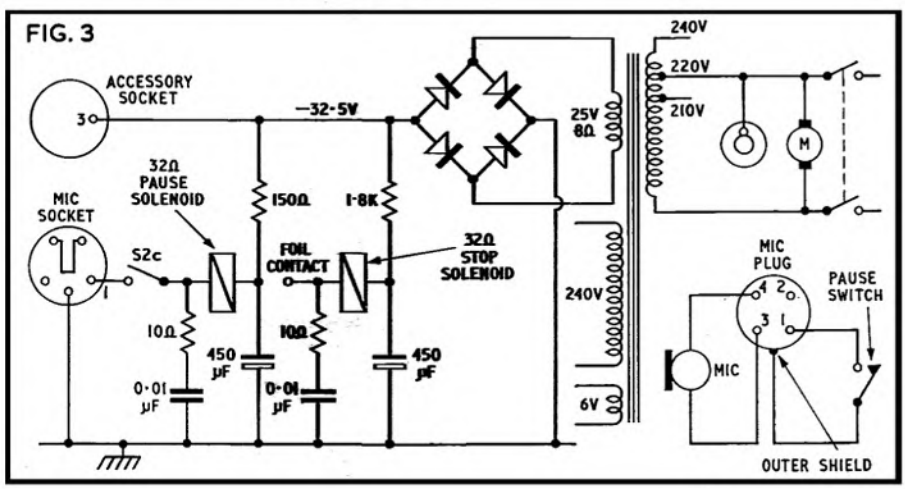
The stop solenoid acts on the latch plate to neutralise the record/play engagement. First, depress the r/p key and note that the latch plate just clears the bottom edge of the control keys when used to neutralise this action. Clearance should be about 0.02in. Depress the key again and short the stop-foil contact to chassis. The solenoid should just trip the latch plate. A link screw is provided to make this adjustment as fine as possible. Too positive an action can affect the clean selection of the other functions.

Note that the holding current for the solenoids is provided by the series resistance from the 32.5V negative supply. It is not advisable to keep this current flowing any length of time and the use of such devices for sleep-learning (that is always providing John Mollon has not already deterred you!) should also incorporate a modification for breaking the main supply. In other words, there should be a reset switch, with the autostop becoming an 'Off' switch for this kind of remote control operation. A small point, maybe, but it could lead to some unfortunate somnambulist living a little longer. (*Some of us would rather die, perhaps, than endure flattened idlers ?*—**Ed.**)

The pause solenoid operates an auxiliary brake arm to the left spool, and as its hold current is in the region of 100mA, you can judge the validity of the foregoing remarks. A clearance of about 10 to 15 thou' between pinch-wheel and capstan should be obtained when the pause is operated and this clearance is obtained by linkage adjustment. Toward the outer end of the brake lever a slot can be seen, weakening the arm rigidity and allowing a bending effect to be produced by insertion of a wide screwdriver blade and a gentle twist. This sets the pause position and on no account should the pressure arm linkage be adjusted to get an equivalent effect.

Note also, in this context, S2C in **fig. 3.** This is part of the safety switching, preventing inadvertent pause action while the machine is being switched from record/play to other functions. The completion of the pause solenoid circuit is through the microphone socket and the switch in the microphone itself, a common defaulter. We mentioned earlier that the microphone will receive more attention later, but at present we would point out that the simplest test is to short pin 1 of the microphone socket to chassis, when the pause solenoid should energise.





Another facility, not so far mentioned, is the use of a straight-through amplifier. The more you look at this apparently simple machine, the more you have to admire the Thorn design, for on a cheap tape recorder they manage to provide quite a few of the features that some higher-priced equipment lacks. Depression of the left-hand button switches the inputs to the first stage on the 3202, disengaging the heads and also shorting out the capacitive section of the equalising feedback loop, which on this model is an 820pF (in place of the 1,000pF, C9. R14 is 220K on the ¼-track model). Neutralisation of the amplifier key is by depressing the stop key on earlier models, but self-neutralising also by a press-press action on all later models. If the machine is intended to be used as an amplifier for any length of time it is a simple matter to add another modification, by disconnecting the motor from the 220V tapping on the voltage selector and adding an extra motor switch.

There were differences between the earlier models and later ones in the production run, principally as regards heads and oscillator coils. Details have already been given in June 1963, but to recap briefly, later heads have a slightly different mounting and any replacement should be followed by adjustment of pressure pads. A suffix 'M' will be found on the later models which have been modified. But there may or may not be new type oscillator coils fitted, and small component changes, regardless of the suffix. The two types of oscillator coil necessitate component changes. Where a coil with a white identifying spot is fitted, and these components on the 3202 are already different from the 3200, C1, 220pF is further reduced to 50pF, as is C13, 220pF, and a 100pF capacitor from the common junction of the two record/play head windings, via the superimpose switch, is also reduced. This last component is employed to reduce the bias to the record/play head while superimposing, to balance the two signals. The erase head windings are simply open-circuited by the same switch, which is part of the amplifier switch assembly previously mentioned.

Finally, the accessory socket: this has other lines taken to it as well as those already mentioned. These are: radio output, from V2A anode, via a tapped resistor pair to pin 4 on play, and a record/play signal direct from the V2A output to pin 5, via an attenuator to pin 6. Pin 7 is earth and pins 8 and 9 the head feeds already mentioned.

The Ferguson 3204 had yet more component differences. These included the capacitor reductions for the 'M' models already outlined, upending of the solenoid suppressor components so that the resistor is to chassis, a noise-reducing modification of a 0.01µF capacitor between volume control slider and the grid of V1B, with an additional 2.2M resistor acting as grid leak. The motor may be connected to the 240V transformer tapping and the solenoids are changed for lower resistance types. The screening of the unused head leads is commoned to the earth pin 7 instead of to pin 1 as in earlier models (a hum-reducing modification worth doing if you possess one of the earlier 3202 models).

After all of which, let us pause for breath and leave some loose ends for next month.

GRUNDIG TK340 STEREO

MANUFACTURER'S SPECIFICATION. Quarter track stereo mains recorder with internal power amplifiers and side facing speakers. **Tape Speeds:** 7½, 3¾ and 1⅞ i/s. **Wow and flutter** (respective): 0.1%, 0.12% and 0.2%. **Frequency Range** (respective) : 40Hz—12kHz, 40Hz—10kHz and 40Hz—5kHz. **Signal-to-Noise Ratio:** 52dB at 7½ and 3¾ i/s, 47dB at 1⅞ i/s. **Spool Capacity:** 7in. **Modulation Indicators:** Two magic eyes. **Input Sensitivities:** 2mV at 1.5M (microphone), 100mV at 1M (gram), 22mV at 22K (diode). **Output power:** 6W per channel. Separate bass and treble controls. Separate record and replay heads. **Weight:** 37lb. **Dimensions:** 21 x 8¾ x 16in. **Price:** £152 5s. (TS340 with walnut case and Perspex lid available at £156 9s.). **Manufacturer: Grundig (G.B.) Ltd., Newlands Park, Sydenham, London S.E.26.**

THE *TK304* is a large, relatively heavy, self-contained stereo recorder and reproducer which gives a very fine account of itself on its internal speaker system.

The control system at first sight looks formidable until it is realised that all record controls are on the left-hand side of the centre line, and all the playback facilities on the right-hand side. Of the eight press-tabs only two have to do with the tape motion and they are clearly marked 'stop' and 'start' . Fast forward and rewind are controlled by a slide bar on the left front of the deck, and a matching bar on the right provides a very convenient and easily found 'pause' control. The rest of the press tabs have to do with track switching and synchronous or track-to-track recording. For stereo record or play the adjacent '1-2' '3-4' tabs are pressed together; for mono only the top or bottom track tabs are operated.

The only input sockets on the deck panel are for mono or stereo microphones The rest of the considerable number of input and output sockets are located at the rear of the machine. A vertical row of press buttons select the appropriate input signal.

Playback volume controls at the right corner of the deck are coaxially mounted for top and bottom channels so that they may be moved together or offset for replay stereo balance. A single record gain control is fitted over an echo fade-in control.

A single magic-eye record level indicator is fitted between the two banks of press-tabs and the top and bottom signals are mixed so that the beam deflection is proportional to the largest of the two input signals.

The hybrid valve-transistor circuit is unusual in using the valves for all recording and input functions, and transistors for the tone control and power output stages only.

An edge operated drum controls the tape speed with an off position between each speed. Tape speeds were well within ±1% limits on all speeds at the beginning and end of 7in. reels. Wow and flutter were very low at 7½ i/s, with an average RMS reading of 0.06%, and top and bottom limits of 0.05% and

(*continued on page 181*)

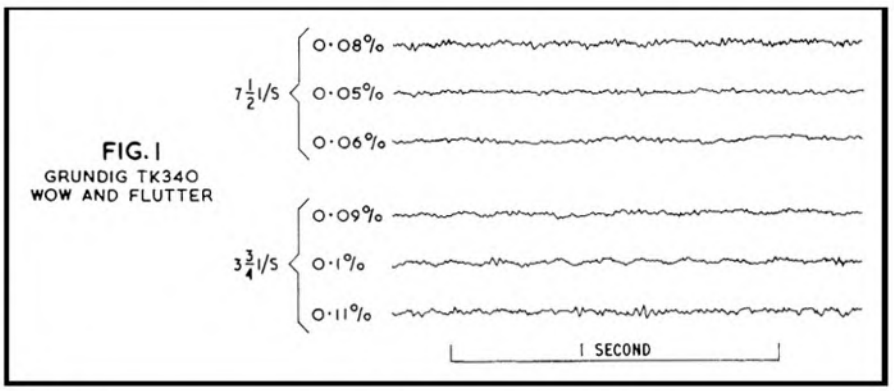


FIG. 1
GRUNDIG TK340
WOW AND FLUTTER

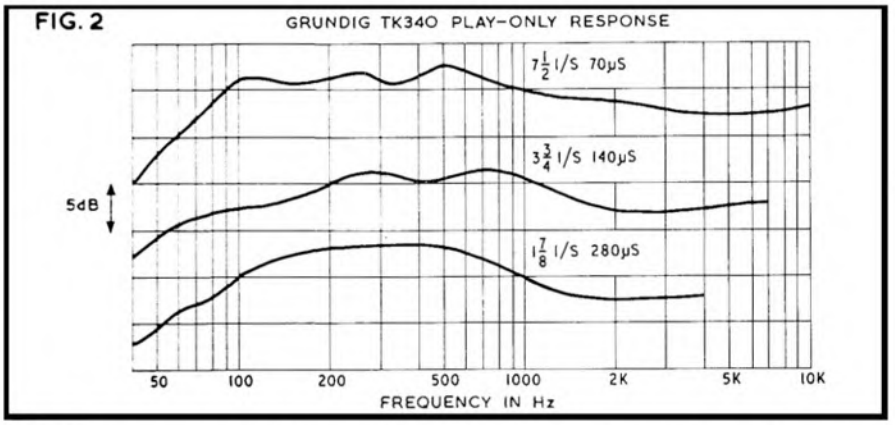


FIG. 2

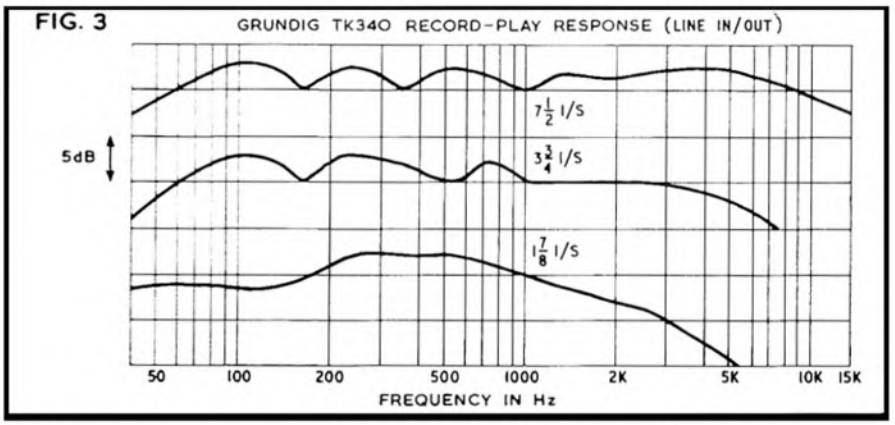


FIG. 3

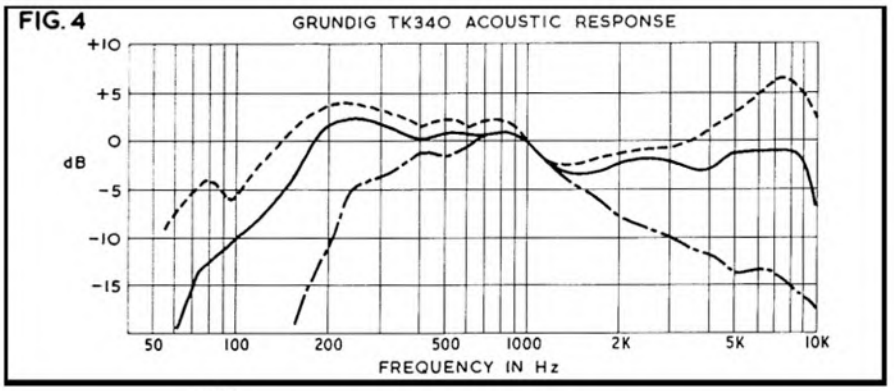


FIG. 4

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0.08% RMS. 3¾ i/s speed imperfections were almost equally satisfactory at 0.1% RMS, and top and bottom limits of 0.09% and 0.11% RMS (see **fig. 1**). At the lowest speed of 1⅞ i/s, readings averaged 0.15%, with a just audible cyclical speed variation at approximately four per second.

The play-only responses were measured at line output by playing test-tapes recorded to known recording characteristics. The responses of **fig. 2** all show a drop in level at mid frequencies followed by a level response over the high frequency range. This indicates that the playback time-constant is different to that of the test-tapes and that the playback equalisation has been designed for recording characteristics of approximately 50, 100 and 200μs. System noise with no tape passing the heads was 40dB below test-tape level at the two higher speeds, and 35dB at 1⅞ i/s.

Record-play responses from radio input to diode or line output are shown in **fig. 3.** By recording a continuously variable tone, as distinct from the spot frequencies on the test-tapes, it was possible to plot the slight peaks and dips in the low frequency response due to the contour effect of the short pole face reproducing heads. The 'wobble' shown is quite innocuous on a single record-play sequence, but it can build up to audible proportions on successive track-to-track transfers in 'multiplay' recordings. It will be seen that bass lift at extreme low frequencies has been used to compensate the head response fall-off below about 150Hz due to the short pole face.

Peak level recording tests at 500Hz showed negligible waveform distortion at a level 12dB above test-tape level where the magic-eye beams just closed. Erased tape measured 38dB below test-tape level at 7½ and 3¾ i/s, giving unweighted signal-to-noise ratios of just 50dB. Weighting the response to that of the ear at low listening levels gave a peak signal-to-noise ratio of 51dB, which is near the specified ratio of 52dB.

The overall acoustic response, from white-noise test-tape to axial response of the internal speakers, at middle and extreme positions of the drum type tone controls, is shown in **fig. 4.** It is well known that a high note peak is a great help in the 'round the corner' listening inevitable with sideways facing speakers, and this together with the wide range of bass control provided to compensate room acoustics accounts for the very pleasant listening quality of this recorder.

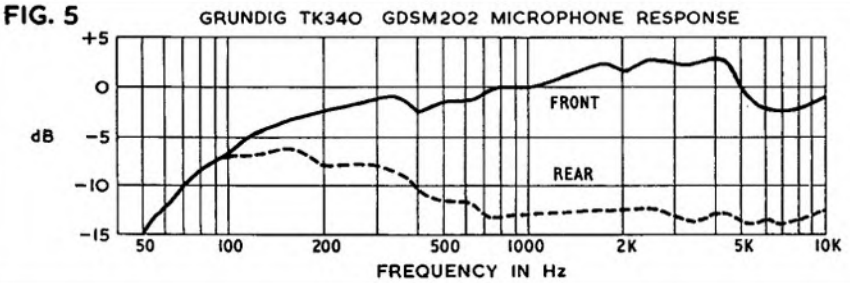
The stereo microphone provided for test with this recorder consisted of two small watch-shaped elements which could be set easily to any desired horizontal angle for best stereo pick-up. The front and rear response of one of the units was measured by the white-noise technique in a normal living room to give the very satisfactory responses of **fig. 5.** Stereo separation is negligible at very low frequencies, but low frequency standing waves can upset the listening pattern of even the most perfect stereo installation in a small room.

COMMENT

This is one of the most effective self-contained stereo systems I have had the pleasure of testing. On both pre-recorded stereo tapes and tapes recorded with the microphone provided, the listening pleasure is increased very considerably when compared to mono signals from the same machine. External speakers would of course broaden the sound field and improve the frequency response, but for close-up fairly intimate stereo listening the TK340 is excellent as it stands.

A. Tutchings

FIG. 5 GRUNDIG TK340 GDSM202 MICROPHONE RESPONSE

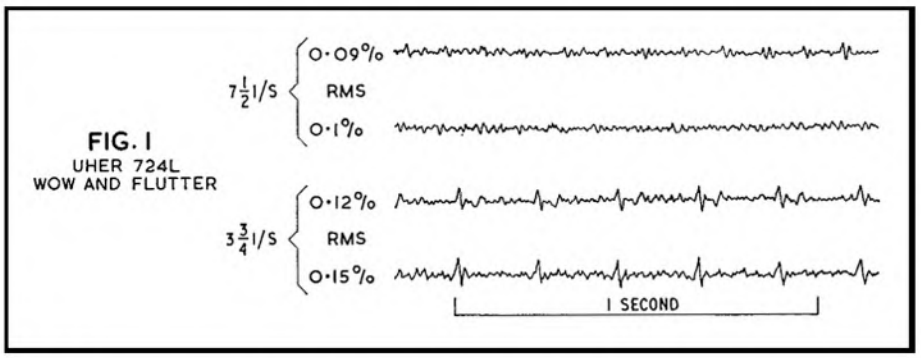


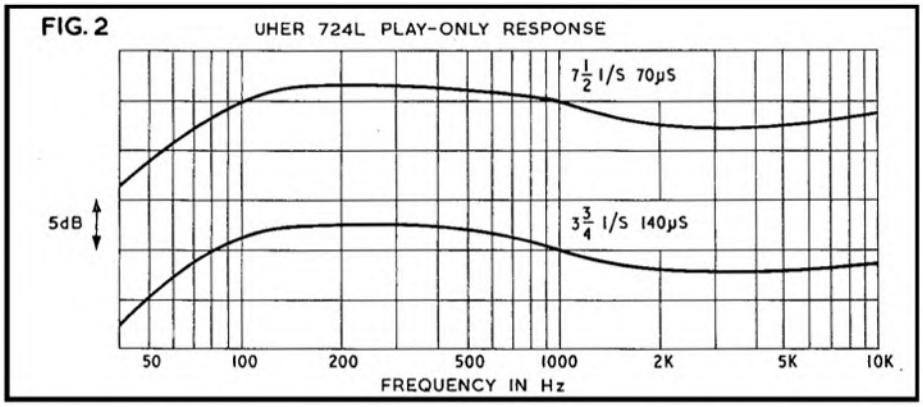
UHER
724L
STEREO

MANUFACTURER'S SPECIFICATION. Quarter track stereo mains tape recorder with self contained transistor amplifiers and speakers. **Tape Speeds:** 7½ and 3¾ i/s. **Wow and flutter** (respective): 0.15% and 0.2%, weighted to DIN 45405. **Frequency Range** (respective): 40Hz—18kHz and 40Hz—14kHz. **Output Power:** 2W per channel. **Spool Capacity:** 7in. **Sensitivity:** 0.3mV at 2K (microphone). 3.5mV at 47K (radio), 65mV at 1M (gram). **Dimensions:** 15 x 7 x 14in. **Weight:** 20lb. **Price:** £78 15s. **Distributor: Bosch Ltd., 205 Great Portland Street, London W.1.**

THIS is a fairly light-weight stereo recorder using a single motor, transistor circuits and relatively small speakers mounted on the sides of a thin walled cabinet. As might be expected from the above description, the sound reproduction suffers from cabinet resonance, limited bass response and inadequate output power. I have remarked on this tendency on certain Continental recorders before, and guessed that part of the reason is that many recorders are connected via the standard DIN lead to radiograms or large radio sets with adequate cabinets, speakers and power outputs for normal day-to-day listening, and that the internal speakers and power amplifiers are only provided for monitoring a recorded programme, or for those customers who know no better and are content with transistor radio quality. Whatever the reason, it does seem a pity that the very excellent design work put into the deck and transistor record-play circuits produces an electrical response which never gets outside the cabinet, except via the line or diode lead!

The tape motion controls consist of a large 'stop' bar flanked on either side by start and pause tabs with a slide bar in front of the 'stop' bar for fast wind and rewind. The record safety button is conveniently near the start tab, so that all these controls can be operated by one hand without diving about all over the deck panel. A volume control and tone control, together with a rotary track switch, complete the generally used front line controls, with a mains switch combined with the tape speed switch and a balance control for stereo a little further back. An interesting innovation is that the top panel also carries symbols indicating the positions of the microphone, radio and left and right LS outputs which are located just under the skirt of the deck panel for sideways insertion of the relevant DIN plugs. This saves a lot of neck stretching and movement of the





recorder to locate inaccessible and badly lit sockets.

A glance at the 3¾ i/s fluttergram of **fig. 1** will show that this particular review sample is what is known in the trade as a 'pipper'. The speed imperfection is not the usual sinusoidal cyclical speed variation, but a short sharp change of speed once per revolution of the capstan or flywheel which gives rise to the characteristic 'pip-pip-pip' on a sustained tone. It is often due to a minute crack or score mark on the capstan itself or a wider crack or 'flat' on the flywheel rim. A similar effect can be caused by a flat on the intermediate idler wheel which drives the flywheel, but in this case it did not correspond to the idler wheel rotation which was considerably faster than the capstan speed. A slight trace of the same effect can be seen on the top trace of the 7½i/s fluttergram. The subjective effect of the 'pip' was out of all proportion to the standard long-term integrated RMS reading, which even at 3¾ i/s was 0.12% to 0.15%, a figure that would normally be considered quite satisfactory. This shows that the ear is still the true criterion despite any number of low meter readings!

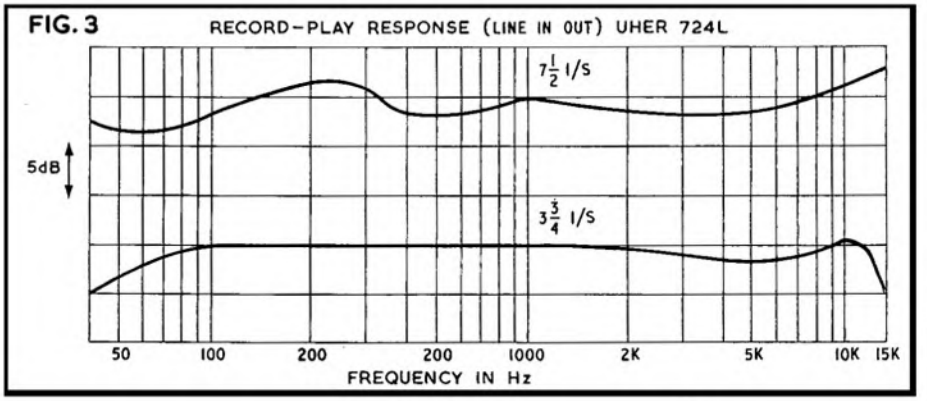
The play-only response to line output using 70 and 140μS test-tapes is shown in **fig. 2** and indicates that the playback equalisation is to approx. 50 and 100μS characteristics. System noise, with no tape passing the heads, was only 27dB below test-tape level.

Peak record level tests showed that a signal 12dB above test-tape level could be recorded with low waveform distortion with the VU-meter needle just off the top of the scale. Erase and bias noise was low as judged subjectively by listening on the recorder's own speakers, but on wider range equipment mains hum could be heard at low level.

Record-play responses at line output are shown in **fig. 3** and, apart from the slight mains hum mentioned above, are perfectly satisfactory for feeding hi-fi external equipment.

The moment of truth is illustrated by the overall acoustic response of **fig. 4**, which

(*continued on page 185*)



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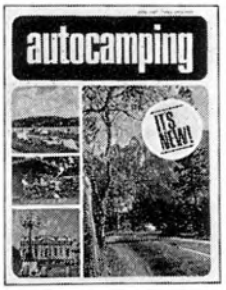

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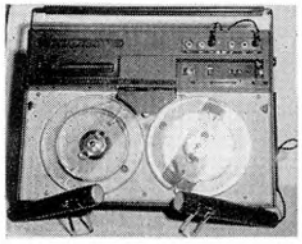

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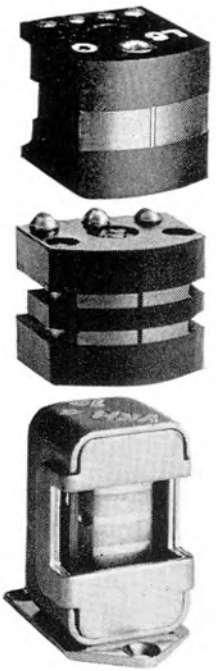

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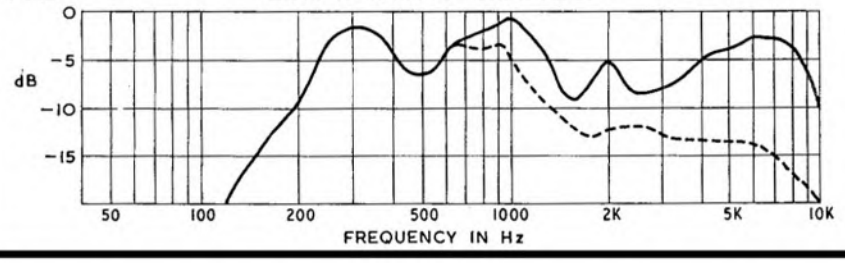
includes the combined effect of the power amplifiers, cabinet and internal speakers. Even this does not tell the full story: the 300Hz cabinet resonance gave much more coloration than is indicated by the sustained tone response curve. It was shocked into resonance by every low frequency transient and it played havoc with the stereo separation of all frequencies up to beyond 1kHz. The result was a rather tiring 'honking' quality which spoiled completely any mono or stereo signal heard through the 'poor half' of the *724L* recorder.

COMMENT

This review raises the question of what happens when stereo speakers are placed on opposite sides of the same cabinet. It is possible to get excellent 'close up' stereo sound from such an arrangement, as will be seen from other reviews. It depends on how much mixing and cancellation of the separate sound sources takes place within the cabinet, and this in turn depends on how completely the cabinet is divided into two halves by the deck mechanics or electronic circuits. It would appear that small, low mass, transistor circuits are much less efficient in this respect than the old brute force valve circuits on large metal chassis!

Seriously though, here is a case of a well designed deck and set of electronic circuits being completely spoiled by the packaging which is normally taken out of the hands of the recorder designer and handed over to a stylist or sales manager who decides what it should look like rather than what it should sound like. The loudspeakers and basic housing should be an integral part of a recorder design, however much it is dressed up later for sales purposes. **A. Tutchings**

FIG. 4 ACOUSTIC RESPONSE UHER 724L



tested in this column. No mechanical deterioration—idler knocks, bearing rattle or increased wow—was noticed, the only failure, in fact, being of the output miniature jack socket. A plug was inserted in this socket in order to dub onto another recorder and, when removed, it failed to remake contact with the internal loudspeaker. Monitoring was then possible only with the supplied earpiece until the cabinet was unscrewed and the plug pushed back into shape with a screw driver. This is a common fault with miniature jacks.

In conclusion, I consider the Sharp RD-504 to be the best under-£30 battery portable I have handled. Since mains-powering facilities are included without creating excessive weight, my enthusiasm for it is all the greater. I know from personal experience that the aforementioned Dutch portable is backed by a large and competent service organisation. If the same can be said for Sharp equipment—and this is something one would need to confirm with the importer before making a purchase—then the RD-504 can be recommended unreservedly.

as for private individuals who cannot obtain the necessary service from some of the retailers concerned.

Our reputation in after-sales-service has been well established for many years and has been complimented time and again.

Yours faithfully

H. W. Hellyer comments

In the February servicing article, which dealt with the *Optacord 408*, I said "I may be wrong, and shall surely be sat upon heavily (as usual) if I am."

Well, I was, and I have been. Highgate Acoustics bring down the considerable weight of their indignation with a bump. I am happy to be able to say I am sorry and am delighted to learn that Highgate Acoustics have a well-equipped service department with a staff of six engineers. Owners of Loewe-Opta equipment, and prospective owners, may take heart at the assurance.

Whilst apologising for my misleading assumption—and it was no more than an assumption—I cannot help noting that Highgate Acoustics welcome the opportunity to refute it. They might, however, have studied the article just a little more closely. They would not then have fallen into the trap of skimming a text and picking out what they consider the essentials—namely the implied criticism. For the rest, I go on to give Loewe-Opta full measure of credit for their equipment, in this and later articles on associated models.

As to the reputation for after-sales service and the points Highgate Acoustics want enumerating, I feel sure they would not wish me to sully a genuine apology with the sort of recrimination that any service manager could bring against any manufacturer or his agent. Let them balance the compliments.

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MISCELLANEOUS

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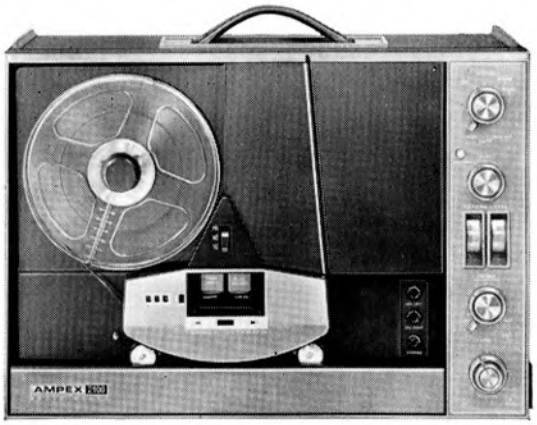

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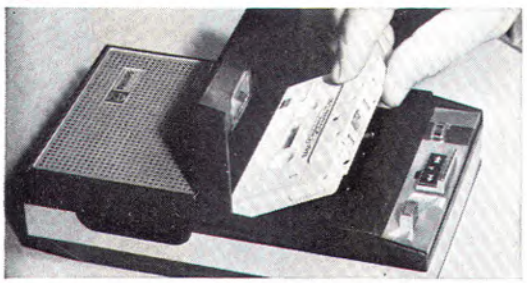
on your mark

get set



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