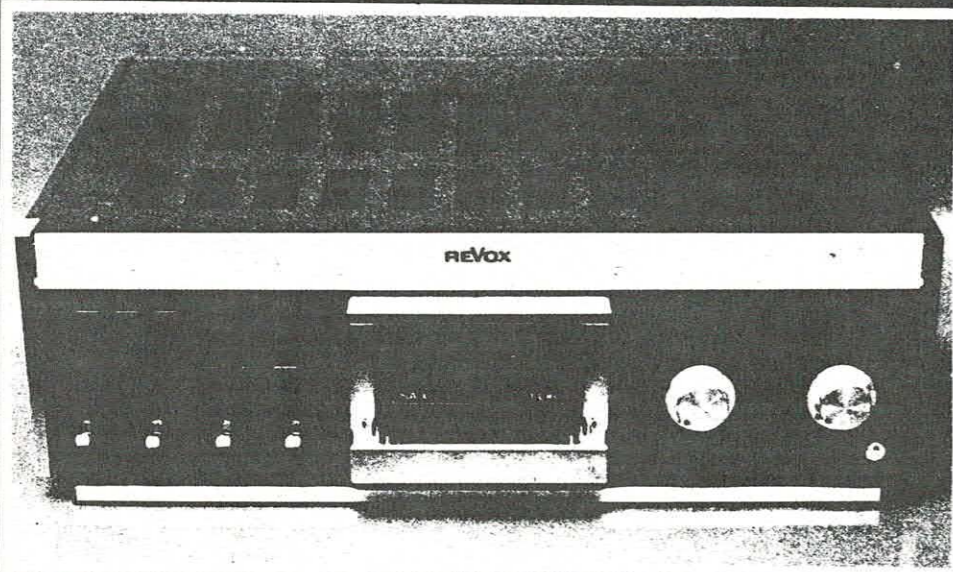


## Editorial Introduction

IT IS PERHAPS a little depressing to reflect that the Compact Cassette, to the non-enthusiast, is most likely thought of as an exclusively Far Eastern concept. The majority of cassette recorders—be they true hi-fi products or the more widespread portables—have Oriental brand names, and Philips, who introduced the system but who didn't originally conceive it as a hi-fi medium, have effectively lost control of the market

they created.

With Grundig and Philips fighting rearguard actions to retain their share of the mass market, other European companies became aware that there was still plenty of room at the top for a genuine high fidelity cassette recorder to compete with such Japanese



## B&O 9000

### Bang & Olufsen Beocord 9000

THIS NEW B & O machine, as well as Dolby-B and -C record and replay noise reduction, features Dolby-HX Professional and readers may find it useful to look back at the September 1981 issue, which explains the entire operation of the system. In addition, it has the most startling microprocessor operations: the user almost needs to attend a Bang & Olufsen night-school educational course to understand all of them. In the absence of a complete instruction book, which was not ready when the machine was delivered, my colleagues and I had to fight the machine for some time to understand all its remarkable features, although I must praise most strongly the presence of fairly detailed instructions underneath a hinged flap which covers some of the programming controls and tape transport.

As with many B & O designs the styling is typically Danish. Main operational buttons are on the right front side, and above them are the meters and numeric display, whilst under the flap on the left is the tape transport and on the right a series of push-buttons to control some of the microprocessor functions. Separate left and right vertically mounted faders are provided to control recording level, while on the extreme left is a ganged fader to vary headphone monitoring level, headphones being plugged into a 1/4in. stereo headphone jack socket under the front panel.

At the top of the 'bug hutch' are LEDs to indicate 'Record Open', 'Tape Type' (1, 2, 3 and 4) and 'No Store'. The microprocessor

controls under the hinged lid include: 'Record Open' (enabling recording to take place on request); 'Time set' (for setting the time of day on the built-in digital clock); 'Timer Start' (enabling the user to program the commencement time of recording or playback); 'Timer Stop' (for cessation of programmed function); 'Tape Type' (cycles between 1-4 on successive operations); 'Tape End' (allows the mechanism to travel to the end of the cassette and back to time the total playing time); 'Store' (for storing the machine's internally measured calibration of bias, sensitivity and equalisation for regularly used tape types in a non-volatile memory); and 'Record Calibration' (used for requesting the machine to line up any blank cassette inserted into it for optimum overall performance).

A three-position switch selects Dolby Off/-B/-C Noise Reduction. An eject bar in

front of the hinged lid (and thus accessible when it is closed), if pressed towards its left end opens the lid and ejects the cassette, whilst if pressed towards the right end, opens the lid without cassette ejection. Unfortunately, if the cassette is ejected, all timing calibrations and recording details are normally wiped from the memory, but tape calibration can be more permanently stored from the working memory. The main operating push-buttons on the front panel include 'Standby', which turns off the main electronics whilst retaining 'Timing' and 'Record Cal' memories. Normal operation can commence when any of the normal operating controls are depressed from 'Standby'. Other push-buttons operate 'Stop', 'Playback', 'Record' (one push activates metering and record input circuits whilst a second push commences Record,

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# FEATURE REVIEW

## Angus McKenzie

models as the superb Nakamichi 1000ZXL, reviewed by Angus McKenzie in September 1981. The Austrian audio-visual company Eumig made waves with their computer-controlled FL1000µp machine (HFN/RR review June 81) but it was B&O, with their 8002 model (HFN/RR review Sept 81), who pushed the state-of-the-art further forward. That machine was the first to incorporate B&O's reworking of Dolby's HX Headroom Extension circuitry which proved to be both simpler and more effective than the original Dolby system: Dolby took up the Bang & Olufsen ideas to produce Dolby HX Professional.

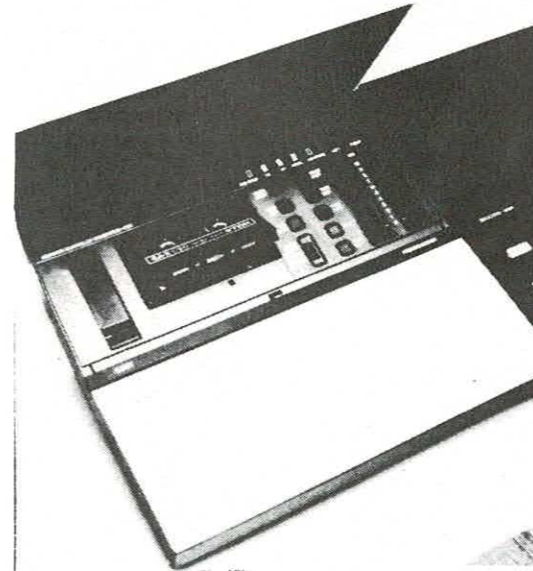
In this review, Angus McKenzie examines both the latest B&O machine, the Beocord 9000, and the long awaited—and promised—cassette deck from the Swiss company Studer-Revex, the Revox B710.

provided 'Record Open' has previously been pressed). 'Fast Forward' and 'Rewind' are conventional. A 'Return' button is provided to allow the cassette to return to the previously initiated record or playback start. Two more push-buttons in the main group select 'Memory Go' which commands the set tape to move to a pre-determined timing position defined by the 'Memory Set' button, which is used in conjunction with the fairly conventional computer type 0-9 keyboard (used to punch in a time in minutes and seconds). The memory keyboard has two additional buttons to the 0-9 ones, one labelled 'CE' for clear entry (this will be used very frequently before most humans—including ourselves—grasp the incredible facilities of this machine) and the other 'Go' (this commences various sequences, including calibration). It is frankly extremely difficult to cover all the facilities that are provided, for the further we delved into operations the more we found the machine could do, and it is even more difficult to attempt to explain these to the reader.

It will perhaps be an advantage to detail all the operations required before commencing a new recording and thus a rough idea of the flexibility may be gained. To begin, press the 'bug hutch' opening bar and then insert a blank cassette tape. Press the cassette tape down and then press the 'Go' button on the computer keyboard. Wherever tape in the cassette has been wound to, it will return to the beginning, and playing time calibration commences. The tape automatically plays for around 13s and then winds on for a while and plays again for a few seconds, after which it returns to the beginning again. This calibrates the tape timing counter in minutes and seconds, allowing for C60 or C90 etc.

To enable a facility which indicates during recording how much time is left at any moment the user can then press the 'Tape End' button after pressing the 'Record Open' button. The cassette will then chunter to the end and return back to the preselected beginning again. If you want to record immediately (a few minutes may already have passed!) you can now press the 'Record' button once, which enables the recording circuitry and metering, and then again, which commences recording. If, however, you want to start recording at a later time automatically you must then time-set the internal clock—if it is not already set—and then press 'Time Start', followed by the required time on a 24-hour clock basis in hours and minutes, followed by 'Go'. After a bit of practice at all this, the machine will very reliably commence recording at the right time, and it will also switch on an external B & O receiver if this

Both cassette and controls are concealed in a 'bug hutch'



itself is pre-programmed to the required FM station, for example, with 'Standby' selected.

Before recording can commence, the machine must be calibrated to work with the required cassette formulation, and to enable this the user must push the 'Record Open' button, followed by 'Record Cal'. The machine then automatically biases, sensitises and equalises the record circuitry for the tape selected and returns back to the starting point for recording to begin, the process taking about 10 seconds. The record parameters that have been internally measured can then be written into memory for the appropriate tape type position, but doing this will, of course, erase the previously set up parameters that were in store for the same position.

While the recording is being made, a digital display shows alternately the total elapsed time and the time remaining on the cassette, thus allowing the user to—usefully?—panic if it indicates two minutes left 2½ minutes before the anticipated end of a Mahler symphony!

It is possible to use the numerical buttons to select any start point on the cassette after it has been calibrated: by pressing, for example, '1230' and 'Go' the cassette moves on to 12 minutes 30 seconds from its beginning and then plays back. If the user requires it, it is possible to obtain a read-out of the bias (L and R), sensitivity, equalisation and the MOL characteristics of the cassette tape type which has been calibrated; this is quite amazing, although too lengthy to go into in detail.

Input connections to the machine are via a stereo jack socket for stereo microphones, duplicated on pins 1 and 4 on an auxiliary DIN socket on the front, a 7-pin DIN socket on the rear into which a 5-pin DIN can fit normally, together with a line input facility either on the rear DIN socket or on pins 3 and 5 on the front DIN socket. A 3-position switch on the front selects auxiliary input, microphone input, or rear DIN socket input, whilst underneath the machine is a further switch, which selects DIN current input or line input on the rear DIN socket. Unfortunately no normal phones are supplied on the UK model for some incomprehensible reason; they are available on the US version, but the latter is only 110 volts AC, so you can't win. Also underneath the machine is a multiplex filter switch which cuts the response steeply above 14 kHz. The only outputs from the machine are on the rear DIN socket on playback only, and on a stereo headphone jack during playback and recording.

The microphone input was very sensitive and worked well with medium impedance moving-coil microphones, background noise being very low. The DIN current input reduced the DIN source to approximately 3.6 mV at an input impedance of 3.6 k-ohms. I was delighted to find that, even using Dolby-C Noise Reduction, the DIN input circuitry proved exceptionally good with virtually no additional noise given from a DIN source. The line input impedance when the DIN socket is used is 22k-ohms, both DIN and line inputs having enough sensitivity for virtually all applications, whilst the DIN input clipping margin was excellent at +25dB, ref. a standard DIN source. The line input clipped at 4.5 volts, which should be good enough for all normal domestic applications. The record level meters read peaks very accurately, responding to even 8ms tone bursts, under-reading these only by 1 dB. However, the meters were heavily equalised, and had rather a low resolution other than near peak

level. We did not like these meters in practice; the meter sensitivity also changes depending upon the MOL characteristics of the pre-calibrated tape, 0 dB representing the 2% distortion point. If 'Record Open' is taken off, the meters refer to 0 dB at 250 nWb/m on playback, but with 'Record Open' on they are as calibrated for record. This can be rather confusing, if not fully understood. I personally didn't like the B & O style record faders, but 'Bang & Olufsen people' no doubt will.

The playback section can be switched to 120 or 70 µs by selection with the 'Tape Type' button, and Dolby-B or /C can be switched in as required. Auto tape selection is also available using the cassette tape lugs. Output levels on the DIN socket are adjustable with two separate screwdriver presets underneath the machine to allow up to 1.9 volts output to be reached for Dolby level, although since these controls operate before the final output amplifier, clipping is reached at just under 4 volts, which represents 6 dB over Dolby level. If the presets are turned down, the clipping margin improves to a maximum of about 15 dB and I recommend them to be set for around 600 millivolts.

Plenty of level into low and medium impedance headphones is available even for those who like to blow their brains out, 1.2 volts into 8 ohms being available before clipping. Replay noise levels, although measuring very well, showed the left circuit to be rather noisier than the right, Table 1 giving the various figures. Replay amplifier distortion was always below 0.1%, even at high levels, and replay responses always showed very good compatibility with the latest IEC playback response cassettes. The line output impedance, incidentally, was around 5.6 k-ohms and I would have preferred to have seen this a little lower. Replay azimuth as delivered was very accurately set judging by TDK and Teac standard cassettes, as well as by B & O's supplied azimuth cassette.

Overall responses, using TDK AD C-90, SAX C-90 and Maxell MXC-90 Metal were all extremely good overall, both with Dolby-B and -C as well as without noise reduction, as can be seen from the accompanying pen charts. Metal tape gave astonishingly even and virtually flat response to 20 kHz at Dolby level, even with Dolby-C switched in. The low frequency MOLs were very good with ferric and pseudo-chrome cassette tapes, and good on Metal, although Nakamichi decks, for example, are better on Metal. Overall CCIR/ARM weighted noise measurements were all excellent, showing around 10 dB NR for Dolby-B and around 19 dB for Dolby-C. The worst measured hum was at -63 dB ref. 5% distortion level at 50 Hz on the left channel, other hum measurements being significantly better. High frequency saturation measurements, using Dolby-C, were extraordinarily good, with TDK at 10 kHz giving a maximum output of -2.8 dB, TDK SAX giving +1.9 dB and Maxell Metal an astonishing +4.5 dB ref. Dolby level.

Wow and flutter were measured at the beginning, middle and end of a cassette, and readings were remarkably consistent and very good, no wow actually being heard during listening tests. Speed accuracy was quite incredible, for our reading of 0.016% fast is right in the middle of the ±0.1% tolerance of the speed measurement cassette. Spooling takes around 100s, and no problems of any kind were experienced with tape handling, even very cheap, nasty cassettes achieving a reasonable alignment,



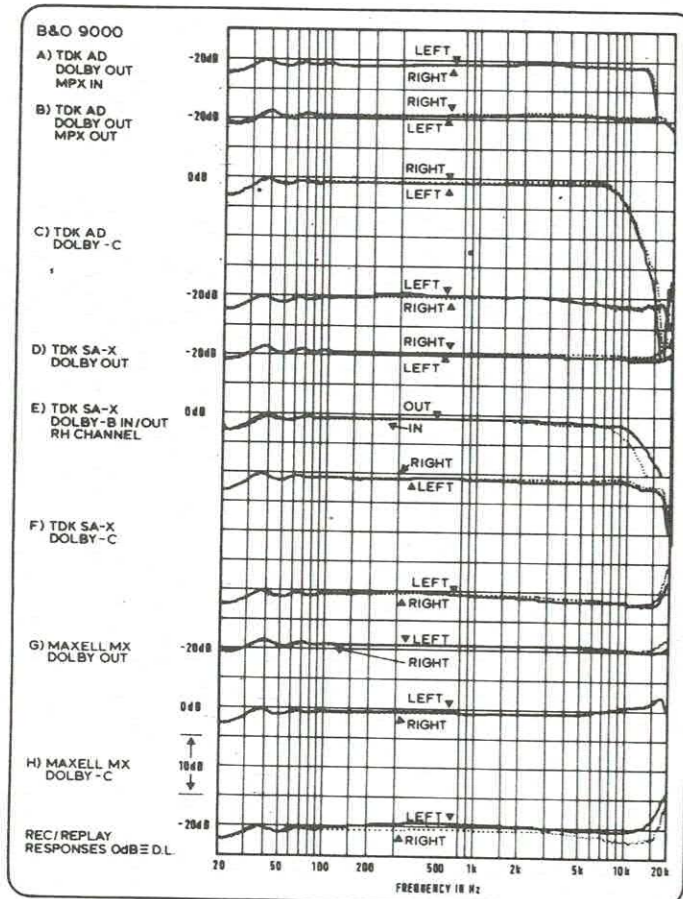
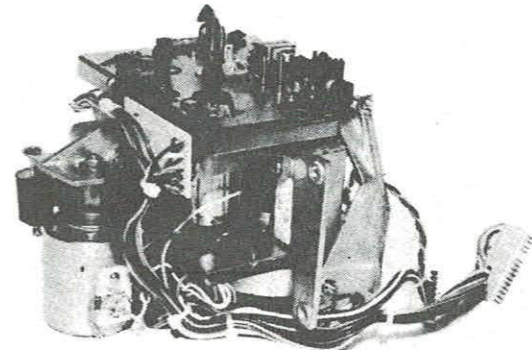


TABLE 1 B&O Beocord 9000		L	R
<b>Replay noise, dB ref. DL</b>			
Unwtd. 20Hz-20kHz, Dolby out, Ferric		-52.0	-56.0
CCIR/ARM (2kHz), Dolby out, Ferric		-58.4	-61.6
CCIR/ARM, Dolby-B, Ferric		-67.8	-71.2
CCIR/ARM, Dolby-C, Ferric		-76.5	-80
CCIR/ARM, Dolby out CrO <sub>2</sub>		-62.0	-65.5
CCIR/ARM, Dolby-C-CrO <sub>2</sub>		-79.3	-83.0
<b>Overall noise via tape</b>			
CCIR/ARM wtd. dB ref. DL. Type I Dolby out		-52.9	-53.9
Dolby-B		-62.8	-63.9
Dolby-C		-72.0	-72.9
Type II Dolby out		-53.7	-54.3
Dolby-C		-72.8	-73.2
Type IV Dolby out		-51.9	-52.2
Dolby-C		-71.1	-71.5
<b>Replay amplifier distortion at 1kHz</b>			
Dolby out +6dB ref. DL 2nd harmonic (dB)		-61	-62
" " 3rd harmonic (dB)		-75	-72
Dolby in -20dB ref. DL 2nd harmonic (dB)		-63	-64
" " 3rd harmonic (dB)		-64	-68
<b>Maximum output levels from tape</b>			
for 5% 3rd harmonic, F <sub>3</sub> = 315 Hz (dB ref. DL)			
Type I		+6.0	+5.9
Type II		+6.7	+6.7
Type IV		+8.0	+7.9
<b>10kHz saturation levels ref. DL</b>			
Type I Dolby out		-5.5	-5.5
Dolby-C		-2.8	-2.8
Type II Dolby out		-1.3	-1.3
Dolby-C		+1.9	+1.9
Type IV Dolby out		+1.5	+1.5
Dolby-C		+4.5	+4.5
<b>Headphone output (max. before clipping)</b>			
8Ω		1.12V	1.1V
600Ω		8.3V	8.2V
<b>Replay azimuth error</b>			
3kHz (TEAC)		+20°	-
12.5kHz (B&O)		-30°	-
<b>Wow &amp; Flutter (DIN pk wtd)</b>			
0.066% Average			
<b>Speed accuracy</b>			
Better than 0.1%			
<b>Line i/p sensitivity for Dolby level</b>			
19mV (i/p gain max)			
<b>Manufacturer/Distributor</b>			
Bang & Olufsen UK Eastbrook Road, Gloucester GL4 7DE			
<b>Typical Price inc. VAT</b>			
£675			



Mechanical heart of the Revox

line and DIN inputs. We found that it was slightly awkward to alter L & R balance, the controls being rather tightly friction locked.

An independent ganged headphone gain control is provided, the 1/4in. stereo headphone jack giving reasonable volume into low and medium impedance headphones from reasonably recorded tapes. On the left of the deck mechanism are four lever switches: power on/off (Off position called Standby since internal memories are active although main electronics are off); tape/source monitor; Dolby-B on/off; and MPX filter. Above these switches are the six normal operational push-buttons in the same order as used by Revox for their B77 open-reel range. Above these controls are three more push-buttons: 'Mode' (switching between tape counter and clock time), 'Run up' (cycles counter or clock to desired starting or stopping position); and 'Zero' (for zeroing the tape counter). Along the top of the front panel is a spring-loaded lid covering what I always term the 'bug hutch', inside which are: four buttons controlling memory and start functions ('Set', 'Start', 'Stop' and 'Clear'); a three-position switch for equalisation (120μs, 70μs or auto); push-buttons for selecting IEC 1, 2 or 4 tape types; and an auto button allowing auto selection from the cassette itself.

The various memory and timer functions include preselection of start and stop times, to allow playback or recording to be initiated without the user being present, or alternatively they can be used in the counter mode, in which case a preset position on the tape can be used for starting and stopping, endless cyclic playback of any required passage being possible—an entire prerecorded cassette could be played again and again in a restaurant to the dismay of all those concerned.

As is usual with Revox, the User Instruction Manual was excellent, explaining user functions extremely well in many languages. We noticed, incidentally, a section entitled 'Copying from Records' on which no further comment seems necessary!

The construction of the deck mechanism is of particular interest, since it appears to be the most stable mechanism I have ever encountered for coping with cassettes. This was evidenced by the remarkably good stability noticed; for example, even when pink noise was recorded equally on both tracks, the reproduced sound stayed absolutely dead centre for minutes on end. Wow and flutter measured remarkably well, and the speed was very accurate (only 0.2% fast). Spooling took approximately 70s for a complete C90 and is thus quite fast.

Revox also loaned me a complete mechanism, thus allowing us to examine its

construction. The mechanism (see photo) features an all-metal diecast transport, which has no drive belts and no friction clutches or mechanical brakes. It contains four motors, one for each hub and one for each of two capstans. The capstans are abnormally large, each being fitted with a heavy flywheel, thus the pinchwheels are correspondingly smaller. A photocell mounted to the right of the playback head scans across the tape path to detect transparent leader tape, the mechanism automatically winding to the end of the blank leader when the tape is rewound. However, we did find that when a prerecorded cassette having transparent leader incorporated was inserted into the mechanism and the 'play' button depressed, the cassette irritatingly stops again at the end of the leader. The erase head is in rather an unusual position, namely to the extreme left of the left capstan. A solenoid controls the movement of the headblock assembly, which comes up to the cassette tape for play and record with amazing firmness and stability, due to the—uniquely?—solid construction of the block. The speed of both capstan motors is accurately controlled by separate phase-locked loop circuits which are referenced to a common quartz oscillator.

Revox's mechanism could well be studied by all other deck manufacturers because of its excellence, it seeming to withstand very wide tolerances of cassette mechanisms. However, it must be said that one tightly wound Decca cassette did jam, the machine fortunately turning itself off before any actual damage to the cassette occurred.

### Lab results

The microphone inputs worked extremely well, giving an adequate recording level from quiet speech around 24in. back from average moving-coil microphones of medium impedance. The five-pole DIN input sensitivity was -23 dB ref. DIN level, and thus one might say unnecessarily sensitive. DIN input clipping was reached at +23 dB, which is excellent, the input impedance being just under 10k-ohms. The DIN input added no noise to the quietest overall tape noise, using Dolby-B, and thus worked admirably well. The line inputs had 38mV sensitivity for Dolby level, whilst clipping was reached at 7.4V, again no noise degradation being noted at normal input settings of the record level control.

Replay azimuth was very slightly in error, but not seriously so, judging by our standard azimuth cassette, but unfortunately it is extremely difficult for a user to alter azimuth: this is a pity since many prerecorded cassettes will only give of their best when a small adjustment is made to the deck. Revox obviously do not intend the consumer to change azimuth but unfortunately we do not live in an ideal world. Whilst the left replay had no hum components worse than -70 dB ref. Dolby level, the right channel did produce -65 dB at 100 Hz, but this should not be audible on normal systems. Weighted replay noise levels all measured extremely well. Replay amplifier clipping could not be accurately measured because machine logic prevented the use of our special probe.

Distortion was generally very good, other than at the very highest levels. Slightly more HF compression was noted than I am accustomed to on the Nakamichi 1000, for example, and it is unfortunate that Revox do not supply the ferric position normally aligned for a more modest tape type for routine recordings. TDK SAX gave very good overall reproduction, but again openness was

allowing a reasonable response. This will be a great boon, since you can select cheap tape for unimportant programmes and still get an acceptable result, whilst a more expensive tape for the same tape position can be used for more important recordings.

### Listening tests

In a very extensive listening test in which we all listened to copies of various digital recordings that I have made of speech and music, we were all struck by the openness and clarity of the reproduced sound using Dolby-C, with no background noise of any consequence even on ferric, when the B & O recordings were compared to the master tape. Ferric cassettes gave an excellent overall sound quality, whereas Metal was truly astonishing and almost as good as most people would ever want in a domestic surrounding (although, of course, slight differences were still audible between the cassette and the master). I would guess that many typical people, though, would be hard put to it to hear these differences.

The only reservation we had in the listening test was when listening to cassettes made from digitally recorded or live speech using Dolby-C, the cassette seeming slightly rough on transients, but very much better than many other Dolby-C machines auditioned. The use of Dolby-B for speech recording was preferred, but on all other material we preferred Dolby-C. Remember that with Dolby-C you do not need to record at so high a level, and thus the sound quality can be cleaner while still maintaining an excellent S/N ratio.

### Summary

This remarkable B & O machine is not only one of the most fascinating I have reviewed, but one that puts B & O right up front in international competition. It should be

seriously considered if its cost can be justified. Once one has become accustomed to the microprocessor operations, the amazing versatility will be found most useful, and ergonomically the deck works surprisingly well. It is not really a machine for people who cannot remember complicated sequences of push-buttons, but since computer operation is increasingly becoming a part of the home environment, why not start with the B & O? I have still not encountered any other make which employs Dolby-HX Professional, and the provision of Dolby-C as well certainly gilds the lily. The Beocord 9000 is a machine that Denmark can be very proud of. It seems amazing that only a few years ago I criticised B & O for being behind the times in their cassette deck development, but what a giant leap they have made in only two years.

Each deck will be supplied with a blank C60 chrome cassette, a non-metallic screwdriver, a 7-pin DIN/DIN lead for interconnection with a B & O receiver, a 5-pin DIN to 4-phonos lead for line input, an azimuth tape in a high quality metal mechanism, and a cleaning kit.

## Revox B710 Cassette deck

FOR WELL OVER 10 years Revox have been observing the domestic cassette deck market, although they have been producing an institutional machine, for language laboratory work etc, for several of those years. Rumours have abounded since 1979 that they were working on a hi-fi cassette deck, and whilst a preproduction prototype was shown in 1980 at the Harrogate Audio Fair, it was only late in 1981 that production machines began to trickle out of the factory. I had been long awaiting a review sample and at last it arrived in January. In its own way it has been well worth the wait, although I must

admit to being slightly disappointed in that it does not contain Dolby-C, nor does it make use of any of the more exotic new circuitry such as Dolby-HX Professional. Furthermore, although the machine is a three-headed one, there is no provision for auto setting-up or even presets for users to alter bias or Dolby record calibration. Revox state that they are prepared to align the deck for any makes of tape specified by the purchaser, the review sample being aligned for TDK type QD (this tape is going off the market very shortly), TDK SAX and TDK MAR.

Many of the B710's features are very similar to those provided on Revox's well-known reel-to-reel recorders: 1/4in. mono jacks being fitted on the front panel for microphone inputs, whilst pairs of phono sockets for record and replay line in/out are on the rear panel together with a five-pole DIN socket for DIN interconnections. DIN remote control socket on the back panel is also provided for interconnection to the B780 receiver.

The deck is a front loader, encased in metal, with the cassette compartment in the centre. Unfortunately, this is literally wide open, no cover being permanently fitted to it; Revox do supply a simple Perspex dust cover but the user must remember where he last put it! To the right of the cassette are two fluorescent bar-graph meters which read even 8ms peaks very accurately (only -0.5 dB). The meters rise rapidly on a transient but fall back slowly, discrimination from -10 dB to +6 dB (full scale) being in 1 dB steps. Indications down to -30 dB are provided and we found the metering very easy to use indeed, although I would have liked the ability to read up to at least +8 dB (0 dB incidentally is Dolby level.) Three LEDs indicate Dolby on/off, auto tape selection on/off and MPX filter in use. Below the meters are two separate concentric rotary input level controls, the left set being L & R mike inputs, whilst the right set is for L & R



# AUDIO PATENTS

Barry Fox

DURING THE course of my meeting in New Jersey with Arthur Keller which led to the recent articles on Bell Labs, he mentioned in passing American patent No. 1 637 082. This was filed in 1925 by Joseph Maxfield, of Western Electric, the Bell manufacturing wing. The patent makes fascinating reading because it purports to prove that 33 1/3 rpm is by no means the ideal speed for a 12in disc record. The Maxfield document is replete with maths, but essentially it claims that there is a definite relationship between the running time of a record, its diameter, the speed of rotation, and the surface area used for recording. The trick is to juggle these parameters for mutual optimisation. Maxfield's patent was concerned mainly with extending the playing time of a disc record so that it

would match the running time of a reel of cinema film.

In 1925 he claimed that from mathematical analysis it was clear that the maximum duration of effective run for a given sized record is obtained if the surface area used for recording is selected so that the inside groove radius is one half of that of the outside groove radius, and the speed of recording in rpm is made equal to 60 times the minimum linear speed in inches per second at which successful sound recording can be effected, divided by  $\pi$  times the distance in inches of the outer groove from the disc centre. The patent offers curves which show the relationship between the speed of recording in rpm and the duration of recording time for records of various diameters ranging from 10 to 20ins.

slightly lacking, although high frequencies were clearer on transients. The entire program reproduced well, with good dynamic range, and the sound was clearly preferred to that of ferric. The sound on Metal was again very good, but with a slight presence valley. Distortion was minimal, provided very high levels were not attempted, and dynamic range, whilst being very good, could have been better. Stability was said by all to be as good as we had ever heard on any cassette tape, whilst the lack of wow and flutter received strong praise.

## Summary

Ergonomically, I liked using the machine very much indeed, finding all the tape operation buttons easy and obvious to use, it being possible to drop into record from playback, and to drop out again, this facility being only rarely available on cassette decks. The machine was clearly much easier to use than the B & O, and can be recommended for those used to Revox controls. However, considering that it excludes Dolby-C, and the record Dolby circuit did not operate quite correctly, I must reiterate a very slight

When plotting these curves, Maxfield used two constants which no longer apply today: a pitch of 100 grooves per inch and a minimum linear speed of 16.7 i/s. But anyone with a mathematical bent and an interest in recording technology might like to re-draw Maxfield's curves using groove pitch and modulation velocity, constants more applicable to today's microgroove high fidelity records. It seems doubtful that the late forties standard adopted by CBS (33 1/3 rpm for a 12in disc) would agree with an update of Maxfield's curves. It would also be interesting to see how the experiments of Nimbus, who are cutting longer playing times into 33 1/3 and 45 rpm discs, relate to the Maxfield analysis of 1925. For anyone interested, a copy of the Maxfield patent is available for free inspection (during weekday office hours) at the Foreign Library of the British Patent Office, or a photocopy of the patent may be obtained for less than £1 from the same source. Only the number (US 1 637 082) will be necessary to identify the document.

disappointment, which is nevertheless combined with much admiration for this deck. In an attempt to be completely fair, I think that this is an astonishingly good first design from Revox, and no doubt the record Dolby problem will be put right. Perhaps also Revox will make it easier for users to have more flexibility in cassette tape choice on a Mk.II model.

A worthwhile addition, then, to top-end cassette decks, though one that may nevertheless have a rather limited sales potential. ●

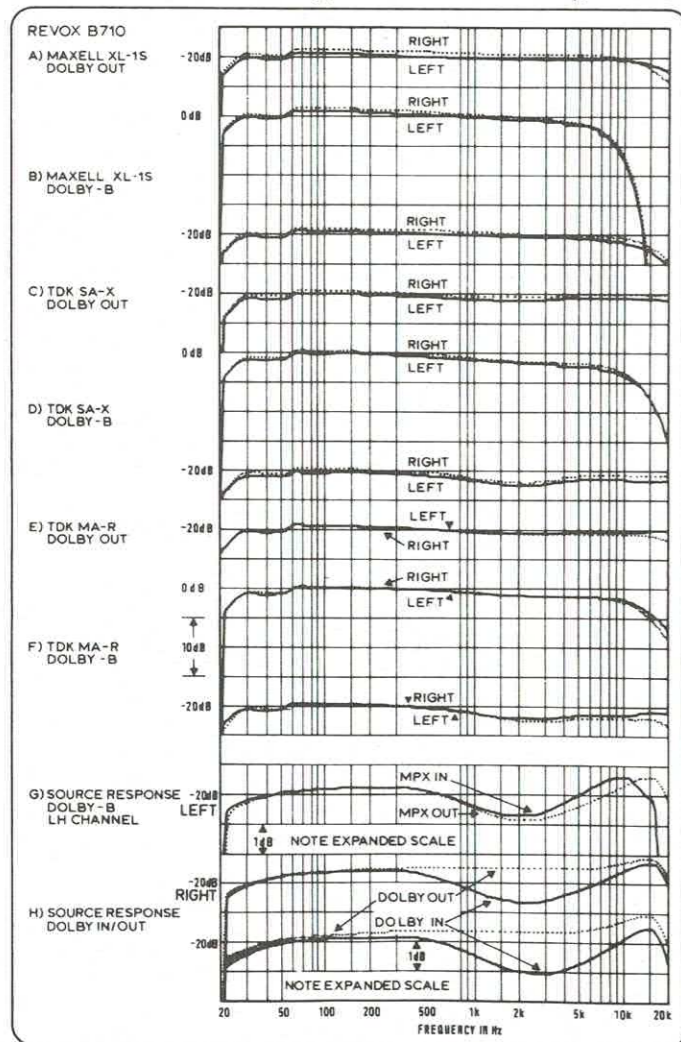


TABLE 2 Revox B710		L	R
<b>Replay noise, dB ref. DL</b>			
Unwtd, 20Hz-20kHz, Dolby out, Ferric		-51.5	-52.5
CCIR/ARM (2kHz), Dolby out, Ferric		-58.5	-59
CCIR/ARM Dolby-B, Ferric		-68.0	-68.5
CCIR/ARM, Dolby out, CrO <sub>2</sub>		-61.9	-62.4
CCIR/ARM, Dolby-B, CrO <sub>2</sub>		-71.3	-71.8
<b>Overall noise via tape</b>			
CCIR/ARM dB ref. DL Type I, Dolby out		-50.7	-50.7
Dolby-B		-60.00	-60.0
Type II Dolby out		-53.6	-53.4
Dolby-B		-62.6	-62.4
Type IV Dolby out		-52.0	-52.0
Dolby-B		-60.8	-61.2
<b>Maximum output levels from tape</b>			
for 5% 3rd Harmonic, f <sub>1</sub> = 315Hz (dB ref. DL)			
Type I		+8.2	-8.3
Type II		+5.6	+5.8
Type IV		+6.5	+6.6
<b>10kHz saturation levels ref. DL</b>			
Type I		-5.4	-5.2
Type II		-3.2	-3.5
Type III		-0.2	-0.3
<b>Headphone output (for Dolby level)</b>			
8Ω		100mV	100mV
600Ω		2V	2V
<b>Replay azimuth error</b>			
315Hz (TDK)		+4°	
3kHz (TEAC)		+27°	
<b>Wow &amp; Flutter (DIN pk wtd)</b>			
0.048% average			
<b>Speed Accuracy</b>			
+0.2%			
<b>Manufacturer/Distributor</b>			
FWO Bauch Ltd 49 Theobald St Borehamwood, Herts WD6 4RZ			
<b>Typical Price (inc. VAT)</b>			
£820			