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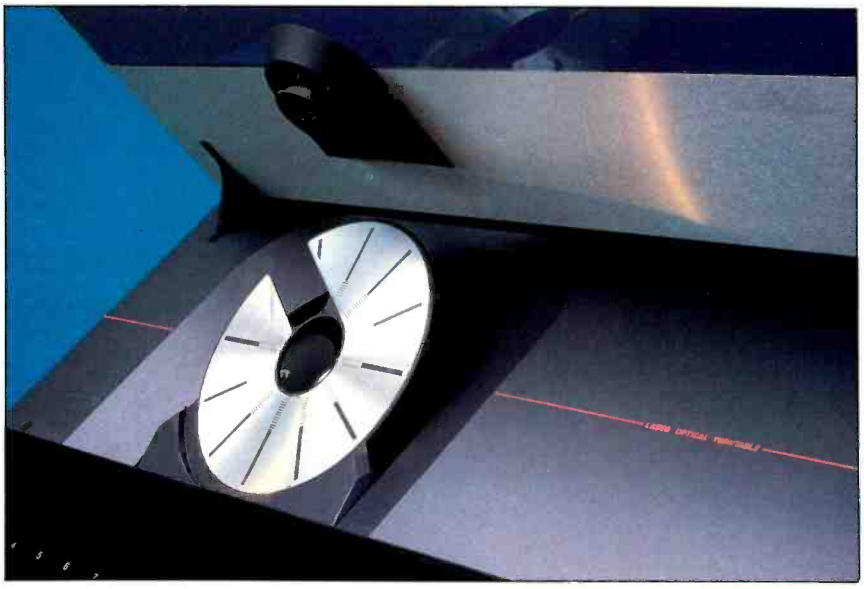

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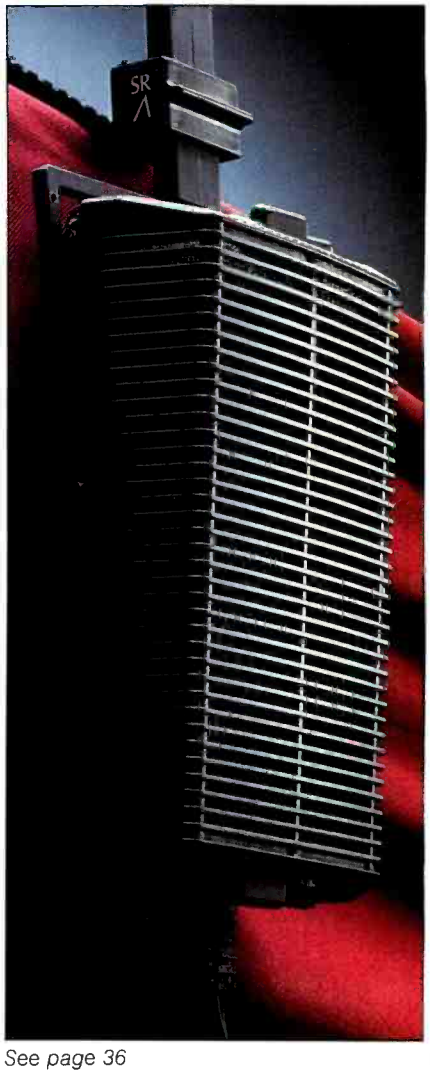

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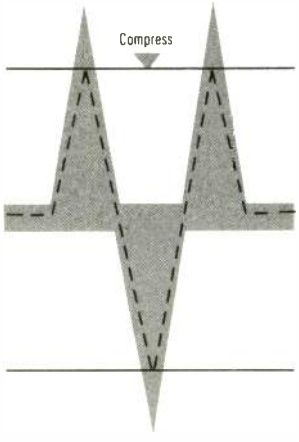

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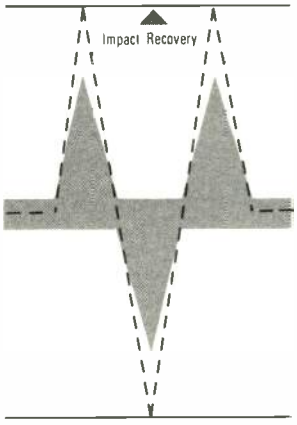

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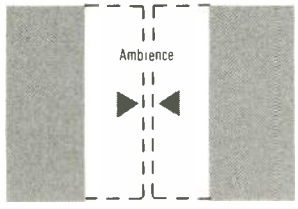

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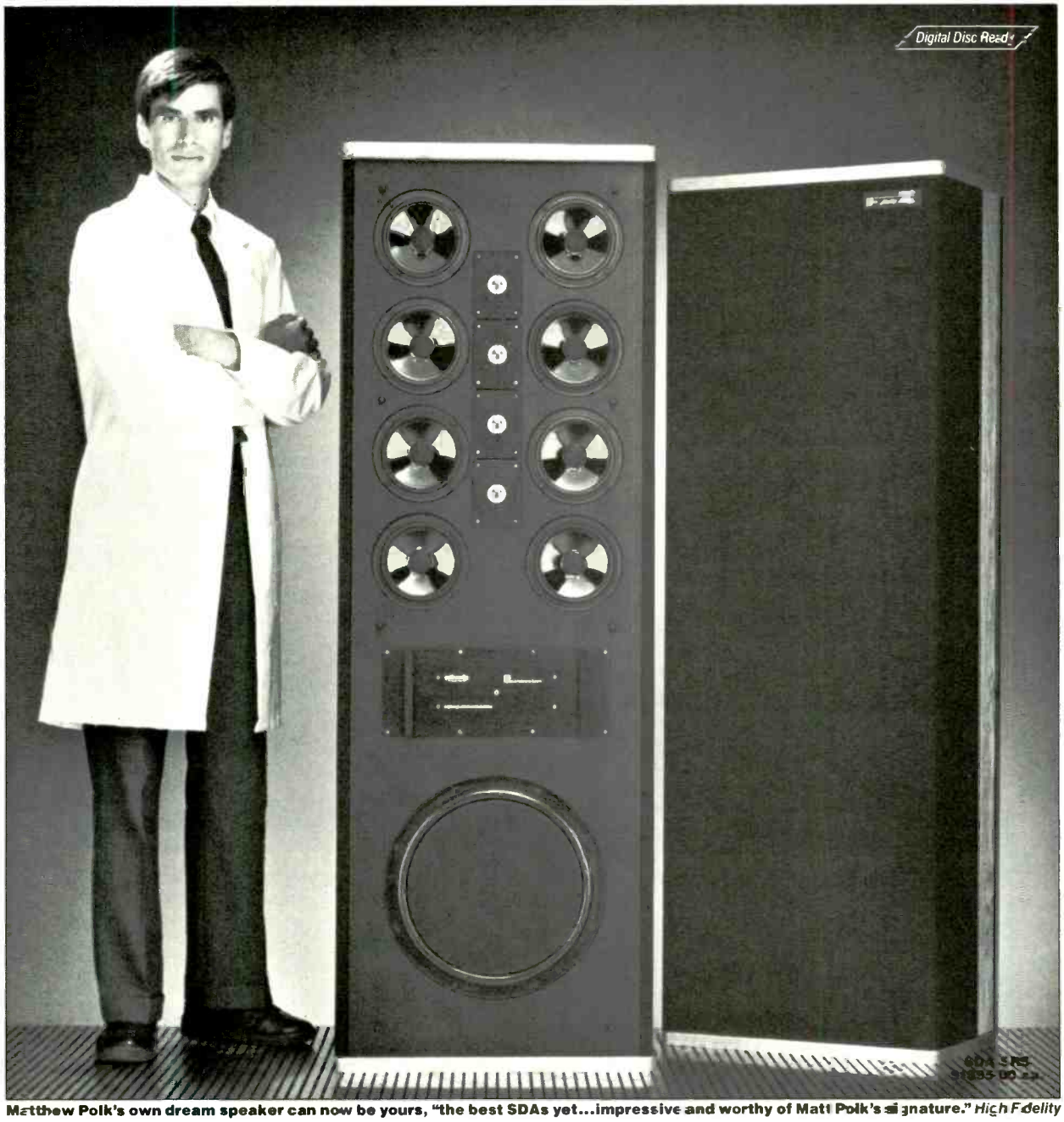

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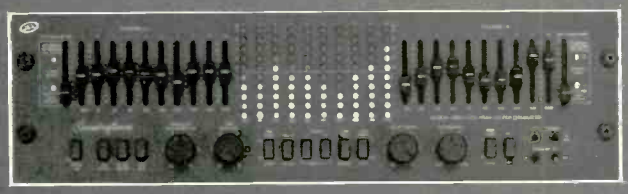

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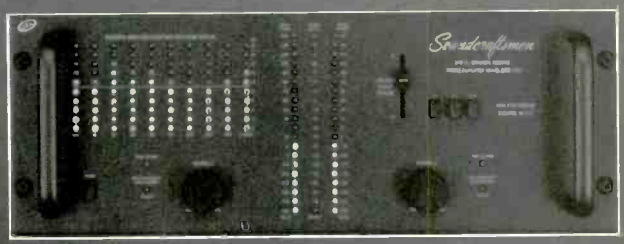

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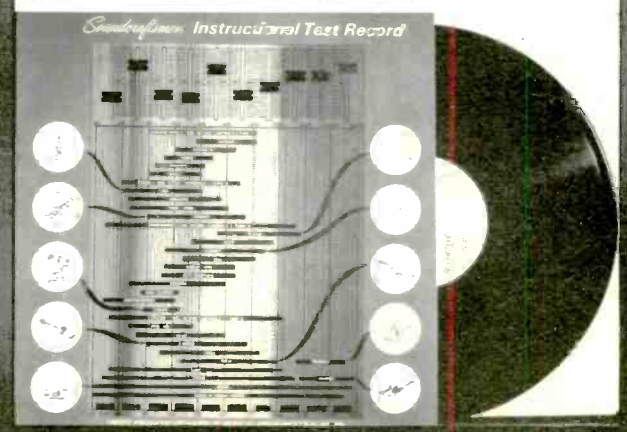

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CANDID CHIMERA

The *indoor* video home movie, with sound! I should have known. That will be it, for a while, anyhow. We'll do our best to make our own TV, just like on the tube—it's the television age, isn't it? And TV is an indoor sport. Besides, the new video cameras can practically see in the dark, and they work well in the living room, right next to the hi-fi.

All this struck me forcefully, a few days back, when I went to a friendly Saturday night party, in a home where I had often been before, and walked, all unknowing, right into the middle of such a video movie. Moreover, the equipment was fresh new, bought the day before, and our host was about to try it out on us. What luck! Just my usual kind.

Now, this account is mildly doctored to protect anonymity, etc., but the audio and the video of it are true-to-life and might even be instructive if you are buying your own video equipment the day after tomorrow. Remember, we are all beginners in this new game, and especially in the audio. We'll be making a new set of amateur bloopers as we try to mate the sound and the pictures. Things will go startlingly wrong, but it will be interesting—and more so as the technique begins to work itself out.

So imagine the scene. The host is an ample Santa Claus type: Gorgeous frowze of gray whiskers and flying hair, cherubic face. He's nuts on showbiz (hence the video equipment, of course), but it's mostly platonic; he tends to silently mime along with recordings of celebrities doing show songs—you know the style. The splendid ex-factory loft he calls an apartment indicates a nice income from somewhere, no doubt a plebeian business, but his home is his stage and showbiz his dream. At parties the folks often gather 'round the spinet piano and bellow Cole Porter et al. (while Canby cringes inconspicuously in a far corner). Or else the show tunes come out of the hi-fi system, just the kind you'd expect—LP, CD, cassette, radio tuner, VCR, big TV monitor, and speakers (typically inadequate), artfully hidden somewhere out of the way. The sound never stops. The VCR shows endless TV or movies, but, oddly, what we usually hear is FM radio—a zany mixture, and who cares? It's all part of the sonic decor, which is just as important as the furniture. Against all this racket, people talk—or rather, shout.

Illustration: Jennifer Skopp

So this time I walk in as usual and am instantly lost. The portable room dividers have been moved again. But instantly my grinning host grabs my arm and steers me left, into a new space next to the kitchenette where the big TV monitor now sits on a table. A lot of people are on the screen, milling around. Some show or other, I think, and plenty distorted—normal Manhattan reception. I turn away but he nudges me and points again. Oops—you can guess. That toadlike body with the bright green head is my own. Short, fat and wide. When I move left, the toad on the tube moves right. We are on camera.

Now, I trust our manufacturers will not take umbrage; the video faults I am now describing are 90% those of technique. We do not yet have the ideal and ultimate consumer video camera, but I quickly discovered that my host's model, a camcorder (with VCR built into the camera) was very far ahead of the simple camera I tried some years ago. The result was grotesque because the operator was a beginner.

The toad-like distortion, a disproportion between horizontal and vertical, was, I think, merely the camera angle. Note that it did not occur to the owner to walk about with camera in hand, or to change location; he set it off to one side and a bit high, some dozen feet from the TV monitor, and there it stayed, with built-in mike. Okay for a start, but he'll have to do better. As for the green heads, I spotted the cause in a moment. The camera hadn't seen enough illumination, so the word LIGHT had appeared on the monitor in large letters. All accommodating, our friend obliged by turning on a bank of white fluorescent tubes directly over the heads of those on camera! That did it. Fluorescent light is rich in greens, and video's automated color balancing is very touchy. This was too much; the balancer turned every pink head a bright green.

The fluorescents went off, the monitor again said LIGHT, and we turned on a number of ordinary, discreetly distant incandescent lights around the big space until the LIGHT went out. Still a comfortable illumination, in fact just right for a party, nothing to glare and blind you, and the colors were now accurate.

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The ESS AMT series loudspeaker; unconventional in design, uncompromising in clarity and definition, and magnificent in their finish and construction.

In an age given to overstatement, it is difficult to convey the achievement represented by these remarkable products.

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My friend's home video wasn't much good, because the sound, picked up by a distant mike in a large and quite live room, was totally unintelligible.

But what of the "movie," and especially the audio? People were still coming in, being startled to see themselves; the rest of us moved to other business, mainly loud talk. The camera had made its ploy; now we forgot it. Were we supposed to stand there like lumps, looking at our toady selves? So the music played, the talk rose up, people blocked the front of the monitor or stood in the camera's way so that only a fuzzy shoulder or arm showed—what a waste of good equipment!

Ah, but our host had further ideas. The camera, all this time, was *recording*. After a while, he would play it back for us—with audio. During recording, of course, there was no sound from the system; there would have been feedback. But on playback we would not only see but *hear*. All those priceless remarks being made, right and left.

What a bust. The playback was good for maybe two minutes of our undivided attention because the sound, picked up from the distant mike on the camera, in a large and quite live room, was totally unintelligible. It was a loud buzz of meaningless voices with fuzzy off-mike music (the loudspeakers) in the middle of it. Nothing else.

The fact is that a show is a show, and this one might have been okay if there had been words to listen to—one or two voices in an intelligible close-up, or some way of picking out voices in the crowd so that there would be continued interest. But *if the sound has no message*, the pictures are spoiled. End of Part II in our friend's rapid video education.

He was amiably undaunted; he had more up his sleeve. Seems that long before we arrived he had set up his camera, pulled his stage curtains (next to the kitchen sink) and put down a big solo act for our later entertainment, as the climax of the evening. With pride he whispered to me ahead of time that it was 40 minutes long. (I groaned inwardly—didn't I tell you that this medium affords *too much* time?)

Accordingly, late in the evening there was a knocking for attention, then clapping, and the Big Show started. Complete, of course, with audio.

I'll have to hand it to this amiable showbiz fan in terms of the visuals. Some of us, we find, are poison to the camera, no matter how distinguished we may look in real life. Others are simply TV naturals. On camera, they blossom, they are more than real. When our hero came forth from behind his own curtains, walked forward to a head-and-shoulders close-up (automatic focus) and smiled a greeting, there was a real hush. This man *had* it, and knew it. That infectious magnetism! Even more than in the flesh itself. But then came the sound.

The music swelled up in the background (out of the hi-fi system) and he began to speak, with that ingratiating and attractive face. A tiny mouse-squeak could faintly be heard: "Good evening, ladies and gentlemen, welcome to . . . " and there was no more, though the visuals went on. We could understand not a word—the "background" music was too loud, and the mike on the camera was much too distant for such a speech. After three or four minutes of visually persuasive but inaudible speech, our host knew he was licked and something had to be done, fast. *Forty minutes* of this? In another three he would have lost his whole audience.

So he did exactly what you would do. He slipped quickly over to the camcorder and grabbed fast forward, to skip violently ahead and maybe locate a few highlights before he lost us. And thereby we discovered an unexpectedly hilarious feature of this and perhaps other new camcorders.

Now, you understand, many VCRs, especially older ones, have a fast forward and reverse in which the picture turns into a temporary nightmare of vague flying figures and wild streaks and flashes of light. (The sound is mercifully turned off in most.) When the VCR is in the fast mode, we try not to look, or endure the violence with what patience we can muster until speed returns to normal. But this camcorder, with VCR built in, is different. The fast forward is slower, I think, maybe two or three times normal. But what is astonishing is that the picture remains serene and absolutely unaltered, just much faster. Even the sound disappears and returns smoothly, with no audible clunks or bumps.

So our friend started to skip, and on the monitor he started to run. As I say, he is a bit of a Santa Claus in size and here he was more, thanks to that toad-

Wouldn't it be nice to have an automated sound zoom, directly coupled to a video camera's automatic focus? It does seem possible, if expensive.

like foreshortening. The instant he pushed the fast-forward control, we burst into laughter. He would talk a moment (soundlessly), then suddenly scuttle madly around the room like some demented groundhog, bless his soul. Then, as suddenly—back to normal speed, as smooth as butter. It was the hit of the evening, and we got through it all in 10 minutes, not 40.

I should note that he did much better in the "mime" parts of his little show, if perhaps by lucky accident. The recorded music, out of that pair of stereo speakers at the far end of the room, was at least fairly loud, just right for his silent "singing" along with the recorded voices, in good lip-sync. That part of his show worked fine, even if the music was unthinkable by hi-fi standards, recorded from speakers at much too great a distance—25 feet or so in that big space. He'll learn to do better. All in good time.

I'll have to throw in a note on the video auto-focus feature since it has so much importance in making the audio meaningful and effective. When those expressive whiskers came into view on the tube and moved easily forward to head and shoulders, sharply in focus, it was the automation that did it, smoothly and suitably blurring the background. With such an excellent picture, a good close-up sound for the voice would have been really persuasive, up to any professional job. This focus automation is immensely improved from a few years back, when it tended to hunt, hysterically, unable to make up its mind what to focus on. No more! Now it is smooth as silk, unobtrusive—a matter of operating parameters. But I note one caution. If in such a close-up you momentarily back away a few feet, or even sway sidewise off-camera, the automation may lose you—your face goes into a total blur and the kitchen sink emerges in all its stark clarity. Disconcerting, and it happened just that way to our friend. To be focused upon, you must fill a certain proportion of the picture. So stay put.

And—somehow—get that mike up close and the audio level right! The camera can zoom but the audio can't, unless you remove the mike and carry it forward in the old-fashioned way. That's a liability. Wouldn't it be nice, it occurs to me, to have an automated sound zoom, directly coupled to the auto-focus? Indeed, it does seem possible, if expensive. We have long had variable-pattern professional mikes, remote-controlled; could such a device be automated to tie in with the video focus, at an "affordable" cost? It could solve a large part of the audio problem in home video. This and other new ideas for miking are likely to get much attention and R&D before we hitch our consumer sound unfailingly tc video.

So—enjoy, and learn as you enjoy. There's plenty of entertainment to come in this area, once we put good sound to good images. A

THE SILENT TREATMENT.

WHY BOB CARVER'S MINIATURE RADIO STATION LEFT THE AUDIO PRESS SPEECHLESS AND HOW IT LED TO THE MOST COMPLETE STEREO TUNER EVER OFFERED.

The new Carver TX-11a Stereo AM-FM Tuner is a technical tour-de-force which further distances Bob Carver's unique products from traditional electronic components – and which can vastly enhance your musical enjoyment.

TWO TECHNOLOGICAL INNOVATIONS.

The performance of the legendary TX-11 Asymmetrical Charge Coupled FM Stereo Detector Tuner is increased by the addition of Ultra High Frequency Wide Band AM Stereo circuitry. With the new TX-11a, AM stereo sounds as good as FM.

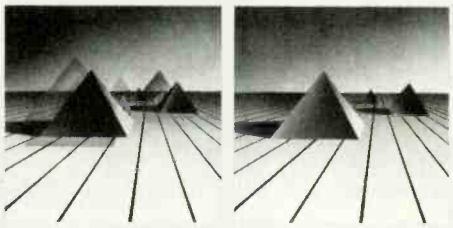
Yes, contrary to popular belief, most AM stereo stations have frequency response (20Hz-15kHz), separation (35dB) and signal-to-noise ratios (70dB) audibly indistinguishable from FM stations of equal strength. It's just that **only** Carver offers the technology to appreciate this hidden performance.

As for FM stereo, the TX-11a virtually eliminates multipath and distant station noise while providing fully-separated stereo reception with space, depth and ambience!

Bob Carver's Asymmetrical Charge Coupled FM Stereo Detector removes (without affecting stereo imaging, frequency response or dynamic range) the hiss, clicks, pops, "picket fencing" and the myriad other unpredictable noises which all too often disturb FM listening.

(Still interested in the story of the miniature radio station and how it impressed hard-to-impress audio critics? Read on. We'll get to it after we explain why the quartz-synthesized TX-11a Stereo AM-FM Tuner will impress you in your own listening environment).

A CLEANER, WIDER FM WINDOW ON THE WORLD.



Because of the TX-11a's Charge-Coupling and Leading Edge Detection technology, ownership may very well change your listening habits. Right now, you probably confine your FM listening to those stations which are strong and relatively interference-free, avoiding weak stations and those filled with distortion. Your options are therefore limited. The TX-11a can significantly expand your choices by recovering stations previously buried in hiss or prone to sudden tantrums of noise.

Ovation Magazine observed that the circuit, "...may well mean the difference between marginal reception of the station signals you've been yearning to hear and truly noise-free reception of those same signals, permitting you to enjoy the music and forget about noise and distortion."

In **Audio Magazine,** Len Feldman said "The significance of its design can only be fully appreciated by setting up the unit, tuning to the weakest, most unacceptable stereo signals you can find, then pushing those two magic buttons."

"Separation was still there; only the background noise had been diminished, and with it, much of the sibilance and hissy edginess so characteristic of multi-path interference."

WHY THE ASYMMETRICAL CHARGE-COUPLED FM STEREO DETECTOR GIVES NOISE THE SILENT TREATMENT.

Thirty years ago, the FCC turned clear mono FM into a substandard stereo medium (with fifteen times poorer signal-to-noise ratio) by approving a broadcast system that is extraordinarily prone to multipath and distant-station-noise.

This system separates stereo into two different bands. Unfortunately, the bands aren't pure Left and Right. Instead, one band is comprised of those parts of a stereo signal that are common to both channels, (L+R, or mono). The other signal, far more fragile and prone to interference, is the difference between the left and right signal (L-R). It bounces off buildings, hills and other objects, and wreaks havoc when

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Carver Corporation
P.O.Box 1237 Lynnwood, WA 98046

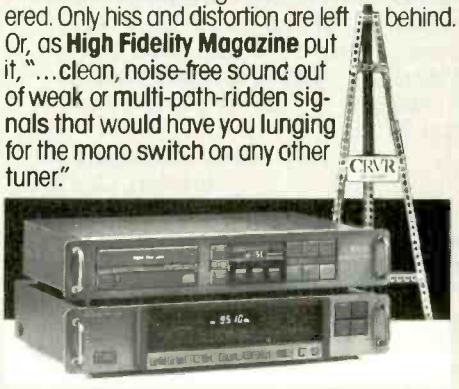
recombined with the strong mono signal.

Bob Carver's Charge-Coupling circuit takes advantage of the fact that almost all noise and distortion is exactly 180 degrees out of phase with the signal it's part of. The TX-11a Stereo AM-FM Tuner cancels these "dirty mirror" images before they can reach your ears. That eliminates up to 85% of the potential noise found in distant or noisy stations.

But Bob wasn't satisfied and knew you wouldn't be either. So another circuit, the Leading Edge Detector, goes a step further by taking advantage of a little-appreciated FM phenomenon: Just 5% of the L-R signal actually contributes to the stereo experience. The rest simply gets in the way of skyscrapers and mountains.

The Carver leading Edge Detector operates only on this critical 5% of the L-R signal, filtering out noise and restoring just that part of the signal needed by our ears and brain to construct stereo imaging.

Blended back into the mono (L+R) signal matrix, a net reduction of 93% – or better than 20dB of noise reduction – is achieved. All ambiant and localizing information is recovered. Only hiss and distortion are left behind. Or, as **High Fidelity Magazine** put it, "...clean, noise-free sound out of weak or multi-path-ridden signals that would have you lunging for the mono switch on any other tuner."



THE LITTLEST AM RADIO STATION.

Before we describe the remarkable attributes of the TX-11a, we owe you the story that proves just how far performance can be extended when a component comes from Carver.

At a recent press conference, Bob Carver unveiled a small antenna connected to a very low powered AM stereo broadcast transmitter (C-QUAM format). Dubbed "Station CRVR," it sat next to a Carver Compact Disc Player and the same TX-11a that's on your dealer's shelves right now.

Bob Carver routed the Compact Disc's signal to the antenna for reception by the TX-11a, and also directly to a preamplifier.

In front of America's top stereo writers, Bob switched back and forth between the transmitted signal (as received by the TX-11a) and the direct CD signal. All listeners had difficulty distinguishing between the outputs of the CD player and the TX-11a Stereo AM-FM Tuner!

Most could tell no difference at all!

HOW AM STEREO GETS THE SILENT TREATMENT WITH THE TX-11a.

* *Unique de-emphasis curve*
* *Whistle Stop cancelling circuit*
* *Pilot Signal cancelling circuit*
* *Ultra-low noise balanced station detector*
* *Very wide band, minimum phase intermediate frequency amplifiers.*

Think of it. Compact Disc frequency response and freedom from noise with AM stereo and the TX-11a. Only Carver could pull it off. But then only Carver could do the same for FM, too.

HUMAN-ENGINEERED FEATURES AND CONVENIENCE.

Many tuners with far less exclusive circuitry than the TX-11a have far more complicated exteriors. Bob Carver wanted to make tuning stations easy, not impress you with flashing lights or complex programming.

So thirteen presets, wide/narrow band selectors, automatic/manual scanning and the buttons which activate the remarkable Charge-Coupled circuits (Multipath and Noise Reduction) are all tastefully inset into the burnished anthracite metal face. Full instrumentation including digital station frequency readout, 6-step 10dB-interval signal strength LED's and other monitor functions is recessed behind a panel, visible but not garish.

The result is performance without theatricality. Access without complication.

A tuner **High Fidelity Magazine** called, "By far the best tuner we have tested..."

CLEAR THE AIR BY VISITING YOUR NEAREST CARVER DEALER.

Ask to hear the most expensive tuner they sell. (It won't be the Carver TX-11a). Now tune a multi-path-ravaged, hiss-filled FM station. Tune the same station on the TX-11a Stereo AM-FM Tuner and press the Multipath and Noise Reduction buttons. You'll see why no other FM tuner can approach it. And why no other AM stereo tuner this good exists anywhere!

MUSICAL ACCURATE

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SIGNALS & NOISE

Awed at a Glance
Dear Editor:

My October *Audio* plopped through the mail slot right on schedule, and a quick glance-through has convinced me it's the best Equipment Directory to date. The color bars, the tape and Hi-Fi VCR listings, and the rethought signal processors section do make it the most useful guide yet, and I'm awed by the ad spreads too. Very enviable work. And "Audio ETC" goes from strength to strength, too.

Chris Greenleaf
Brooklyn, N.Y.

Coming to Take Me Away
Dear Editor:

I was so intrigued by the specifications for the Lirpa Labs IPS-D loudspeaker in the Annual Equipment Directory that I immediately attempted to get the Lirpa telephone number from information. When I was told there was no such listing, I threw a temper tantrum and hung up.

Then I looked up the company address in the directory, jumped on my Moped, and went to the Big Apple looking for Main and Elm Streets. Well, to confess to you what happened is slightly embarrassing. I questioned several of New York's finest (policemen, that is), getting madder and madder as each one told me there was no such place. One policeman finally told me to wait a minute while he made a phone call. Shortly thereafter, a large van appeared, out of which came two burly men in white jackets giving me the suspicious eye. Needless to say, I hopped back onto my Moped and took off for home.

James H. Harger
Annandale, N.J.

Give Us a D. . .
Dear Editor:

Just wanted to drop you a note to compliment you on the 1985 Annual Equipment Directory. To me, this issue is worth the price of a one-year subscription, easily. I act as a neighborhood consultant on stereo equipment, and this issue (as well as the Car Stereo Directory) has proved to be a very big help in comparing products. Keep up the good work!

Joe Roberts
Groton, Conn.

It Ain't Heavy, It's My Speaker
Dear Editor:

Before starting, I should state that I have no technical competence in the audio field and, as a consequence, some of my comments may reveal my shortcomings.

When I received my Annual Equipment Directory, I started to look at the equipment specifications. I noted a CD player manufactured by Lirpa Labs, a company I had never heard of. (An observant friend pointed out that Lirpa is April spelled backwards. So what?) As I have said, I lack technical knowledge, but it did seem that 180 pounds was on the heavy side for a CD player. Lirpa appears to specialize in substantial equipment, *vide* a 62-pound microphone and a 999-pound loudspeaker. (I assume they make a 30-pound cartridge, too, but it was not listed.)

This loudspeaker's weight intrigued me so much that I looked over the rest of its specs. Aren't woofers usually circular? If so, isn't 36 × 3 inches a queer shape? The midrange diameter is given as 2 × 4 inches. Reminds me of my builder. Tweeter diameter: 12 inches That must emit a significant tweet.

Most of the other specs of this loudspeaker seem strange to me too. I have already suggested that 999 pounds seems sort of heavy, but this is redeemed by the price. You can buy this contraption for a dollar a pound! I can't wait.

Although you gave the company address, my letters have been returned to me as undeliverable. Could you give me the correct address? On second thought, don't bother.

Wilfred Godfrey
Osterville, Mass.

Flipping for Lirpa
Dear Editor:

Upon receiving the 1985 Annual Equipment Directory, I immediately flipped to the loudspeaker listings. After comparing the specifications of the Lirpa Labs IPS-D loudspeaker to some other speakers in the same price range, I went to my local Lirpa dealer to audition a pair, and subsequently ended up buying them. The dealer suggested that I also purchase Lirpa Labs BMA amps as they would help produce a cleaner sound than my two Julius Futterman OTL-1s. How right he was; I made an even exchange. Unfortunately, I was not able to audition the PMS preamp or the LSD Compact Disc player; the dealer had sold all his stock, including the floor samples, the previous day. I hope to see them in the near future. I did see the VR-The World, Lirpa's Hi-Fi VCR, and at $18.98 it is a real steal. I placed an order for one, and the dealer promises to have it in stock soon. I can't wait. Thank you for another excellent Equipment Directory issue.

Mark Friedman
Lincolnwood, Ill.

Native or Not?
Dear Editor:

I have been enjoying your 1985 Annual Equipment Directory. It is very complete and my copy will be used all through this year, no doubt. However, next time, I wonder if you could add one more bit of information about each item—whether or not it is made in the United States.

Jimmy S. Wiggins
Bremen, Ga.

A Question of Parentage
Dear Editor:

In September's "Roadsigns" column, Ivan Berger refers to Design Acoustics as being "in friendly competition with parent company Jensen."

Design Acoustics is very happy to be a division of Audio-Technica. I would hate to leave the public with the wrong impression and would appreciate it greatly if you could print a correction in an upcoming issue.

Rock Wehrmann
Assistant Advertising Manager
Audio-Technica U.S., Inc.
Stow, Ohio

Editor's Note: Oops! Two well-known home audio names made car-stereo debuts at their parent companies' booths at the Summer Consumer Electronics Show; hence my confusion. Design Acoustics' production models were at the Audio-Technica booth, while Jensen's display included prototypes of car speakers they will bring out under their Phase Linear name. I'm sure the competition between Design Acoustics and Jensen is friendly, nonetheless—but not quite as friendly as I implied.—*I.B.*

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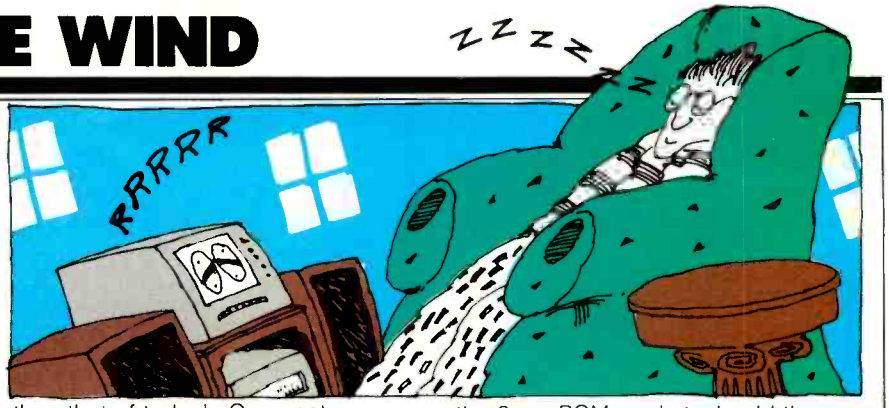
A FAVORABLE WIND



Illustrations: Thomas Waters

No Shave, No Sandwich

The new Digital Audio Tape standards, now that I've had a chance to think about them, have some worrisome aspects. Will the industry actually come out with both stationary-head (S-DAT) and rotary-head (R-DAT) formats? That would set digital tape back several years, while customers and manufacturers trod nervously around the possibility that they might be backing the wrong format. And if R-DAT wins, will it have the same tape-handling problems as today's most popular rotary-head systems—VCRs?

With today's audio decks, tape handling is quick and easy. Punch in the mode you want, and you get it instantly; the tape stops or starts in a fraction of a second, and it takes about one second to rewind one minute's worth of tape. VCRs are sluggish by comparison. Press "Play" and it takes several seconds for the tape to wrap around the head drum and synchronize its tracks with the positions of the heads. "Fast" forward takes about 3½ to 5 minutes for two hours' worth of tape, long enough for you to shave or make yourself a sandwich, but plenty boring if you're waiting for the winding to end.

Since the first R-DAT prototype I saw was at Sony's labs, back in the spring of '84, I expressed this concern to Marc Finer, Sony's product communications manager. He says that R-DAT probably will predominate, but that its tape handling will be quicker, if anything, than that of today's Compact Cassette audio system. (This I gotta see, but probably won't be able to check until late '86 or early '87.) R-DAT's fast tape handling is due to miniature rotary-head assemblies and track-locking circuits.

Marc also told me a bit more about the DAT tech standards: All DAT machines will be able to record and play with a 48-kHz sampling rate, raising the frequency range available to well above CD's 20-kHz limit. All DAT decks will also be able to play tapes recorded at a 44.1-kHz sampling rate, but will not be able to make such tapes themselves. Manufacturers may, if they wish, provide 32-kHz playback too.

Why all the sampling rates? The 44.1-kHz rate will allow easy production of prerecorded digital tapes from the same master tapes that are used to make CDs; DAT's inability to record at 44.1 kHz will ensure that home users won't be able to make direct digital copies of CDs. The 32-kHz sampling rate will allow playback of prerecorded tapes made from masters originally intended for the 8mm PCM market, should there be any available.

The 48-kHz rate will allow direct dubbing from studio masters made with 48-kHz sampling. I see that as a potential security problem for studios (beware the employee who brings his pocket DAT recorder "for listening to tapes during lunch hour"), but no avenue to home piracy—home listeners have no access to studio master tapes or playback decks.

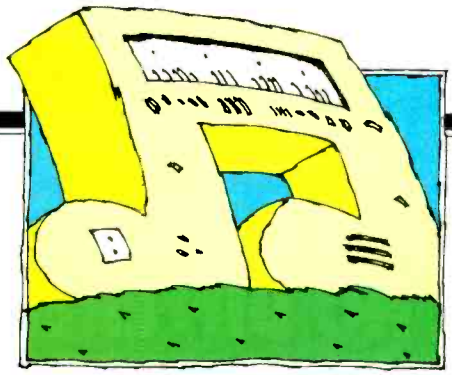
The main home uses for DAT, however, should be in dubbing existing records (including CDs, but via the analog domain) and in live taping (which few amateurs do). The fidelity should be more than high enough for either application, since the 48-kHz sampling rate allows recording of audio frequencies up to a theoretical 24 kHz (22 kHz in practice). That's more than CDs or the vast majority of microphones can deliver. It's nice to have a recording medium which is better than the material you're recording. But will people (other than audio nuts like us) be willing to spend their money for this? Time will tell.

Going for Baroque

One of the things that make life in the audio industry so enjoyable is that so many audio people are drawn to it by a love of music. Those who do make money from audio often give some of that money back to music. The best-known example of this is probably Avery Fisher Hall, part of Lincoln Center in New York. Another recent example is the E. Nakamichi Foundation.

The Foundation was funded by Mr. Nakamichi's estate (with a bequest of Nakamichi Corporation stock now worth $20 million) "to encourage the propagation and appreciation of baroque, classical and other musical forms." To date, the Foundation has underwritten the broadcast of *Music in Time*, a PBS TV series about music history; a number of concert and lecture tours throughout Japan by European artists, and the dissemination of video and audio tapes of these lectures to Japanese secondary schools. Plans are underway for the E. Nakamichi Baroque Music Festival at UCLA in June 1986. The Foundation also intends to support musical competitions, concerts, and lectures in the U.S. and Japan, and to help music students from each of the two countries to study abroad.

A monument of deeds can be as worthwhile—and enduring—as a monument of stone.



Thin AES

Back when I still did live recording, I relished my annual visit to the Audio Engineering Society's convention. The exhibits were full of equipment I could use, and almost afford: Two-track tape decks better than mine, handy little mixers, better microphones, noise reducers, and so on. Now, my interests and the recording industry's have diverged.

It's not just because I'm no longer actively recording—I still would, if I had the time. But the emphasis at today's AES exhibits is on equipment that's of no interest to the amateur recordist. The pro world has gone multi-track; most new tape decks and mixing consoles for pro use are therefore far more elaborate than I could possibly use (or house), even if I could afford them. Small mixers tend to be built for live-performance use, with built-in amplifiers or foldback circuits which I'd have no need for. Only the microphones have remained what they were, the main changes being improved performance, often smaller size, and prices which seem to have just kept pace with inflation rather than skyrocketing beyond it.

Still, last fall there were some pro products which attracted me:

• Studer introduced a special "QC" version of its A725 CD player, which is, in turn, a pro version of the Revox B225 (reviewed in *Audio*, September 1984). Near as I can tell, the standard A725 differs from the home version chiefly in having rack-mount ears and additional, balanced-line outputs. The QC version adds some digital outputs, providing access to the data stream coming from the disc, the audio data just before D/A conversion, the subcode data, and the block-error rate counter. Though it's designed for such purposes as quality control in CD plants, the unit is also ideal for audiophiles who want to compare the quality of various discs or simply to snoop among the subcodes.

• The Electric Valve Editing Co-Professor (from Electric Valve Communication, here in New York) allows you to use widely available video editing equipment to edit PCM tapes made on such popular PCM converters as Sony's F-1, F-501 and F-701, the Nakamichi DMP-1000, and the Sansui X-1. (The PCM processor must be modified for use with the editing system.) Crossfade time is 8 mS, and editing accuracy varies from 16 to 33 mS, depending on your other equipment. The crossfade time compares favorably with analog—for a 45° splice on ¼-inch tape at 15 ips, it's 17 mS. But the editing accuracy is less impressive: I've shaved and even transposed edits 1/16 inch long on 15-ips tapes, equivalent to just over 4 mS. I suspect I'd find the digital system a bit coarse for really hairy work, though fine for such relatively undemanding jobs as splicing two takes together at a rest in the music.

• Monster Cable showed its Prolink series of plugs and cables. These bring audiophile cable design into the pro area, where balanced lines, three-conductor XLR plugs and ¼-inch phone plugs replace the unbalanced lines and RCA phono jacks we're used to at home. I especially liked the XLR connectors' emphasis on easy soldering and all-captive parts. Monster's reference to "those little pieces with those silly little screws that always seem to get lost" hit home with me—between XLR plugs and phono cartridges, there was probably a quarter pound of screws in the last rug I discarded.

Not every item that piqued my interest was related to recording. For example:

• Sound Ideas, of Toronto, now has a sound-effects library on CD. I've used a lot of commercial sound-effects LPs in college and Off Off Broadway shows that I've done sound for, and surface noise has always been a menace, ever ready to dispel the audience's illusion. With CD, that problem's gone. What's left is the problem of paying for it. The 3,000-effect library takes up 28 CDs and costs $1,450. That's larger than the production budget for many shows.

• Two pro-equipment manufacturers have sidled towards the home market. Aphex Systems, best known for its Exciter, showed a decoder for surround video sound (though apparently not truly Dolby-compatible), for SQ quadraphonic recordings, and for SQ-8, an eight-channel enhancement of SQ developed by Aphex. The AVM-8000 can be set up for correct imaging with anywhere from three to eight outputs connected; there's also a subwoofer output.

EXR's Exciter, similarly named but otherwise different from Aphex's, is now being made available to manufacturers as a module for incorporation in audio components. It is claimed to add "a crystalline clarity, intelligibility and separation to an audio signal without changing its tonal quality or phase integrity." Exciting claims, those.

• Since I'm also a computer buff, I was intrigued by the IED Audio Control System (from Innovative Electronic Designs of Louisville, Kentucky), which puts large stadium or institutional sound systems under the control of a Sony microcomputer. I'd like to see something like that for home use, only far cheaper, simpler, and designed for use with any home computer; it will come, someday, but I'm not holding my breath. I was also interested to note that there is now a Broadcast and Communications area on Compuserve, a computer communications and information service.

• I heard about, but did not see, a 2,500-watt amplifier called The Beast, from C Audio. It's presumably designed for large-scale (e.g., rock-concert) sound systems, but would not be as absurd as you might think for home use. I once calculated that a worst-case home system (a large, softly furnished room, in which loud music is played through very inefficient speakers) would require at least 2,000 watts per channel to ensure that no musical peak would ever be clipped by the amplifier. (What the speakers would do with all that power is another problem.) And that was before the Compact Disc, with its higher peak-to-average level ratios.

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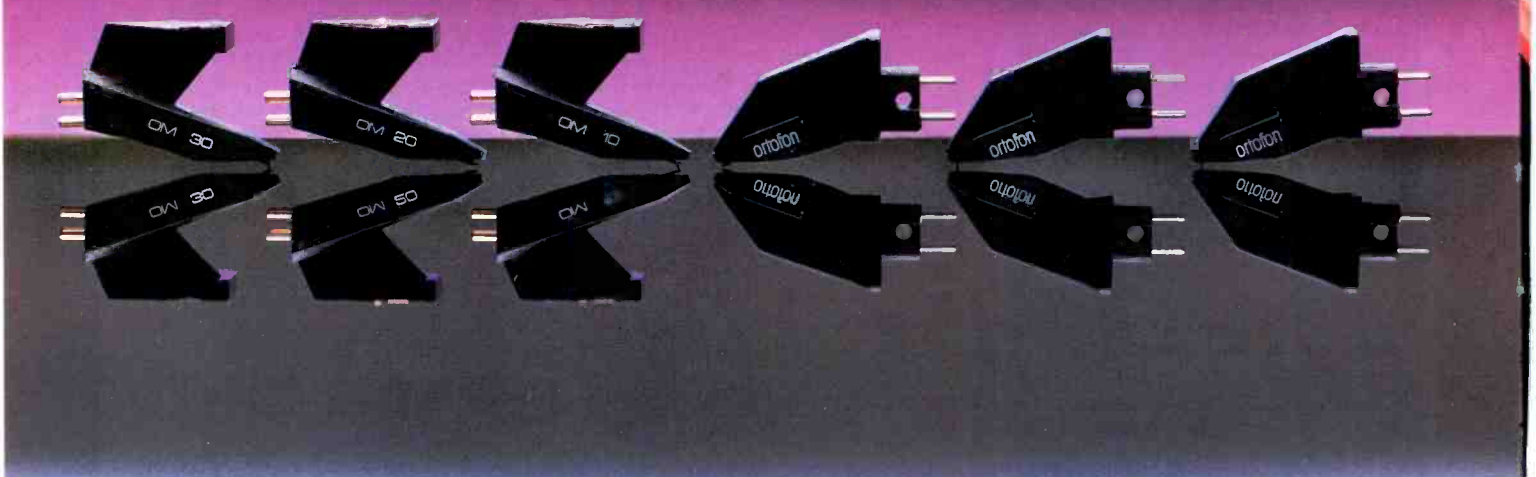

With all of these features and performance benefits, it is no surprise that the OM cartridges are the most successful series ever introduced by Ortofon.

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Subsonic Filters

Q. I always leave my amplifier's subsonic filter switched in. I use a Nakamichi noise-reduction unit with its subsonic filter switched in, too. I also use my equalizer's 16-Hz band as a subsonic control. I know that such filters are helpful, but how much is enough? And does all this subsonic filtering degrade my system's bass response?—Terry O'Shea, Canadian Forces, Europe

A. Chances are you're using more subsonic filtration than is necessary. And it is certainly possible that you're losing some deep bass (30 Hz and lower), especially because of the 16-Hz equalization control, whose effect extends to 32 Hz or higher.

Depending on your cartridge, the flatness of your records, your turntable's rumble level, the internal circuitry of your amplifier and the design of your loudspeakers, you may not need any subsonic filters. For sources other than phono, you probably need none at all. One way to check, for each source, is to remove your speaker grilles and observe your woofer cones during silent or very quiet passages in the program material. If you can see your woofers moving slowly in and out, you need some subsonic filtration.

Back-Cueing Phonograph Records

Q. How bad is it to back-cue records? I have heard everything from "disastrous" to "harmless."—Joseph M. Roberts, Wilbraham, Mass.

A. For those unfamiliar with the practice, "back-cueing" is a two-step process used by disc jockeys and the like to start a recording precisely on cue. First, the stylus is placed in the groove and the disc turned forward until the beginning of the first recorded note is heard. Then the disc is turned backward, just far enough so that, when the turntable is started, the first note will reach the stylus just as the turntable has attained full speed. (This distance must be measured individually for each turntable.)

If we were still using phonograph cartridges which required high tracking force, back-cueing would degrade records. Even so, radio broadcasters have used this technique over the years. When a record was popular (and therefore played a lot), one could hear a bit of noise at the beginning of the disc. Otherwise, one would never realize that the discs were back-cued.

Today, back-cueing is more likely to cause damage to delicate styli. Most major cartridge manufacturers offer special styli, designed to withstand back-cueing, for at least some of their cartridges. However, I back-cue frequently without such styli, even with moving-coil and other delicate cartridges, and have never had a problem. Perhaps your luck won't be this good, but if you don't do it very often, I don't think you need to worry.

Gauging Tracking Force

Q. When I set my turntable's anti-skating force to zero and its counterweight to have zero tracking force, and when I next set the arm's tracking-force and anti-skating adjustments for 1.25 grams each, my independent, external tracking-force gauge reads only 1.0 gram rather than the 1.25 grams I expect. Should there really be such a wide discrepancy between readings obtained by the calibration controls on my tonearm and those indicated by an independent tracking-force gauge?

When the arm "floats" (at zero tracking and anti-skating force), should it float all the way to the spindle? Mine floats about one-third of the way and stops. Does this suggest, perhaps, friction in the pivots?—Name withheld

A. I would trust a good, independent tracking-force gauge more than I would a tonearm's calibration adjustments. Even if the arm's calibration scale is correct, you can throw the results off by not correctly balancing the arm to zero before you set the tracking force. Suppose, for instance, that the arm is neutrally balanced when it floats just slightly above a disc placed on the turntable; if you float it too high above that, or just above the turntable mat, subsequent calibrations will be off.

As for the tonearm's drift toward the spindle, check the arm's instructions. If the arm is floating freely, the anti-skating force is really zero, and the turntable and arm are level, I believe it should not drift at all.

Once you have set all adjustments in accordance with the manufacturer's instructions, I believe the best way to get maximum performance from your cartridge is to use a test record designed to aid in setting tracking force. This takes into account the performance of your particular arm and cartridge.

Shielded Cable for Speakers

Q. I have heard that shielded cable should not be used as speaker wire. Why is this so?—Thomas W. Ward, Manchester, Conn.

A. Shielded cable is too light-gauge to handle the power from an amplifier, and some amplifiers may not tolerate the capacitance of shielded cable. Shielded cables *are* used between other audio components, where the signal levels are much more nearly the same as ambient electrical noise fields. Without shielding, the cables might pick up hum and other noises. Even with shielding, cables may pick up fields radiated by the sizable currents flowing in speaker cables, which could lead to oscillation. If the speaker lines are kept well clear of the other cables, such interference is unlikely.

Stereo/Mono Switch

Q. I have heard that the "stereo/mono" switch on a preamplifier affects the way a phonograph cartridge works. Would you explain the function of such a switch? —Eugene Gash, Washington, D.C.

A. Unfortunately, these switches are not found too often, but most audiophiles may not really need one.

When the switch is set to "mono," the differences between the two channels—including any noise that is part of this difference signal—disappear. This is especially useful when playing monophonic material, whose difference signal would consist *only* of noise. When playing mono phonograph records, the "mono" setting may also eliminate rumble, which is often more pronounced in the vertical plane. On stereo records, the difference signal is cut vertically. This rumble may be recorded on the disc, or it may come from your own turntable. Thus, the switch does not affect the cartridge's operation, but it does affect the signal that the cartridge produces.

If you have a problem or question about audio, write to Mr. Joseph Giovanelli at AUDIO Magazine, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.

Sometimes there's audible hiss even on digital recordings, but it is not usually annoying unless levels are very high and the treble is pushed up.

The "mono" setting is also useful in listening to weak, noisy FM-stereo signals. Most noise rides on the L – R difference signal, and when this signal is cancelled, the noise disappears. Of course, the signal then becomes monophonic, with the same sound coming from both speakers. The "mono" switch on a tuner does the same thing; many tuners also have automatic or manual "high-blend" switches which eliminate most of the difference-signal noise (most audible at high frequencies) while leaving some stereo information in the signal. My most common use for a high-blend switch is when playing or dubbing a monophonic signal source such as an old tape. When the switch is set to "mono," a signal feeding into just one input channel will automatically be fed into both output channels.

Such a switch is not indispensable. Lacking one, you can use a Y-connector to patch a monophonic signal source into two channels, or two Y-connectors, back-to-back, to eliminate the difference signal from a stereo channel.

Recording Discs at Home

Q. If a CD player cannot be used to record, why waste money on it?—Greg J. Weimer, Quincy, Ill.

A. Do you own a phonograph? Can that phonograph be used as a recording device? Consider these questions, and you might see the matter in a new way. However, as a matter of fact, at one time the home enthusiast did enjoy making phonograph recordings as a hobby. The discs used were quite expensive. Once recorded on, they could not be reused. Stereophonic recording on phono disc was quite a challenge in the home, and required bulky equipment.

There will probably come a time when it is possible for the consumer to record on CDs, but this is definitely impractical at this time.

Hiss on CDs

Q. I have several CDs which are digitally recorded, mixed and mastered. Nevertheless, I hear a faint hiss in the background when I play them. What is causing this? When I listen to my integrated amplifier at full volume, with no input or with the CD player on pause, I hear no hiss at all.—Bill Law, Bolingbrook, Ill.

A. Sometimes there is audible hiss present even where a recording is digital "all the way." This hiss is, in most instances, caused by inherent noise in such analog equipment as the recording/mixing console and the microphones used in the recording studio. (Few studios have digital consoles yet, and I know of no digital microphones.)

This hiss is usually not in the least annoying. But when listening levels are very loud, and when the treble is pushed up or the tweeters are very bright, the hiss will be apparent.

Variable Pitch

Q. Is there any way to install a variable-speed (pitch) control in a tape deck that doesn't have one?—Mark Mayhew, Platteville, Wis.

A. There is no easy way that I know. One can build a variable-frequency power supply—assuming that the speed of the capstan motor varies with frequency—if one has sufficient knowledge and skill. Articles on building such a power supply have appeared from time to time in various electronic periodicals which your local library might have. (One such article, if you can still find it, is "Programmable Control" by Gary McLellan, in *Popular Electronics*, April 1981.)

Time for a New Deck?

Q. I have an eight-year-old tape deck whose frequency response and signal-to-noise ratio are not as good as another, three-year-old deck which I also own. The older deck is in need of repair. Since I need a second deck for dubbing, I'd like to know if I should repair the older deck or buy a new one.—John DeRosa, Mattapan, Mass.

A. In a time when very good performance can be obtained from cassette decks costing less than $300, it is questionable whether it pays to try to bring an eight-year-old deck back to its original level of performance. Such a deck may have any number of problems, including pronounced head wear, excessive wow and flutter, improper frequency response, etc. You should get an estimate as to what the appropriate repairs would cost. If the amount approaches $100, it would probably be best to apply this sum toward a new deck.

Emphasizing Treble Response

Q. To accentuate treble response, I understand that some people record on high-bias tapes with the proper equalization but play back with normal equalization and with Dolby NR. Can I get the same or better results if, using a deck with fine bias adjustment, I slightly *lower the bias while recording but in playback use the proper equalization? What adverse effects would this have?*—Gabriel Vazquez Padua, Bayamon, P.R.

A. First let me state that using Dolby noise reduction only in playback and not in recording will *reduce* treble response. On the other hand, using normal (120-μS) instead of high-bias (70-μS) playback equalization will accentuate treble response. The net effect would appear to be a moderate cut in treble.

Recording with underbias in order to emphasize the high frequencies tends to increase distortion. Whether the effects of underbiasing are audible depends on the extent to which you underbias, on your recording level, and on the sensitivity of your hearing. The better course, if you want to moderately emphasize treble, is to use 120- instead of 70-μS playback equalization. Or you could judiciously use your audio system's treble control. I suggest that you experiment with various combinations of bias, playback equalization, use of Dolby NR only in the record mode, and use of your system's treble control to learn what best satisfies your taste.

Dolby Level

Q. The term "Dolby level" crops up in the literature frequently. What does it mean? Why is it indicated on some decks and not on others? Why is it referenced in some deck specs and not in others? How can the average schnook use this information?—Russell Stepanchak, Columbia, Pa.

A. The Dolby B and Dolby C noise-reduction systems work by boosting weak treble signals in recording and cutting them by an equal amount in playback, thereby restoring flat response and cutting high-frequency noise. The amount of treble boost varies with the high-frequency signal level; for the treble cut in playback to be complementary to this boost, the playback circuits must be able to determine what the original levels were. To make this possible, both record and playback circuits require a reference level of magnetism on the tape. This Dolby reference level is 200 nanoWebers per meter for a 400-Hz signal.

When properly adjusted for a given tape, a 400-Hz signal which just reaches the Dolby-level mark on the meters in recording will be recorded at 200 nWb/m on the tape, and a signal of that level will register at the meters' Dolby mark in playback. Some decks come precalibrated for correct Dolby-level matching on specific tapes; since tapes differ in their sensitivity, other decks can be adjusted by the user for correct matching on any tape.

Improper matching of recording and playback levels ("mistracking") when using Dolby NR will adversely affect frequency response, usually in the form of treble loss or rise. Mistracking of up to 2 dB is usually not considered serious.

Inaccurate Speed

Q. I recently purchased a home cassette deck which I use mostly to record tapes for playback on my car deck. But when I play these tapes they seem to run slower than on my home deck. A friend who owns the same home deck says he too notices slow playback on his car deck. What could be the problem?—Mike Egan, Lindenhurst, N.Y.

A. Either your two car decks are both running slow or your two home decks run fast. It's more likely that the home decks are at fault, since identical decks are more likely than dissimilar ones to develop identical problems. Buy some prerecorded cassettes which list the timings of selections on the liner notes or labels. Listen to these cassettes on both home and both car decks, and check their timings on all four decks. If you notice audible speed differences, they are probably on the order of 6%, enough to alter the music's pitch by a semitone. Most people do not notice pitch deviation until it's an appreciable part of a semitone, though very few can detect a pitch deviation as small as 1%. Once you have found out which decks are at fault, have them adjusted by a qualified service shop.

Azimuth Alignment

Q. Please explain how I can check the alignment of my cassette deck's head through the entire frequency range, not just at one frequency.—Edward Kalinowski, Philadelphia, Pa.

A. Presumably you refer to azimuth

If you have a problem or question on tape recording, write to Mr. Herman Burstein at AUDIO, 1515 Broadway, New York, N.Y. 10036. All letters are answered. Please enclose a stamped, self-addressed envelope.

If a tape splice is made diagonally, as opposed to perpendicularly, transitions between sections will be both mechanically and audibly smoother.

alignment of the record-playback head or playback head. Inasmuch as accurate azimuth grows more critical as frequency increases, it is tested at a high frequency, such as 12 kHz. If the check is performed at much lower frequencies, such as 1 kHz, little is learned. That is, an error in azimuth which produces insignificant loss at 1 kHz may produce disastrous loss above 10 kHz or so. On the other hand, an azimuth check isn't ordinarily made at a very high frequency, say 18 kHz, because many decks have very little response this high in the audio range. Further, the playback level may tend to fluctuate considerably, making it rather difficult to ascertain the peak reading when adjusting the head's azimuth. Third, at very high frequencies one tends to encounter false peaks in head response, so that an incorrect azimuth alignment may result. (To avoid aligning to a false peak, the procedure sometimes followed is to preliminarily align the head on the basis of a frequency in the low treble range, such as 5 kHz, and then touch up the alignment on the basis of a high frequency such as 12 kHz.)

The customary way of checking and adjusting azimuth is to play a test tape containing a high-frequency tone, say 12 kHz, and adjust the tilt of the head until you obtain maximum output as indicated by an audio voltmeter or an oscilloscope. If the cassette deck's meter indicates playback level, this can be used, too.

In the case of decks with separate record and playback heads, the playback head is aligned first. Then the record head is aligned by simultaneously recording and playing a high-frequency tone and adjusting the record head for maximum output in playback.

Dropouts on Splices

Q. I am having difficulty when splicing cassette tape. I have tried both perpendicular and diagonal cuts. The trouble is the dropout of 1 S or so that I hear when the spliced area (which is ½ inch long) passes over the heads. The splicing tape seems to be considerably stiffer than the cassette tape, and my guess is that, in playback, the portion of the tape with the splice loses contact with the heads.—Leo Unger, Los Angeles, Cal.

A. The pressure pad should be effective in maintaining tape-to-head contact. Are you by any chance putting the splicing tape on the wrong side of the audio tape? It must go on the side away from the heads—the shiny side of most tapes (though some newer types are shiny on both sides). The two ends of the tape should butt up against each other perfectly, with no gap through which the splicing tape can be seen or through which its adhesive could ooze onto the heads or the next tape layer. Diagonal splices offer a smoother audible and mechanical transition between the tape sections than do perpendicular splices.

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FORMAT FORECAST

When we left our story last month, Intergalactic Widget's top engineer, Smedlap, had just completed his presentation on digital audio cassette systems. Smedlap explained that both rotating-head (R-DAT) and stationary-head (S-DAT) systems were entirely feasible from an engineering standpoint. Criteria such as mechanical and electronic complexity, data density, head life, recorder size, playing time, and cost were amazingly balanced between the two systems. It was up to you, the Chief of Intergalactic, to decide which format to embrace.

While in the throes of indecision, Ms. Meyerbeer, your ace marketing analyst, had angrily burst into the board room. She planted herself firmly at the head of the conference table, making her convictions quite clear.

"The potential problem with digital tape," she explained, "is that maybe no one will want to buy it." She paused for dramatic effect, while Smedlap's eyebrows did the talking, and then continued. "You see, we have to consider the marketing implications before we jump into this. Above all, let's not repeat the same old scenario in which you engineering types huddle in the lab, appear with some new product, and then expect the marketing people to create a market for it. The world doesn't need any more quadraphonic receivers or Elcaset tape machines, or even digital audio recorders based on videotape. So why does it need not one, but *two* new digital tape formats?

"Think about it. Why was the analog compact cassette such a success? Primarily because it offered a combination of features not present in any other format. Given steady improvements in sonic quality, the cassette's supremacy over the vinyl disc was apparent: It was recordable, and portable. Cassette decks were also more portable, and less destructible, than open-reel recorders. And the cassette was more convenient, smaller, and easier to record than the eight-track cartridge. It constituted an entirely new format concept, which proved to be so strong that the cassette has become the dominant medium for prerecorded music. When you add sales of blank tape, the numbers are staggering.

"The lesson is one of originality. When a new product appears, to be successful it must be wanted by the buying public. That requires the presence of an unfilled need, and the proper means to exploit it. The Compact Disc is an ideal example of a product destined to succeed, because it embodies the magical combination of benefits which make it an original: It combines, for the first time, the phonograph's advantages of rapid access to any portion of the music, and the cassette's advantages of convenience and durability—plus the new advantage of super-high fidelity.

"Digital audio cassette recording, however, does not offer a new concept in format. Aside from smaller size, digital cassettes essentially duplicate the analog cassette, with potential for better sound quality—quality already available in the CD format. Thus, the question of success for the new DAT formats rests on their head-to-head competitiveness with analog cassettes, with the Compact Disc—and with each other. As makers of prerecorded cassettes, will we need to make tapes for both formats, or only for one—and if so, which one?

"How do S-DAT and R-DAT stack up against the analog cassette? There are some advantages: Sound quality will be better, cassette size will be smaller, and the formats will enjoy the favored status of being 'digital.' There are also negative attributes: Two formats are inherently weaker than one; the cost of hardware, tapes and duplication will be higher; hardware size will probably always be larger, and DAT will have to compete against an existing standard.

"A similar list of pros and cons may be drawn up for DAT versus the CD. Digital cassettes have advantages: They are recordable, and the cassettes are slightly less bulky than CDs. There are also disadvantages: The tape will probably cost more than a CD, will not be as durable, and will wear out with repeated playings. Also, the hardware will be more expensive, the heads will wear out, and players will not be as portable.

"Clearly, DAT faces stiff competition from the leading contenders. Furthermore, no matter how we sort out the pros and cons of DAT, we cannot come up with an original application in which it is clearly unique, or superior to existing formats. Therefore, because it lacks concept originality, the DAT will apparently not create an entirely new market of its own. Its only hope is to supplant existing markets. And that leads us to the obvious question: Exactly what are the existing markets?"

There are two existing markets for cassettes—prerecorded tapes and blank tapes. While the former accounts for significant sales, sales of the latter, continued Ms. Meyerbeer, are even more significant. Being a marketing wiz, she quickly cited statistics to back her claim. "According to a study commissioned by the Recording Industry Association of America, in 1982 home

Illustration: Philip Anderson

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Copying an analog cassette or an LP onto digital tape won't improve fidelity, and copying a CD onto DAT will not mean greater portability.

tapers recorded 564 million albums worth of music—about 20% more music than was purchased. And, the study shows, it's not just a few nasty teenagers doing the home taping. The RIAA reports involvement by a broad group of age ranges: 31% of those who tape at home are 10 to 17 years old, 39% are 18 to 34, 25% are 35 to 54, and 5% are 55 to 79 years old. Blank tape is big business, and a full 84% of all blank tape purchased by consumers, says the RIAA, is used to copy copyrighted music.

"Why," Ms. Meyerbeer asked, "have honest Americans become pirates? One possible answer might be money. Blank tape is certainly cheaper than buying an album and wasting all that money on things like artists' royalties. But most pirates live in above-average-income households, and often only tape records they have already purchased. There is also another, more important reason why they tape: A cassette is more convenient. It plays at home, in the car, at the beach, or while you're exercising; anyone who carried a turntable when jogging would be considered eccentric.

"Where does this leave us? We may conclude that the market demands a high-fidelity sound carrier which is portable. The DAT will certainly fulfill these criteria, but the trouble is that two other formats—the analog cassette and the Compact Disc—already fulfill them. Both kinds of recordings may be played at home, or outside the home on inexpensive players. Particularly in portable applications, because of inevitable degradation caused by the ambient environment (automobile noise, wind, crowd noise, etc.), the sound quality of even the analog medium is fully acceptable.

"Thus we are stuck with the basic question: How successful can a pair of new formats be, if they offer no new market innovations over existing formats, if the hardware and software will be more expensive, and if the hardware will also be bulkier?

"Well, you say, the DAT will be *digital*—a significant improvement over the analog cassette. And it's better than the CD because it is *recordable*. That is a new combination in itself: The first widely introduced consumer digital recorders.

"But that brings us to yet another stubborn question: Does the consumer really need or want a digital recorder? Specifically, what is he going to record? If he buys a prerecorded analog cassette or an LP, what is the advantage in copying it onto a digital medium? A cassette is already portable, and copying it onto a digital cassette would not increase fidelity. And an LP might as well be copied to analog tape, since it is cheaper than digital and captures the LP's fidelity. And if the consumer buys a prerecorded digital medium (CD), why bother copying it onto digital tape if car and portable CD players are cheaper? Even if digital recordability is desired, the CD already has that base covered. Both write-once and fully recordable/erasable CDs, compatible with regular CDs, have already been developed.

"The bottom line is not promising," Ms. Meyerbeer concluded. "For digitally prerecorded music, the CD will be cheaper and more portable. And digital recordability may not be very important; besides, the CD will offer this too. And let's not ignore the multi-billion-dollar industry of prerecorded and blank analog tape. Even a wildly innovative, more convenient, and cheaper format would have difficulty supplanting such a successful standard. A non-innovative, less convenient, and more expensive format will certainly have its work cut out for it.

"Nevertheless, in the long run, the DAT probably will replace the analog cassette, and share the prerecorded and blank medium markets with the CD. That will happen because the DAT will sound a little better, the cassettes will be a little smaller, and its digital technology will be a little more desirable. More than anything, the DAT will succeed mainly because it is new. But at best, that adds up to a slowly gained success, indeed."

Her marketing argument concisely put, Ms. Meyerbeer falls silent. As Chief, the decision is now up to you. Do you: Forget about the digital tape thing and stick with analog cassettes? Get into S-DAT? Get into R-DAT? Get into CDs? Go back to Monte Carlo for another extended vacation?

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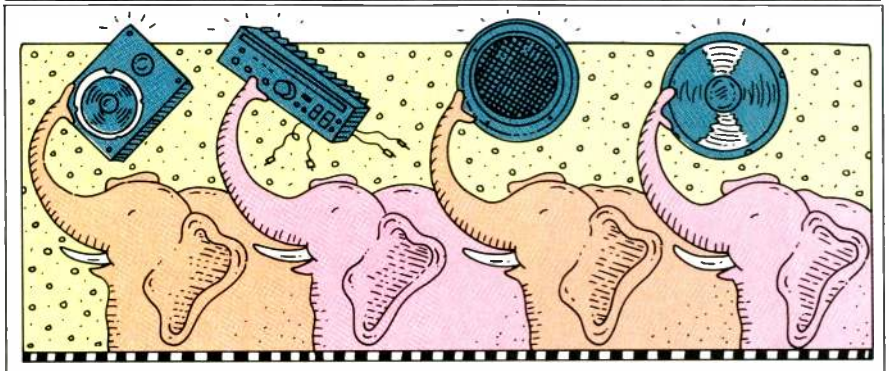
IVAN BERGER

ADVANCE TO THE REAR



Trunk Lines

Sometimes, trends move so glacially that you don't perceive them as trends at all. One I've failed to notice until now, even though both my current and forthcoming car systems exemplify it, is the gradual move of equipment from the dashboard back into the trunk. In my car, as in millions of others, the amplifiers and crossovers are in the trunk already—that's been common practice for about 10 years now. My subwoofer is back there too—also common, as there are no other spaces large enough, in most cars. There were even trunk-mounted carousel-type changers for 8-track cartridges, way back before 8-track became the wave of the past.

According to a roundup of predictions in *Installation News*, a magazine for car alarm and stereo installers, we can expect to see the trunkward trend speed up in the future. Kerry Schrode of Yamaha predicts remote-mounted radios (though not this year) to cope with the increasingly cramped spaces allotted by dashboard designers. Sid Schieber of Autotek feels separate amplifiers will become still more popular, and AudioMobile's Paul Stary says the same about subwoofers.

We can also expect to see more trunk-mounted changers in the next year or two—both for cassette and for CD. I'm not sure how popular that idea will prove—I normally keep at least two dozen cassettes or CDs in the car, and I suspect that is more than any affordable changer will handle. Being forced to choose my day's listening when I first set out, instead of waiting until I'm on the road, takes some of the bloom off the idea, for me. And while it's easier to select disc C, track 5 than it is to open up a CD jewel box, I suspect it's easier to pick your box and open it than to remember which selection C-5 is. Still, for those who listen to the same few recordings most of the time, a remote changer, preferably programmable, should prove a godsend.

Another trend that points toward remote components is the growth of remote control in the past year or two. So far, it's just to let the rear-seat passengers control the front-seat system. But front passengers would need remote control for trunk-mounted components too.

ZAP's QAP

How good is that car-stereo component you're buying? Will your particular sample meet the model's specifications? Purchasers of ZAPCO amps and equalizers can tell. As part of the company's Quality Assurance Program, each component is burned in at the factory to smoke out early defects, then individually tested. Plots of its frequency response and distortion at various power levels are packed with the unit.

Efficiency Expertise

How much of your car's electrical power does an autosound amplifier draw? According to Paul Stary of AudioMobile, it's a lot higher than you might think.

Consider, he says, a Class-AB amplifier delivering 100 watts per channel (200 total) into 4 ohms. With the 60% efficiency typical of this amplifier class, 333 watts of power must be delivered from the power supply for 200 watts of audio output. And to provide this, assuming a typical switching power supply of 70% efficiency, 476 watts of d.c. must be delivered from the battery.

The amount of current varies with the voltage delivered to the load. For 10.8 V, 476 watts would require 44.1 amperes. Higher voltages would lower that figure: 39.7 amperes at 12 V and 33.1 amperes at 14.4 V. I've never measured 14.4 V in my car—11.8 to 12.1 is more typical. Stary cites 10.8 V because of the effect of the load on the battery voltage (a battery producing 12.2 V with no load would drop to about 11.7 V with a 60-ampere load), and because the resistance in a typical wire run from battery to amplifier (24 feet of 8-gauge at 0.0006 ohm per foot, plus 0.0025-ohm resistance for the chassis ground) would drop the voltage another volt or so.

Incidentally, the figures cited in Stary's example are for *average* current draws. The *peak* current required for full rated performance at low frequencies is higher: 676 watts, or 62.7 amperes from the battery.

In practice, the current drain could be even greater. Most speakers drop down below their nominal impedance at some frequencies. If the impedance dropped down to 2 ohms at some points, the current requirements for a given power level would be doubled at those frequencies.

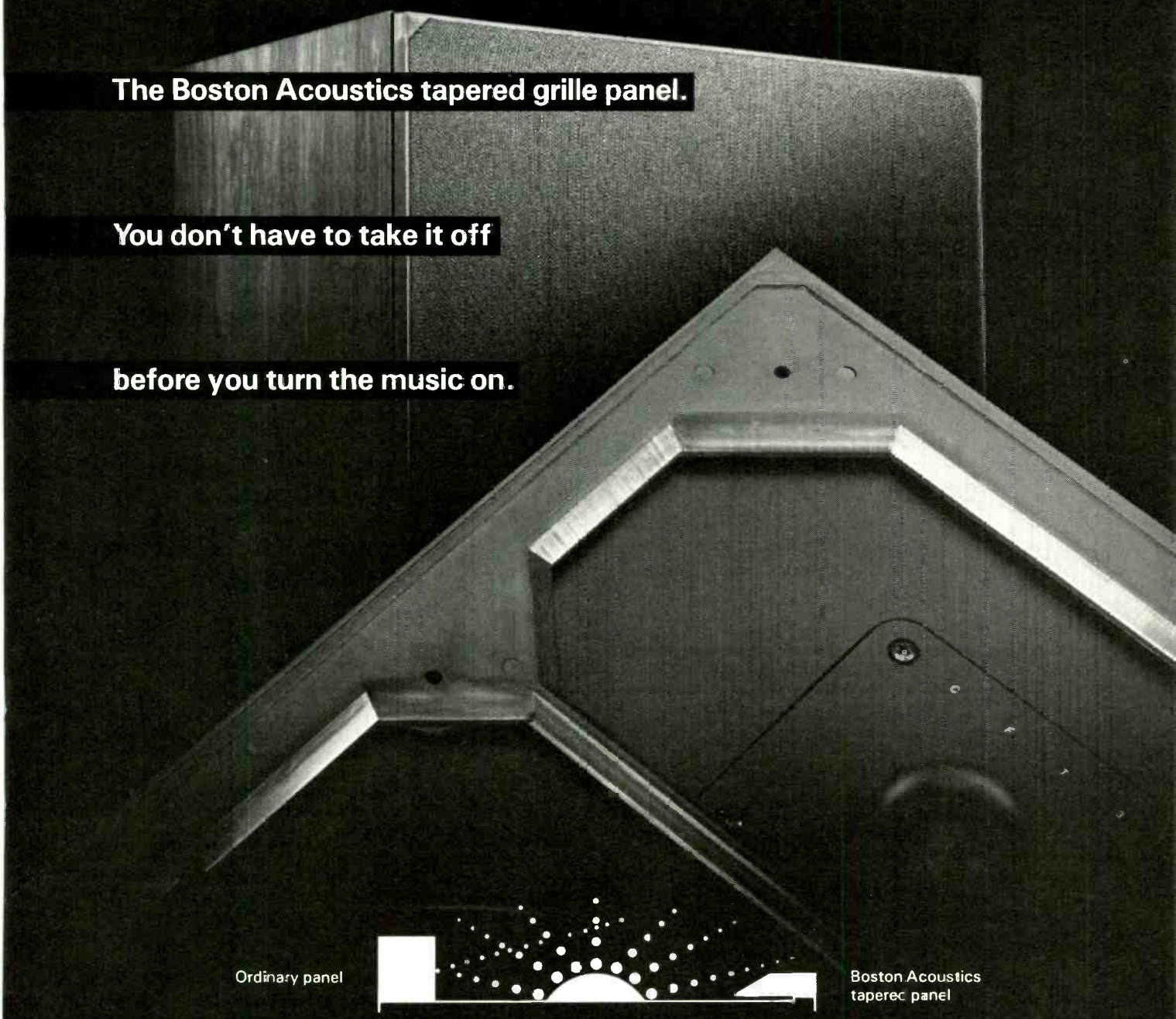
This doesn't mean your lights will flicker every time you play your sound system. In practice, your amplifier won't be putting out 100 watts per channel much of the time. Not unless you normally listen to loud rock while driving at 80 mph with the top down and the windows open—and you replace your speakers often.

Illustrations: Teresa Anderko

The Boston Acoustics tapered grille panel.

You don't have to take it off

before you turn the music on.



You may have noticed that most speakers sound their best only if their grille panels are removed. That's because a portion of their sound diffracts off the thick inner edges of the panels, reaching your ear later than the direct sound. Some audio frequencies are reinforced and others cancelled, distorting frequency response. The diffracted, delayed sound also smears the time cues essential to accurate stereo imaging.

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Boston Acoustics

BERT WHYTE

A CHANGE OF VENUE

I owe this column to the combined effect of three experiences: Listening to a new London/Decca CD recording of Sibelius's Third and Sixth Symphonies (with Vladimir Ashkenazy conducting the Philharmonia Orchestra), learning more about the forthcoming reconstruction of venerable Carnegie Hall, and reading some biographical notes on Gustav Mahler.

As the last passages of the Sibelius Third Symphony came to their triumphant conclusion, and the opening bars of the Sixth began, it was immediately obvious that the latter was recorded in an acoustic environment quite different from that used in the Third Symphony. London/Decca is one of the record companies that thoughtfully provides information in their liner notes about who produced and engineered the recording and the hall where the music was recorded. Sure enough, the Sibelius Third Symphony was recorded in May 1983, in Kingsway Hall in London, while the Sixth was recorded in June 1984, in the renowned acoustics of Walthamstow Town Hall.

Although nothing is cast in concrete, works presented on the same CD or LP are usually recorded in the same venue. This generally holds true even if the recording dates for the two pieces are far apart—which can be the case if there are problems with artists' availability or with hall scheduling. In the case of this Sibelius CD, the change of venue was less a consequence of scheduling than of digital recording, which, with its lack of noise-masking, makes a quiet recording location absolutely mandatory. Kingsway Hall, long favored by Decca engineers for the lovely, warm and spacious ambience of its acoustics, has become a victim of the increasing volume of external traffic noise and rumble in the vicinity of its London location.

Decca's philosophy in recording classical music is the same as mine. The overriding consideration is a recording hall with really good acoustics. Fighting a locale with poor acoustics is a handicap that even the most skilled engineers usually can't overcome. Accordingly, when I was Decca's guest in London last April, Tony Griffiths, digital guru and new general manager of the Decca Recording Complex, told me that Kingsway Hall was no longer a practical choice for recording. He said Decca would make as much use of Walthamstow as they could, though this famous recording hall, with its superb acoustics, is very much in demand and thus difficult to reserve.

Illustration: Yvonne Buchanan

Carnegie Hall, located as it is on the corner of 57th Street and Seventh Avenue in New York City, has to contend with a massive volume of traffic and the unrelenting noise this generates. It is interesting to note that when Carnegie Hall was built in 1890-91, the use of structural steel was in its infancy, and thus the hall was built of heavy, solid masonry, with walls some 2 feet thick. You would think that such massive construction would effectively block external noises, but apparently, through some quirk of the underlying strata or some unknown phenomena, low-frequency rumble is transmitted through the walls. Furthermore, when the New York City subway system was constructed, some tracks were unwisely laid beneath Carnegie Hall, giving it its infamous subway rumble. (I've written previously about how Bob Fine and I were supplied a copy of the subway train schedule when we were recording Yehudi Menuhin in the Bartók Second Violin Concerto.) Thus, Carnegie Hall has not been used much for recording despite its fabulous acoustics. In my view, however, I would be happy to record in Carnegie Hall at any time, and I suspect many other engineers would feel the same. While I am unalterably opposed to the use of filters that would roll off audible bass frequencies, I do not think a filter that would remove the really bothersome subsonic frequencies would be out of place. The real reason for the paucity of Carnegie Hall recordings lies more in the difficulty of scheduling sessions in such a busy hall, and also, I am bound to say, in the exorbitant fees demanded by the stagehands union for carting recording equipment in and out of the hall.

I am sure most music lovers know that in 1960 Carnegie Hall was rescued from the wrecker's ball by the heroic efforts of violin virtuoso Isaac Stern, and others who were passionately fond of the acoustics of this most famous of all American concert halls. Demolition of Carnegie Hall would have been tantamount to a criminal act. Fortunately, Carnegie Hall now enjoys the status of a historic landmark. As you read this, scaffolding is in place for preliminary work on enlarging and rebuilding its foyer, and in May, the hall

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Fighting a recording venue that has poor acoustics is a handicap that even the most skilled engineers usually can't overcome.

will be closed to undergo extensive rebuilding and refurbishing and installation of an air conditioning system. It has been emphatically stated that none of this work will in any way alter the fabled acoustics of the hall, which will reopen with appropriate fanfares and special festivities in January of 1987. In the longer view, all this refurbishing is being undertaken with an eye on the approaching centennial of Carnegie Hall in 1991.

Some biographical notes on Gustav Mahler I recently read (from a record jacket, appropriately enough) made much of his two seasons in Carnegie Hall as conductor of the New York Philharmonic. Up until the construction of Philharmonic Hall (now Avery Fisher Hall) at Lincoln Center, Carnegie Hall was the N.Y. Philharmonic's home. I was fascinated by the interlocking relationships between Mahler and the N.Y. Philharmonic and Carnegie Hall.

Carnegie Hall was made possible by a gift from Andrew Carnegie, the legendary steel magnate, who was present for the opening concert on May 5, 1891. Walter Damrosch conducted the New York Philharmonic for the first part of the program. After intermission, none other than Peter Ilyitch Tchaikovsky conducted some of his works; by that time he had composed all his symphonies except for the Sixth, the "Pathétique."

The list of the giants of music, of legendary composers who have conducted in Carnegie Hall, is mind-boggling. In 1904 Richard Strauss conducted the N.Y. Philharmonic in performances of his "Ein Heldenleben" and "Also sprach Zarathustra." For the conservative ears of the rich patrons and particularly the patronesses of Carnegie Hall, his "blaring dissonances" were a bit too much! In 1906, Camille Saint-Saëns, then 72 years old, played his piano concertos and even the organ part of his beloved Third Symphony. Dvořák was present in the Carnegie Hall audience when his "New World" Ninth Symphony was given its American premiere.

Gustav Mahler had won critical acclaim in 1907 for his performances with the Metropolitan Opera. It is well to remember that in those times, the Opera and the N.Y. Philharmonic were supported by the patronage of the very rich. The wives of the tycoons of that era particularly involved themselves with the Philharmonic board of directors, and with their hands firmly in control of the purse strings, they wielded tremendous power. Needless to say, this included the choice of who was to conduct the Philharmonic and what kind of music would be performed. Remember that all this participation in the Philharmonic was considered a social function, and it came from a desire to participate in cultural activities. Few patrons, if any, were intellectually involved with music.

These, then, were the arbiters of musical taste, and in 1909 they signed Gustav Mahler to conduct the N.Y. Philharmonic for the 1909 and 1910 seasons. The ladies didn't know what they were getting into! Mahler was a very intense man, fanatically devoted to music. He was highly respected in Vienna, and there was no one who questioned his authority.

The first thing Mahler did with the Philharmonic was to drastically weed out all the players who did not perform up to his lofty standards, replacing them with younger, more talented players. Then Mahler began to retrain the orchestra, with endless rehearsals and an emphasis on tonality and ensemble precision. The music of Beethoven was sacrosanct to the Philharmonic patrons, and when Mahler turned his now highly polished Philharmonic loose in vibrant, dynamic performances bristling with energy, the ladies nearly fainted from the shock!

Up until the arrival of Mahler, most of the Philharmonic conductors had been nothing much more than earnest hacks. Their performances of the music of Beethoven and other standard classicists had degenerated into a form of devitalized, easy-to-digest musical pablum. The musicologists, as you might expect, were lavish in their praise for what Mahler had wrought, and some of the more knowledgeable critics also applauded his efforts. But the majority of the popular press and the patrons were outraged. Thus began a battle that was almost without surcease, with Mahler, the absolutist and perfectionist, on one side and the music illiterati on the other.

(Incidentally, contrary to what one might expect, Mahler did not overwhelm his patrons with frequent performances of his own music. He gave the American premiere of his First Symphony and then gradually performed the rest of his output. Sergei Rachmaninoff premiered his Third Piano Concerto with Mahler and the Philharmonic, and was much impressed with the care lavished by Mahler on the accompaniment.)

The ferment about Mahler grew among the patrons, but surprisingly, they kept him on for the second season. However, the strain was beginning to tell on Mahler. After a series of confrontations over some performances, which resulted in his untypical acquiescence to some of their demands regarding choices of music, he grew ill. He never made it through the second season, and in 1911 returned to Vienna, where his weakened heart finally stopped beating. There is no doubt that Mahler's stewardship of the Philharmonic, brief though it was, made it a respectable orchestra.

Through the years since, Carnegie Hall has resounded to great music performed by great orchestras. The podium has been graced by such legendary figures as Igor Stravinsky, Pierre Monteux, Serge Koussevitzky, Bruno Walter, Leonard Bernstein, my beloved friend Leopold Stokowski, the tempestuous Arturo Toscanini, and his diametric opposite, the rather gentle Dimitri Mitropoulos.

It is one thing to attend a concert at Carnegie Hall, with great music wrapped in the warm embrace of those splendid acoustics. It is quite another thing to record there. The first time I did so was in 1953, for the great "Jazz at the Philharmonic" series. When I first set foot on the hallowed stage to place my microphones, and stood precisely on the spot that had known the presence of Tchaikovsky, Richard Strauss, Mahler, and a whole panoply of other musical giants, I was simply overwhelmed. I felt a sense of awe and reverence, and in subsequent visits to the stage, that feeling of awe has never diminished.

So, all hail to grand old Carnegie Hall! I look forward to seeing its refurbished splendor. God willing, my wife Ruth and I will raise a champagne toast on the occasion of its 100th birthday in 1991!

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A History Of Binaural Sound

John Sunier

There's only one way to come close to reproducing human hearing— binaural reproduction. This method is so basic and simple that its first use came way back in 1881.

Over the years since stereo became the norm, various approaches have been tried to carry its spatial realism a step or two further. These have involved both the continuous refinement and improvement of stereo itself (with, perhaps, some temporary backward steps) and the exploration of other approaches.

The best-known of these multi-dimensional alternatives, quadraphonics, failed to win public support. This led, however, to other multi-speaker approaches. Two of these, the Dolby Surround system used in video software and movies, and the Ambisonic system from Britain, resemble the old quadraphonic systems in their use of matrixes which encode four channels of information into two (and, in the case of Ambisonics, the alternative of using four discrete channels). The others either extract ambient information from the main program, which the quad, Ambisonic, and Dolby Surround matrixes can also be used for, or simulate ambience by feeding a delayed version of the main signal through rear or side speakers. The signals from delay systems (and, occasionally, other multi-dimensional add-ons) are sometimes mixed with the main speaker and sent to the front speaker pair, though this can muddy the sound if used too liberally. The aim of all these systems is to increase apparent spatiality.

Another approach is to treat the main signal so as to increase the spatial ambience or localization, or both, available from two stereo speakers. Examples of this include Bob Carver's Sonic Holography and past or present units by Sound Concepts, Omnisonix and Fisher, as well as the Polk SDA speakers and speakers from Imaged Stereo.

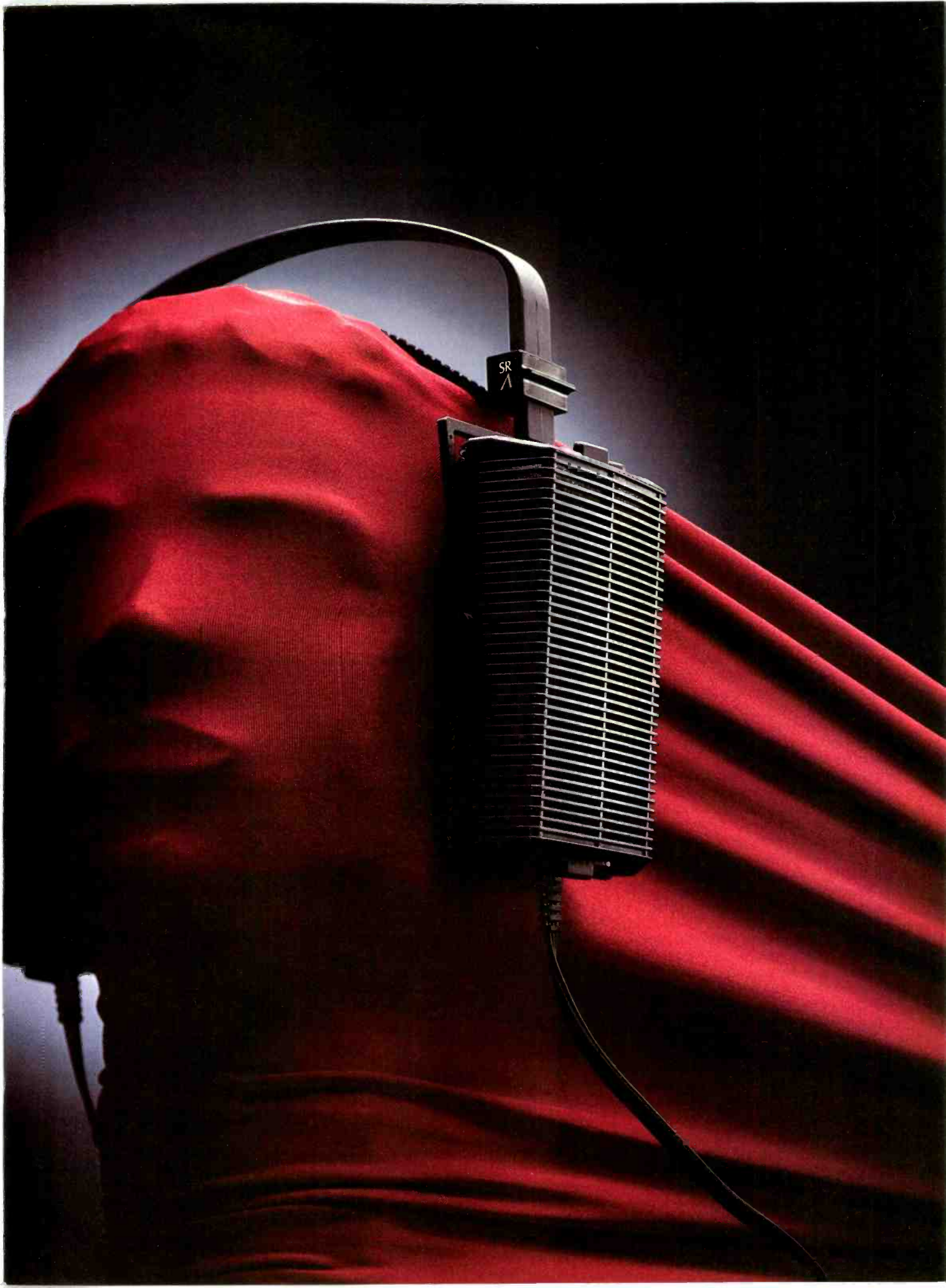
When properly set up and sensitively employed, some of these units can add a tremendous realism and naturalness to loudspeaker reproduction, but none of them can accurately reproduce the human hearing experience in all its amazing accuracy and versatility. There is only one way to come fairly close to that goal, and it is by using a method of reproduction so basic and simple that its first recorded use came only a few years after the invention of the phonograph—in 1881, to be exact. It is called binaural reproduction—bi, for two, and aural, for ears.

On August 30 of that year, the German Imperial Patent Office granted a patent to the Parisian engineer Clement Ader, covering "Improvements of Telephone Equipments for Theatres." This was, of course, long before the development of either vacuum tubes or radio, so connections originated with simple telephone transmitters (mouthpieces) and pairs of telephone lines from the stage of the theater to the homes of the telephone subscribers. Evidently, more than one transmitter was used to feed each of the two phone lines, probably to get enough volume. The transmitters were distributed across the stage in right/left pairs, and the subscribers listened via separate phone earpieces at each ear—one for the left phone line and one for the right. Ader's patent states: "Thus the listener is able to follow the variations in intensity and intonation corresponding to the movements of the actors on the stage. This 'double listening' to sound, received and transmitted by two different sets of apparatus, produces the same effects on the ear that the stereoscope produces on the eye."

Ader was quite aware of what he was doing, and he did not hit upon his arrangement merely by chance; his patent drawings substantiate this. His device received much attention during the 1881 Paris Exposition, when it was used to broadcast live presentations direct from the stage of the Paris Opera. A similar setup was installed by an inventor named Ohnesorge in the mu-

John Sunier is the author of three books related to audio, including The Story of Stereo: 1881—. *He writes about music and audio for a number of national periodicals, and hosts* Audiophile Audition, *a weekly radio program carried by 115 public and several commercial stations.*

Photograph: ©Bill Kouirinis Equipment: Stax SR Lambda Professional headphones


SR

The advantage of using mikes on a dummy head is that, by modifying the sound field just as human features would, conditions of human hearing are nearly duplicated.

sic hall of the Crown Prince of Prussia. Later in the 19th century, a commercial venture based on this approach was marketed under the name Steidel's Stereophony.

How Binaural Works

The analogy of binaural hearing to stereo seeing has often been made (Fig. 1). Though in its finer points there are some sizable differences, the analogy makes the whole function of binaural reproduction more understandable. The workings of the brain are responsible for both of these physiological phenomena. The brain takes the two very similar but also very slightly different signals, whether they be optic nerve impulses or impulses from the inner ear, and processes them instantly to give us depth of image or depth of sound.

Early in man's evolution, this increased accuracy of perception meant the difference between life and death. The poor fellow deaf in one ear or blind in one eye had had it—no getting away from that saber-toothed tiger! Our senses have probably been dulled over the eons, but listening to binaurally recorded or broadcast material can make one aware of just how specific our hearing can be. We have some sense of spatial location when listening to well-done stereo recordings through properly set-up speakers, but this is only a pale imitation of binaural, which allows one to locate sounds not only horizontally but also vertically—actually 360° in every direction.

In binaural, there is a lack of accurate location when the sound source is directly above, ahead or to the rear. But if you close your eyes and have a friend click fingers directly in front of, above, and behind you, you will discover this problem is inherent in the hearing apparatus, not in the binaural approach! It is very difficult to tell if the sound is in front or behind, unless it moves to that point from the sides.

So just what, exactly, *is* a binaural microphone setup? Well, it can be as simple as two omnidirectional mikes spaced on a stand about 7 inches apart to simulate the separation of the human ears. The left mike signal is kept totally separated from the right signal through the entire system. One can record in any stereo tape format, though the greater the signal-to-noise ratio, the better will be the binaural effect. Hiss can be very noticeable with stereo headphones, as most of us are aware, and there are few other sounds leaking in (even with open-air headphones) to mask any of the noise in the recording. Further, with binaural, some extremely low-level and subtle sounds can be clearly heard by the listener, and it is vital not to have such delicate sounds obscured by the high noise floor of most analog recording methods. PCM digital recording is therefore the perfect medium for binaural reproduction. The other alternatives, if digital equipment is not available, would be cassette recording with dbx NR encoding or, as a second choice, with Dolby C NR encoding. The best-quality metal-particle cassette tape should be used, and one shouldn't be concerned if the recording levels seldom hit peaks, because few sounds will be close to the mikes.

A simple improvement to the spaced-mikes approach is to mount a piece of quarter-inch plywood, about 4 by 6 inches in size, exactly between the two mikes to act as a head shadow—a baffle which simulates the acoustic effect of the human head. This is also sometimes called a septum. You can refine it even further by covering the board with a layer of felt (Fig. 2).

As you can see, the equipment required for binaural recording and listening is probably already available to you. No special encoders or decoders or processors are needed—just two clean channels of recording and reproduction ending in a pair of good stereo headphones. The better the headphones, the better the results will be; I prefer good electrostatics, but the effect will be startling with almost any type. Also, the mikes need not be the most expensive. While better mikes give better results, the general binaural effect will come through well with the most basic equipment.

Another advantage to doing your own binaural recording is the ease of mike placement. Just listen through headphones to the signal from the mikes as you move them to several locations; the location that sounds best is obviously the one to use. The binaural method is extremely forgiving of mike setup. No musicians will ever be "off-mike," because you are not trying to bring the musicians into your listening room—*you* are going to the concert hall or studio! Similarly, you may find that audience noises that would be extremely annoying with ordinary stereo just become part of the "in person" concert-hall experience and actually *add* to the realism.

Dummy Heads and Live Heads

If you would like to go all the way with binaural recording, you can use a "dummy head." The first appearance of such a head was, in fact, the most publicized experiment with two-channel reproduction (until the advent of stereo recording in the 1950s). In the winter of 1932, a wooden tailor's dummy, named Oscar by some Bell Laboratories engineers, took up residence at the American Academy of Music in Philadelphia. He was part of a project in which Leopold Stokowski, always interested in improving music reproduction and recording, took part. (This project also made some of the first experimental stereo recordings, using basically the same 45/45 cutting system as today's stereo discs.)

Oscar had sensitive microphones—as sensitive as they had in 1932, that is—implanted in his cheekbones in front of his ears. These were used to pick up Stokowski's Philadelphia Orchestra; a monaural pickup was also made, alongside. Visitors to the American Academy were asked to listen in another hall, using headphones, and to note any preference between the full-range mono sound and a filtered, limited-range binaural signal via Oscar. They all preferred the binaural reproduction, even when all frequencies over 2.8 kHz were cut off.

Oscar then travelled to the Century of Progress Exhibition in Chicago, where he continued to amaze visitors. They listened through headphones while looking at people, at some distance, who moved around Oscar while speaking or making sounds. (In another part of this exhibit, the public was tested for hearing sensitivity at various frequencies and sound levels; this eventually yielded the parameters for the Fletcher-Munson loudness curve.)

The advantages of the dummy head over unadorned spaced microphones

were noted by the Bell engineers. By modifying the sound field near the two mikes, just as human features modify the sound we hear, the conditions of human hearing were duplicated as closely as possible. During later experimental work in Germany, as mikes of smaller size were developed by Brüel & Kjaer and others, they were placed deep inside dummy heads, where eardrums would be on a human head, at the ends of ear canals. The effect was startling, but unnatural, because the sound had to pass through *two* sets of ear canals—the dummy head's, during recording, and the listener's, during playback. In spite of this, such an end-of-the-ear-canal dummy head is still used in some binaural work, together with special equalization to correct the problem.

Even finer adjustments can improve the realism of the binaural dummy head, also called *Kunstkopf* ("art-head") stereo by the Germans. The makers of Mercedes cars use a Kunstkopf, together with a Sony PCM-F1 digital processor and Stax headphones, to record interior car noises for test purposes. Mercedes' demands for better low-bass reproduction via headphones led Stax to develop their top-of-the-line earspeakers. The Mercedes engineers also found that including shoulders and even hair on their dummy head improved the realism and accuracy of the binaural pickup. Their latest head, with tiny B & K mikes buried at the ends of the ear canals, has also been used experimentally for some state-of-the-art binaural concert recordings in a German cathedral.

If you want to use a dummy head for binaural recording, Neumann makes one, the KU 81, complete with their condenser mikes mounted inside, but it is not inexpensive. Sennheiser also sells a head, dubbed Fritz. Another possibility is to find a foam wig head and make your own. Hollow out a space at the center of each ear large enough to accommodate a small tie-clip condenser electret mike such as the Sony ECM-16T. If you already have a pair of good omnidirectional mikes, you can hollow out just enough indentation near the ears to lay the mikes as close as possible to the sides of the head. Face them straight up or forward, and remove any wind screens to allow closer proximity to the foam head. If the head will sit by itself, the mikes can be held in place by rubber bands. Add a wig, and if the head lacks a nose, attach a putty one or glue a small baffle in the proper place, because even this has an effect. You might also try two pieces of foam tape curved into a "C" shape if the ears of the head are not prominent.

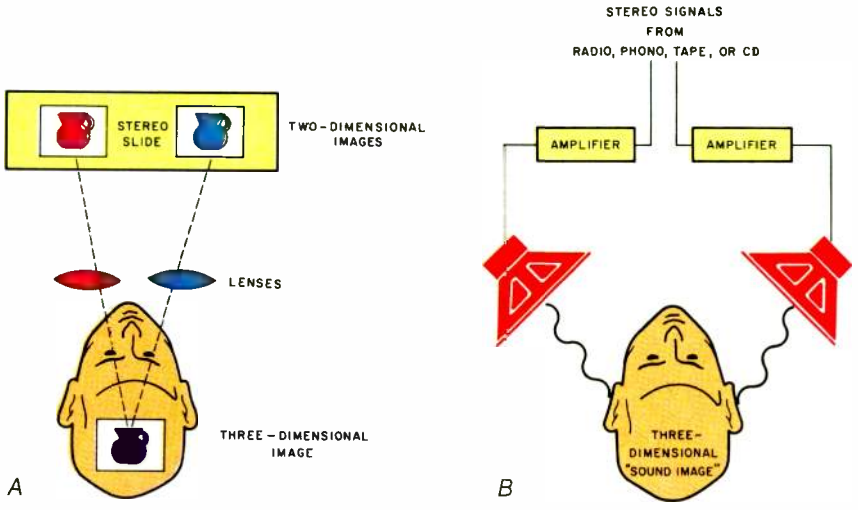
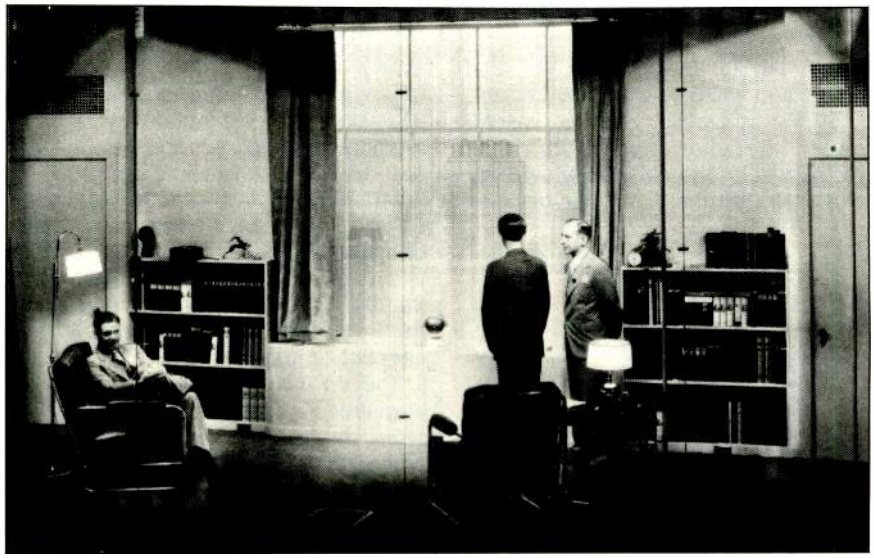


Fig. 1—Our two eyes (A) and our two ears (B) work with our brain in analogous, though not identical, ways to capture three-dimensional images. (After The Story of Stereo: 1881—*, by John Sunier.)*



At the 1933 Century of Progress Exhibition, audience members listened through binaural telephone receivers while demonstrators addressed "Oscar" (back to camera), a tailor's dummy with a sensitive microphone implanted in each cheekbone.

Photo: Courtesy of AT&T Bell Laboratories

In the Air and On the Air

To return to binaural's history, the process was used in both World Wars. In World War I, binaural receiving trumpets were used to locate enemy warplanes (Fig. 3). They were spaced several feet apart to increase location acuity, and were connected via rubber tubing to the two ears of an operator. Similar devices known as geophones

In 1925 a New Haven radio station experimented with binaural broadcasting. Those who tuned in with two radios got an impression of increased depth and volume.

were used to determine the direction of underground sounds such as enemy trenching operations. In World War II, underwater binaural pickups were made with hydrophones to help detect enemy submarines.

In the March 1924 *Journal of the AIEE*, an article titled "High Quality Transmission and Reproduction of Speech and Music" appeared. Its authors, W. H. Martin and Harvey Fletcher, had some prophetic things to say about two-channel broadcasting: "With binaural audition, it is possible to concentrate on one sound source and to disregard other sounds coming from different directions or distances. Because of the monaural character of broadcasting, it is necessary to go even further in reducing noises and reverberation at the transmitter than would be the case for an observer using two ears at the same location. . . . In broadcasting, those who make use of the system are becoming more critical of the service which it renders and the quality of reproduction will be of increasing importance in the future."

In the following year an inventor named Kapeller developed an improvement on the early Ader system of 1881. He mounted six microphones, spaced as three pairs the same distance apart as human ears, at the edge of the stage of the Berlin Opera House (Fig. 4). The left mikes of each pair were connected to one set of cables and the right mikes to a second set. Realizing the difficulties in supplying two separate cables to each listener's home, Kapeller saw the possibility of using radio broadcast. He cited the example already set by a Berlin radio station which had experimentally carried out two-channel broadcasts using two transmitters, at wavelengths of 430 and 505 meters.

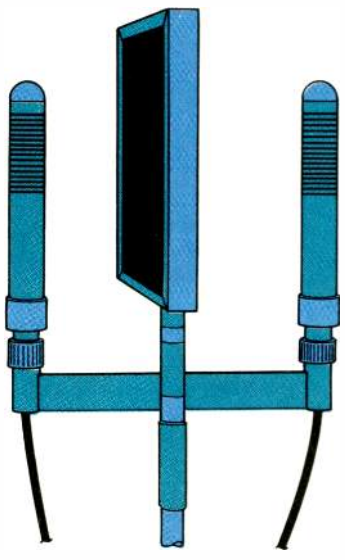


Fig. 2—A binaural microphone setup using a baffle to simulate the acoustic effect of the human head.

In that same year, 1925, a U.S. radio station, WPAJ in New Haven, Connecticut, was experimenting with binaural broacasting. An additional wavelength of 1,110 kHz was added to their original frequency of 1,320 kHz, and duplicate transmitters were installed (Fig. 5). Two standard broadcast mikes of the time were used, one to each channel, with a 7-inch separation. Ordinary reception was not impaired, since basically the same program was heard on each wavelength. Binaural listeners used one radio set tuned to 1,320 kHz feeding a single earphone on the left ear, and a second radio set tuned to 1,110 kHz feeding a single earphone on the right ear. At this time, loudspeakers were just beginning to come into use for radio listening. It was found that the speakers mixed up the sound from the two discrete channels and seriously impaired the binaural effect.

The WPAJ work was described by engineer F. M. Doolittle in *Electrical World* magazine. The station used a single transmitting antenna for the two frequencies, and the two home radios could also be operated from a single antenna. The experimenters found that an impression of greater depth and more distance between listener and performer was gained if the mikes were moved somewhat further apart than 7 inches. But if they were moved too far apart, the binaural impression became vague and was eventually lost altogether. It was also found that binaural transmission produced an apparent increase in volume.

Doolittle showed his understanding of the binaural effect very clearly in his article: "The phonograph and the radio have educated the ear to believe that a close approximation to true tone values is really all that can be expected, and hence the listener does not expect an exact reproduction. Reproduction, using the word in its strict sense, would, of course, mean a rendition so nearly identical with the original that one would be unable to tell, without bringing into play other faculties than that of hearing, whether or not he is present at, and listening to, the original performance. A close approximation to such reproduction is possible with [this] method. . . ."

A few American radio stations conducted similar experimental binaural broadcasts at this time, but radio was still in its infancy and not many people owned the two sets necessary for listening to the broadcasts. So the pioneering work of WPAJ was almost forgotten until the FM-plus-AM stereo broadcasts of the late 1950s, most of which were not binaural.

Binaural's Modern History

Audio's own Bert Whyte brought binaural recording out of the attic for a while in 1950. During his employment with the Magnecord tape recorder company, General Motors requested help in recording and analyzing the specific locations of car noises. Whyte recalled the Oscar demonstrations of 1933 and assembled two Telefunken U-47 omnidirectional mikes on a stand separated by a quarter-inch slab of wood for a baffle.

Two-channel tape heads were not yet available, so the simplest way to record and play back two separate signals was to modify a monophonic three-head assembly to include a full-track erase head, a normal half-track monophonic record/play head where the record head was normally mounted, and a second half-track record/play head, inverted to scan the normally unused half of the tape, in the position of a normal playback head. (*Editor's Note*: Magnecord heads of the time had removable pole pieces, which made such gap inversions easy.—*I.B.*) This staggered-head arrangement, with the heads 1¼ inches apart, worked fine, according to Whyte. It became a temporary standard for two-channel recording, with a few decks and prerecorded tapes available in this format, until stacked-gap stereo heads became available a

year or two later. (*Editor's Note*: By 1955, some companies were issuing two-channel tapes in both staggered and stacked formats, but primarily for stereo [loudspeaker] rather than binaural [headphone] listening.—*I.B.*) When stereo tapes were first issued to the public by Livingston, and double-groove stereo LPs (played with a forked arm holding two cartridges) by Cook Laboratories, they were erroneously called binaural, though they were actually stereo. This caused some confusion later on.

A second request for a way to use tape recording to localize sounds came to Magnecord from the Navy's Special Devices Center in Sands Point, New York. The Navy was provided with equipment similar to that provided General Motors, and used it for underwater work. The headphones of the time were very primitive, with a narrow frequency range, but the binaural results were still astounding.

It occurred to Whyte that it might be interesting to record music with the Magnecord binaural equipment, so he took it to a local high-school band concert. When these tapes were played in binaural demonstrations at the 1950 New York Audio Fair, listeners were amazed by the results. Later, Whyte began taping professional musicians binaurally. First he recorded Benny Goodman, Stan Kenton and others, informally, at a Chicago jazz club. Some time after, Whyte went on tour for six months with conductor and sound buff Leopold Stokowski, making binaural tapes of him conducting various college orchestras.

With the advent of stereo, which could be enjoyed by many listeners at once without the encumbrance of headphones, binaural recording attracted less interest. It has never faded out completely, however. In Germany, for example, Sennheiser's 1968 introduction of the classic HD 414 open-air headphones, which weighed only 4½ ounces, and the swift introduction of open-air headphones by Beyer, AKG and others, brought new popularity to headphone listening. This, in turn, stimulated a renewed interest in binaural in that country.

Attempts to produce quadraphonic sound, beginning about 1970, also spurred interest in capturing a more

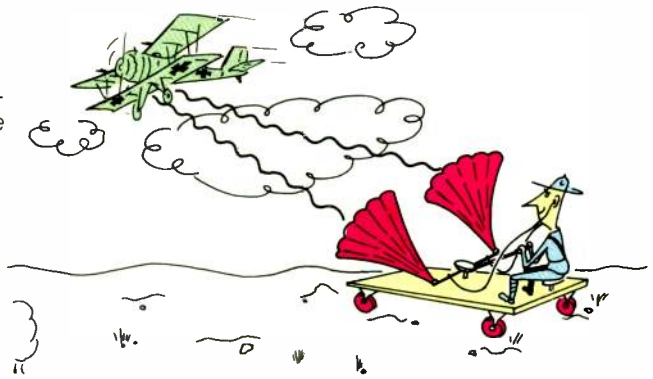


Fig. 3—Binaural listening apparatus was used in World War I to locate enemy airplanes before the invention of radar. (After Sunier.)

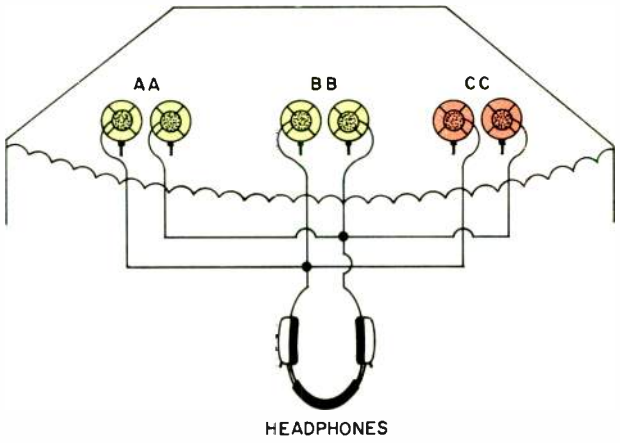


Fig. 4—The binaural pickup system used at the Berlin Opera House in 1925. (After Sunier.)

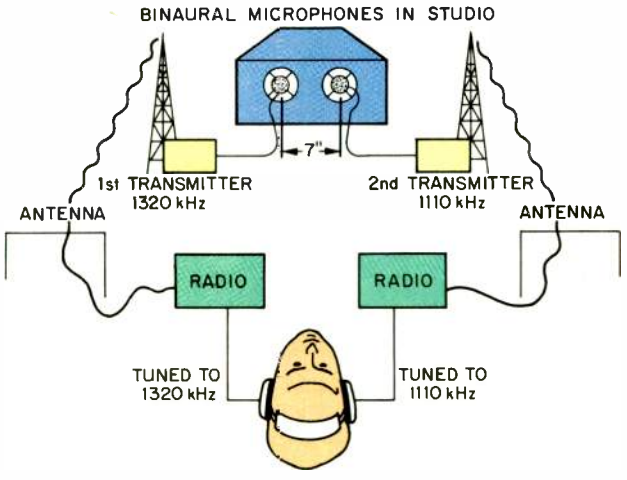


Fig. 5—The binaural broadcasting setup used by New Haven radio station WPAJ in a 1925 experiment. (After Sunier.)

Binaural isn't 100% accurate; problems remain with frontal and direct-rear locating. For example, dead-ahead sounds may seem to be elevated or to come from behind.

Fritz II, the Neumann dummy head used to record the radio series The Cabinet of Dr. Fritz.

The Sennheiser MKE 2002 binaural microphone system was worn like a stethoscope, with the wearer's head serving the same function as a dummy head.

These prototype JVC headphones included a second pair of drivers in front of the listener's ears to enhance frontal localization.

realistic sound field than was possible with two-channel loudspeaker approaches. Binaural was a natural avenue to this goal, and it was much less equipment-intensive than quadraphonic. In the notes to Sennheiser's series of 7-inch, 45-rpm *Kunstkopf-Stereofonie* demonstration discs of 1973, the following was addressed to headphone listeners: "In these times of superlatives regarding technical achievements, it is still often believed that only high expense can offer better results. . . . If this documentary disc provides better results at lower cost, why shouldn't it be worthy of such advancement as, for instance, the much-disputed quadraphonic sound?"

Sennheiser went on to point out that quad could establish spatial location of sounds in a horizontal plane, but not with great accuracy, and that it had no abilities at all in the vertical plane.

At the 1973 International Radio Exhibition in Berlin, Sennheiser introduced their MKE 2002 "head-bound" stereo microphone. This consumer version of the professional binaural Kunstkopf system mounted the microphones like a pair of stethoscope-style headphones, allowing the recordist to substitute his own head for the dummy head. A few years later, JVC offered a binaural headphone/microphone combination, the HM-200E (now discontinued), and Sony now offers a similar system, the ERW-70C.

However, live heads, unlike dummy ones, are not perfectly stationary. When a recordist wearing binaural microphones moves his head to one side, the effect, to binaural listeners, is as if the auditorium were swinging in the opposite direction, as sounds formerly coming from dead ahead shift to one side.

The three demo 45s from Sennheiser (no longer available) were recorded in various natural environments, primarily with the MKE 2002 mike system placed on someone's head. The discs included warnings that only Sennheiser's own open-air headphones should be used, for best results. One disc was recorded in an ordinary living room; the narrator explained where he was moving in the room and what he was doing. Another featured sounds of everyday life, such as someone using a phone booth and a scene at a swimming pool. A train station scene began in a way that used one of binaural's unusual features to the utmost: A man and a woman are meeting as a train arrives. They are first heard, one on each side of the listener, as they shout to each other across the crowd. They approach one another until they are slightly behind the listener's position. The intriguing point here is that the man is speaking German and the woman English, yet the listener can easily pay attention to whichever one he wishes! With ordinary stereo, listening to this exchange would be extremely frustrating.

Another of the demo discs contains an imaginative little sci-fi playlet called "The Exploration of Simeon 2"; unfortunately for most of us, this one is entirely in German. There are also musical impressions in which the listener is entirely surrounded by the musicians, and a rendition of "Windmills of Your Mind" in which the female vocalist moves around the listener.

The Japanese audiophile community also showed an interest in binaural reproduction in the '70s. A number of binaural LPs were issued, including one, titled "Adventure in Binaural," which opened with a lengthy binaural sound-effects extravaganza re-creating the Battle of Midway. (A rather strange choice, since this was the battle which turned the tide of World War II, in the Pacific, against Japan!) There was also a jazz piano album featuring Junior Mance, recorded binaurally in New York City at a club which had exceptionally noisy patrons, considering that a recording session was under way. However, one hardly minds when listening in this amazing format—it rather adds to the feeling of sitting at a tiny table right in the middle of that smoke-filled club!

Imperfections and Solutions

As already mentioned, the binaural method is not 100% accurate in all of its parameters, nor is it completely compatible with loudspeaker listening—in mono or stereo. Even with headphones, there are difficulties in frontal, overhead, and direct-rear locating. When a marching band, say, passes in a straight line in front of the dummy recording head, it will seem to the headphone listener to have

marched in an arc, getting farther away as it moves directly in front of the listener, then getting closer as it continues moving to the other side. Sounds recorded in a circle around the dummy head seem to surround the listener in an oval, and many listeners feel that the entire sound field has moved behind them. Sound sources dead ahead may also seem elevated above their true positions, or be perceived as occurring to the rear instead of in front. Some of this is thought to be due to differences between the characteristics of the dummy head and those of the human listener, as well as the transmission characteristics of the stereo headphones used. These difficulties in locating sounds in some positions seem to indicate that the ear and brain sometimes need just a bit more data to process things properly.

Misaligned tape heads in recording, playback, or tape duplication can also cause problems with binaural. A slight misalignment whose effects might be unnoticed with ordinary stereo can seriously degrade the binaural phasing information. The problem does not occur with digital, however.

In an attempt to make binaural recordings compatible with loudspeaker listening, JVC developed their Biphonic system. Sound recorded by a single dummy head is fed into a processing unit, producing a 180° sound-field wrap around the speakers (Fig. 6). The processor electronically "eliminates the spatial crosstalk that is a normal result of loudspeaker reproduction," according to JVC.

Because this system provides localization in the forward direction only, JVC undertook further research into sound-locating techniques. In one test, they placed a dummy head in an anechoic chamber, with a noise generator feeding speakers at five points in an arc from directly in front of the head, to straight overhead, to directly behind the head. Listeners monitored these signals via pairs of speakers arranged at various points around the room. It soon became clear, not surprisingly, that unambiguous determination of sounds located front or rear depended on the relative positioning of the reproducing loudspeakers. Four speakers were felt to be necessary to include rearward sound sources.

This led to the development of the Q-Biphonic system, using four speakers surrounding the listener, and a double binaural pickup system. This system employs two dummy heads, both facing forward towards the primary sounds, one about 8 to 10 inches in front of the other (Fig. 7). A baffle is mounted between them, similar to the baffle often used in place of a dummy head. Each head produces a pair of binaural signals which are fed to a special processing unit. The processor uses complex equalization and time delay to produce two pairs of signals suitable for presentation through loudspeakers rather than headphones. The processing, in effect, produces a binaural-to-stereo transformation.

This system is said to correct some of the problems of both binaural and quad reproduction. It greatly stabilizes both front and rear localization, compared to ordinary binaural. It also can create very convincing side images within the normal quad speaker array of two in front and two in the rear, producing a 360° sound field around the listener. Side images have been a problem for ordinary quad reproduction. Another improvement is the accurate re-creation of sounds very close to the head, next to impossible with a standard four-speaker setup.

The system is not without some drawbacks, as expected. Since the processed sound must be totally free of relative phase shift, the various quad matrix systems such as SQ, QS and UHJ (Ambisonics) cannot be used. The all-pass networks which are part of these circuits would damage the re-created sound field around listeners. A discrete four-channel reproduction system (possible with the Compact Disc!) is the only answer.

In the JVC Q-Biphonic system, the listening position is also restricted to a very narrow area along the axis of left-right symmetry in the loudspeaker setup. The spatial phasors which are responsible for dimensional realism cannot be accurately re-created over a wide lateral range. Listeners positioned outside of this narrow range will hear quadraphonic reproduction as it is normally perceived.

Finally, JVC introduced a special Q-Biphonic processor which, when fed by multi-track studio recordings which had not been made with binaural microphone techniques, electronically produced Q-Biphonic signals equivalent to those from the dual dummy heads. The distance and direction of sound images could be controlled over a 360° field with a control similar to a conventional pan-pot. But no more has been heard of the Biphonic systems; they seem to have gone down the tubes with consumer quadraphony.

Single-Ear Binaural: The Holophonic Approach

The newest, and perhaps most controversial, multi-dimensional system is Holophonics. The story of its concept has been told elsewhere, but for those who missed it, we'll tell it again: Once upon a time, Hugo Zuccarelli was lying in bed, with one ear buried in the pillow. Someone walked through the room, and Zuccarelli realized that, even though one ear was closed off, he was still able to hear which direction that person was coming from.

The observation of this young physiologist/audio engineer led him to question the conventional theory that human beings locate sounds by calculating, in the brain, the difference in time it takes for sound to reach each ear. Zuccarelli studied how the brain *perceives* sound, rather than how the ears receive it. This laid the foundation for the trademarked Holophonic recording system, which Zuccarelli feels is an approach totally different from binaural. In fact, Zuccarelli Communications in Los Angeles and Holophonics International in London don't want to be associated with binaural.

Zuccarelli's mind-bending hypothesis is that the ears independently *generate their own sound!* He proposes that the ear's own reference beam (he calls it "reference silence") is responsible for generating the spatial information that is an integral part of the human hearing process. The complex interference pattern caused by external sounds coming in contact with this reference beam adds the dimensions of space and time to the hearing experience, he theorizes.

Zuccarelli used a digital recording system in his experiments. He taped various sounds accompanied by a spectrum of almost inaudible tones as artificial reference beams. Finally he

It's unfortunate that almost no commercial binaural recordings are available, because there is definite interest in this unique method of reproducing sound.

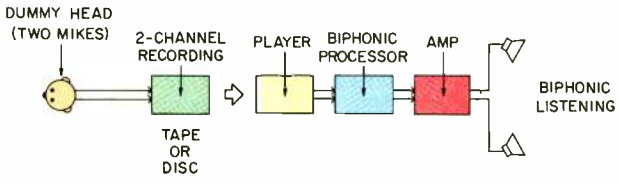


Fig. 6—JVC's Biphonic system electronically processed binaurally recorded signals for use with loudspeakers.

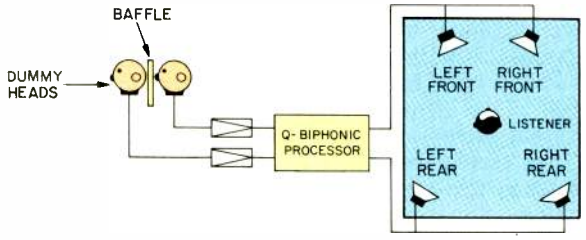


Fig. 7—The JVC Q-Biphonic system used two dummy heads in tandem to pick up four signal channels, then processed the signals for quadraphonic listening through loudspeakers.

found the combination of tones that duplicated those he felt were produced by the ear.

With this critical information, Zuccarelli developed electronic equipment that generates a synthesis of the ear's "reference silence," and which records on tape the interference pattern between that synthesis and other external sounds. During playback of recordings made Holophonically, the brain provides a second reference beam, bringing to light the original ambient sounds in their full realism.

The Holophonic recording system, which consists of a transducer and a great deal of associated electronics, is being marketed to the entertainment industry. One disturbing aspect to me is the secrecy regarding what the transducer really is. At recording sessions, Ringo, as Zuccarelli has named the transducer, is always covered up with a fabric bag. Also disturbing to me is the claim regarding Holophonics' ability to be perceived on *any* playback equipment—high or low quality, stereo or *mono*.

The Holophonics promoters argue that this capability comes about because the system does not depend on any sort of electronic decoding system for its effect. Recordings encoded Holophonically are said to be decoded directly by the brain. As a result, the promoters claim, even the tiny speaker of a monaural TV set can deliver all of the information the brain requires to "hear" Holophonically. Some listeners detect some added spatial information in Holophonic tapes played monophonically, but to others, they sound exactly like any signal played through a mono speaker. Proponents admit that single-driver speakers do a better job than multiple-driver systems and that, in a four-speaker auto installation, the two rear speakers should be turned off for best results.

The Return of Binaural Broadcast

A fascinating series of binaural radio dramas has been airing on many public and college radio stations for some time now, and, like many series, it will likely be repeated on one of your local stations. Titled *The Cabinet of Dr. Fritz*, the series of half-hour dramas produced by ZBS Media grew out of an experimental Halloween binaural broadcast of a scary play, entitled "Sticks," in 1982.

Producers Tom Lopez and a woman who goes only by the name of Phoenix used the Neumann KU 81 hard-rubber Kunstkopf, and did original digital recording with a Sony PCM-F1 unit and portable Beta VCR. They nicknamed the head Fritz II, hence the name of the program series. Some of the original recording was done on location, since the entire recording system is portable. For a scene in a car, for example, recordist Bob Bielecki got into the car with the actors, the dummy head, and the Sony system. The original digital recordings were dubbed to multi-track analog, using dbx noise reduction for the studio effects and music that were added.

The best production in this series of radio dramas, all of which have a bit of the macabre about them, is the first one—Stephen King's "The Mist," which features 35 actors and is described as one of the most detailed radio dramas ever produced. Monsters were created by putting various live animal sounds into the computer of a Synclavier II digital synthesizer and then playing them on its keyboard. The meow of a Siamese cat became the sound of spiders the size of large dogs, which dropped down on the unsuspecting listener from directly above. The chirp of a parakeet was turned into the shriek of a pterodactyl. "The Mist," when heard in the proper setting (at night, in the dark) with good stereo headphones, can be much more scary than a motion picture of a Stephen King story. It ran over three of the programs in the series, for a total of 90 minutes—the same as a feature film, interestingly enough.

The other excellent use of binaural in the radio drama series was the story "Aura," by Latin American author Carlos Fuentes. A young man answers an advertisement and is slowly drawn into the lives of a strange old woman and her stranger niece, while losing control of his own life.

If *Dr. Fritz* is not aired in your area, or if you wish to bypass the vagaries of FM transmitters and reception—which can sometimes degrade the binaural effect—you can order either of these dramas on chrome cassettes with Dolby B NR, duplicated in real time, directly from ZBS Media, Box 1201, Fort Edward, N.Y. 12828, (518) 695-6406. Be sure, when you sit down to listen, you warn others in the house that they may hear some disturbing sounds coming from *you* when those gurgling giant spiders come creeping up from behind!

Tickets for Binaural

Another binaural event that may be both seen *and* heard if it plays in your area is the brainchild of a Seattle composer with a rather bizarre bent, Norman Durkee. He calls himself and some of his performances "The Binaural Man." Each seat in the theater where he appears is equipped with a pair of Sennheiser HD 40 headphones connected directly to Durkee for his combination live and digitally prerecorded binaural performance/broadcast. There is no such thing as a bad seat or poor-sounding auditorium when Durkee performs his seriocomic bits, which were described by one critic as a combination of Laurie Anderson, Charles Addams and Hunter Thompson. His performances are something like an audio equivalent of 3-D movies, in that they require the audience to wear special equipment and endeavor to put the audience *into* the entertainment. However, Durkee is also an artist and an extremely versatile composer and keyboardist/synthesist. His two different "Binaural Man" programs have toured Los Angeles, San Francisco, Chicago, New York, and Milwaukee.

Durkee's latest project is the world's first binaural opera, which premiered early last year in Seattle and will eventually tour the country. (It will play to audiences limited to 200, since that is all the headphones Durkee has at the moment.) "Oxymora" is based on the diaries of Japanese court ladies of the feudal period of ancient Japan. Durkee wrote the script and music, and his wife Louise created the choreography. Also featured is the sound of the Kurzweil 250, said to be the first electronic musical instrument that can re-create the sound quality and dynamic range of *any* acoustic instrument. It was used to create the prerecorded orchestral parts for the opera.

Excerpts of all three of Durkee's binaural projects are available on cassette on a limited basis. He can be contacted at the International Binaural Institute, Box 45575, University Station, Seattle, Wash. 98145.

Comparing "The Binaural Man" to a 3-D movie brings us to the next place where binaural sound can soon be experienced along with visual entertainment. Since the second wave of 3-D motion picture efforts seems to have run its gimmicky course, one production company has taken a hard look at what other audience-involving format could lure a public that is being lost to video. They chose binaural sound.

The firm's name is Optimax III, and they call their binaural soundtrack system Sonimax. They see it as a total dimensional sound-reproduction system for motion pictures and television. By utilizing individual stereo headsets, viewers of the feature films will be able to localize the positions of each sound exactly, to experience the illusion of actually being there.

To avoid the immense problems of wiring hundreds of stereo headphones, Sonimax employs Walkman-type FM radios to feed the headphones and a two-channel FM signal broadcast inside the otherwise silent movie theater. Audience members may bring their own FM receivers or rent "designed-for-viewing" receivers and headphones at each theater.

The Optimax III people are keeping very quiet about the exact nature of the proprietary transducer used to pick up the binaural sound during shooting; in photographs I have seen, the equipment at the end of the mike boom is blacked out. Three feature films are said to be in current production using the binaural Sonimax process.

Optimax's initial brochure seems to have missed one advantage of the process that is *really* something to tout: Even *without* the binaural feature, this system will be pure bliss to serious filmgoers who are being gradually driven out of the movie theaters by those who seem to think they can freely talk to their friends, out loud, as though they were in their own living rooms! For those who want to hear the *soundtrack*, headphones would be welcome.

Binaural in Your Home

Finally, another opportunity to hear binaural sound, and at no cost, is offered occasionally by the weekly program on National Public Radio which I myself produce, *Audiophile Audition*. This hour-long program, which features audiophile recordings in all formats and short interviews with audio and music personalities, aired several all-binaural programs during its four years of local San Francisco-area broadcasts. The new national series of *Audiophile Audition* aired an all-binaural program on May 12, 1985, and again last December 15. The series is carried by many NPR stations (115, by March 1986) and a few commercial concert stations. Most of these stations air it live at 2 p.m. EST on Sundays; check your local radio listings for the exact time in your location, since some stations tape-delay the broadcasts, using PCM digital equipment. Excerpts from most of the binaural projects discussed in this article are featured on the special binaural versions of *Audiophile Audition*. This format always brings in the greatest amount of listener mail, demonstrating there is definite public interest in this unique method of reproducing sound.

It is unfortunate that almost no commercial binaural recordings are currently available. This writer has urged several record labels to consider a binaural sampler, but the only current one is a demo CD from Sennheiser, containing a sci-fi drama—in German. (It's also the only binaural CD that I'm aware of, but apparently it's not available in the U.S.) The only presently available binaural material, in addition to that already mentioned, are three recordings: The Holophonics group has produced an extremely clever and enjoyable little demo cassette titled *Touch the Future*. On one side, it contains a sound-effects tour de force integrated into a story concerning some robots and their programmer. On the other side are two selections of music that feature instrumental surround effects not only in a horizontal plane but also in a *vertical* one, up the wall in front of the listener. It is on chrome tape with Dolby B noise reduction, and is available in the U.S. for about $10 at participating Alpine and Luxman audio dealers.

The other binaural recordings were made back in the heyday of direct-disc in the mid-'70s. Sonic Arts Corp. in San Francisco has two binaural albums which may be unique in also being direct-to-disc. The first presents pianist David Montgomery in a program of Schumann, Liszt, and Chopin. The album begins with Montgomery opening the studio door, walking to the piano, seating himself at the occasionally squeaky piano stool, and announcing

Millions are enjoying music through headphones, yet they're hearing material never designed for such listening! It's time to get the binaural show phased in.

his first number. Clearly audible is the slightly squeaky shoe of his page-turner, who also sometimes gets caught up in the livelier passages and taps his foot in tempo.

The other binaural direct disc is a bit more spectacular, featuring seven jazz performers (though not all at once) in *Woofers, Tweeters, & All That Jazz*. Pianist Art Lande is perhaps the best known of the jazzmen, and the arrangements of the four original tunes are by James B. Treulich. This session spread the instrumentalists around the studio, with a live "dummy" in the center wearing the Sennheiser condenser binaural mikes. During some passages, some of the instruments are wheeled around the studio while they are played, and to top it all off, sound effects of thunderstorms and rain are played through stereo speakers in the studio during one number. The latter—which might have been passable in stereo loudspeaker listening—sounds canned and unnatural through headphones. Producer/engineer Leo de Gar Kulka comes up with a great description of binaural's effect in the liner notes, referring to its "sensuously expansive circular sensations." The albums are Lab Series 5 and 7 respectively, and should still be available from Sonic Arts Corp., 665 Harrison St., San Francisco, Cal. 94107.

By the way, there are some Holophonic effects on two of Pink Floyd's albums, *The Wall* and *The Final Cut*, also available on CD. It appears these effects are limited to sound which was recorded Holophonically by Hugo Zuccarelli, but the entire albums may have been run through the Holophonics processor—it is not clear from the notes.

Headphones vs. Stereo

More people are enjoying their music through headphones today than since the days of the crystal radio. And what a giant improvement has been made in stereo headphone quality in the last several years! Today the best ones—especially the electrostatic variety—rival and even surpass some of the most lavish loudspeaker systems as to frequency response and low distortion, and at a fraction of the cost.

The Walkman revolution has millions listening to their music wherever they are and no matter what they are doing. Yet all of these folks are hearing source material *that was never designed for headphone listening!* The separation factor is the primary difference, though there are many others. Everyone with stereo headphones is hearing grossly exaggerated separation that puts half of the orchestra at the left side of the head and the other half at the right side. They are also hearing greatly exaggerated dynamic levels designed for speaker listening rather than headphones. At very high listening levels, hearing damage could occur. Some headphone manufacturers have offered mixing boxes which can blend the two channels as desired, but this does not make the result binaural, by any means.

This huge headphone audience is the perfect audience for binaural—ready and waiting. A few prerecorded cassettes have been issued in "Mixec for Headphone Listening" versions, but this again is far from binaural since the music was not originally recorded binaurally.

In addition to increasing musical enjoyment and participation immensely, a pair of binaural mikes or a dummy head, together with either a portable recording cassette deck or a portable PCM-type unit and portable VCR, can be put to many nonmusical uses by the consumer. These can include taping business conferences and panel discussions. With binaural, every voice will be clearly heard—no one will sound "off-mike." And transcribing will be a breeze—just from the location of voices, there will be little doubt who is speaking. Stage plays and rehearsals can also benefit in a very practical way from binaural recording. Even if several people talk at once, each can be clearly singled out. (Edward Tatnall Canby has written at length in his *Audio* column about some of these binaural boons.) As for recording live musical events, it is simple if you wear the mikes yourself. It will successfully capture the event with a you-are-there quality almost wherever you sit; there is really no "wrong" mike location. (Be sure to get permission from the organizers of the concert, of course. And don't move your head.)

Binaural is a thrilling experience for the first-time listener. If you haven't heard it yet, give it an ear—or rather, two ears. Let's get this show "phased in" soon!

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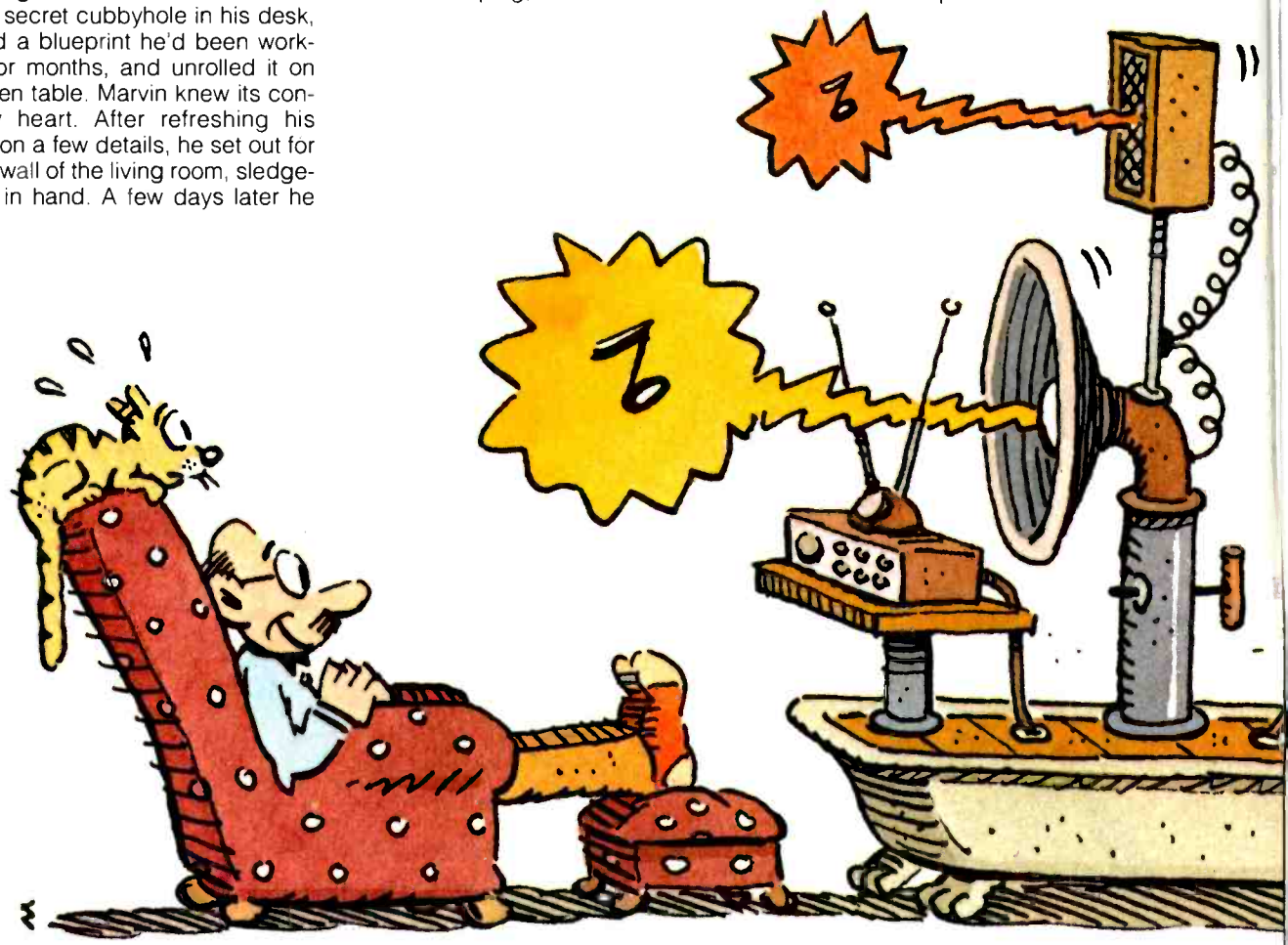
Confessions Of A Loudspeaker Sale

The year: 1952. The place: Palo Alto, California. An aviation engineer we'll call Marvin suddenly began suggesting to his wife that she go visit her mother while he took a week of his vacation. Now, Marvin's wife knew her husband was an audio tinkerer with some pretty grandiose ideas about how to attain the ultimate in sound reproduction in their two-bedroom bungalow, but little did she know what he had in mind: A dream horn-loaded loudspeaker system.

Mrs. Marvin's Studebaker was barely out of sight when her husband scurried to a secret cubbyhole in his desk, extracted a blueprint he'd been working on for months, and unrolled it on the kitchen table. Marvin knew its contents by heart. After refreshing his memory on a few details, he set out for the front wall of the living room, sledgehammer in hand. A few days later he had installed a concrete horn which used the entire wall for its mouth. The horn projected into the front garden and featured a right-angle curve that terminated in a 55-gallon drum buried in the front yard. Driven by a 15-inch woofer installed in the sound-absorbent, waterproofed drum, the horn was painted green and was screened by additional shrubbery planted by the glow of automobile headlights the night before Frau Marvin was due back home.

Having finished the outdoor work and landscaping, Marvin moved indoors to cover the mouth of the horn with tightly drawn fabric and other appropriate decorations placed so as not to interfere with the output of the midrange and tweeter horns. Marvin did the job carefully, and when his wife arrived home, she commented on how attractive the front garden looked. Then, for some reason history fails to record, she leaned against the living room wall, which proved to be nothing more than speaker fabric.

It is not known whether, in the divorce which followed, she allowed her husband to keep the house.



by HAROLD WEINBERG
as told to ROBERT ANGUS

sman

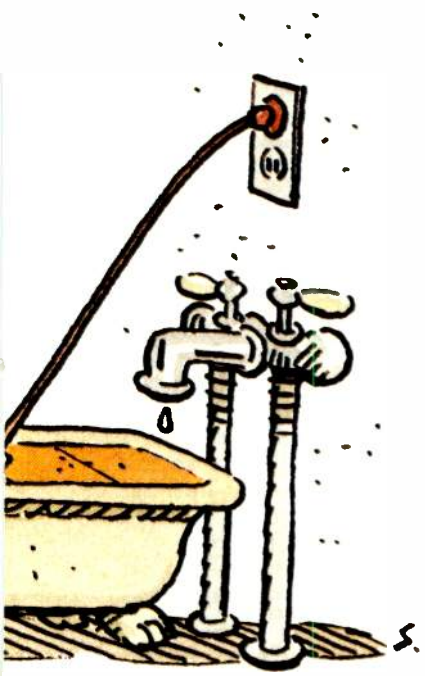
As unlikely as the tale of Marvin may seem, it is only one of hundreds from that crazy period in hi-fi history when every enthusiast fancied himself a loudspeaker designer or sought the goal of perfect 16-Hz reproduction. The 1950s was a decade given to do-it-yourself speaker projects. It was easier to find separate drivers, crossovers and cabinets than complete speaker systems—and, since the art of matching cabinets to speakers was still primitive, your chances of getting the best possible sound were at least as good if you assembled your own system as they would have been if you bought a factory-integrated one.

I'm not quite sure why loudspeakers are considered funny, but even then people laughed at them. The very designations "woofer" and "tweeter" brought smiles to the faces of people whose knowledge of high fidelity was limited to an occasional article in *Fortune*, *The New Yorker* or *Consumer Research* magazines. Among enthusiasts able to buy woofers, tweeters and midrange units for the first time, no idea seemed too far-out to try. Result: An awful lot of very bad sound, some ideas which came to fruition only years or decades later, and plenty of good anecdotes which bring chuckles to the audio fraternity even today.

During the 1950s, I worked as a salesman for several of New York City's leading audio emporia. It was my lot in life to be singled out by would-be creative geniuses who had baroque ideas they wished to execute and needed a pointer here or there, or who had just converted Grandpa's coffin into a folded-horn enclosure and wanted a 26-inch woofer to put into it.

For example, there was the young man from New Jersey who copied the R-J enclosure, a popular one at the time, in welded boilerplate. He had in mind somehow carrying it upstairs, but in the end, since he lived in a large, old-fashioned, three-story frame home, the enclosure had to be brought into his top-floor listening room through the window, using a block and tackle. It weighed almost 500 pounds with a 15-inch woofer installed. According to him, it sounded quite good. I never bothered to check it out for myself.

The early 1950s was a time when extensive home and apartment remodeling was going on. Bathrooms, in particular, were targets for weekend do-it-yourselfers eager to replace the bilious greens and yellows that had survived through the World War II years. And those cast-iron bathtubs from the 1920s and '30s, the ones with the claw feet, simply *had* to be replaced with built-in plastic tubs, which meant that just about every scrap yard in the country had more cast-iron tubs than it knew what to do with. They were available free or for a few cents per pound to anybody willing to haul them away.



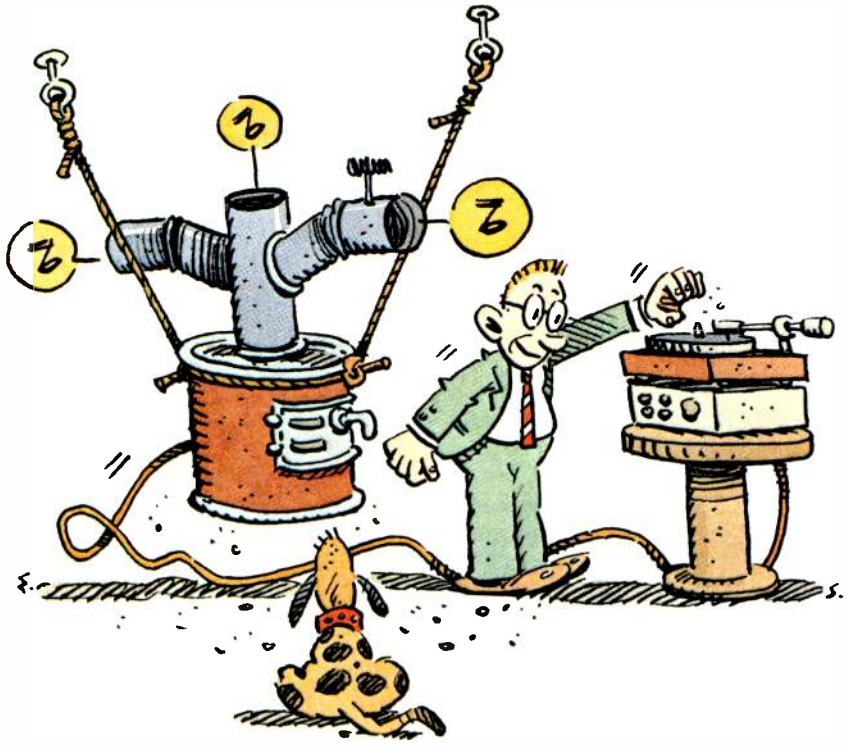
Illustrations: Elwood Smith

The plastic bathtub boom of the '50s filled scrap yards with iron tubs that made ideal, nonresonant speaker enclosures.

What could be more ideal for a nonresonant enclosure?

One of the features of electronics magazines of the period was the do-it-yourself project. The pages of *Audio* and *Popular Electronics* and *Audiocraft* were replete with circuits and projects and designs that you could build in a few evenings. Like creating recipes for women's magazines, the effort of coming up with new ideas every month sometimes taxed the inventiveness and imagination of the projects editor who, faced with a deadline, might not have been above dusting off a project a year old and changing one or two parts.

Speaker systems were particular favorites because, for the most part, they were easy for anybody with woodworking tools and experience to build; and required a minimum of technical expertise. Besides, tuner, amplifier and preamp manufacturers who supported these magazines were none too happy at seeing cheap substitutes for their equipment. But speaker makers such as University, Stephens TruSonic, Electro-Voice and Jensen were as interested in selling individual drivers as complete systems, so they were delighted to have readers see new and creative ways to use their products.



One of these do-it-yourself projects was a grotesquerie known to its admirers as FAS, the Flewelling Audio System. Its heart was a low-frequency enclosure, something like an organ pipe. Like a real organ pipe, it had the ability to produce a single note loudly. The original enclosure was 6 feet long and wide enough to support a woofer 12 to 15 inches in diameter. The woofer was mounted on the outside of the enclosure, and it fired inward. The inside depth of the air coupler was about 6 inches. A slot about 4 inches in height and running the full width of the enclosure was cut into the side opposite the woofer, which was mounted about one-quarter of the way down the length of the enclosure, with the port about 4 inches above it.

With the FAS enclosure, the loading needed to control the woofer's movement was essentially provided by the woofer's magnet alone; the enclosure itself contributed almost nothing. The result was strictly one-note bass, but with a big, loose and sloppy quality—the musical equivalent of a big, wet kiss from an overfriendly Saint Bernard dog.

To "improve" the design, some people built a second, longer air coupler on top of the first, with one woofer driving both enclosures. Other people folded the design over on itself. And, as if that weren't enough, some genius came up with the idea of using the space between a building's floor supports for an enclosure, boxing it in and mounting the woofer in the basement. This also permitted the use of substantially longer enclosures; one was 32 feet long and used an 18-inch woofer. Had the poor fellow who built that monstrosity only known that mounting the same driver in a simple hole in the floor would have produced much better bass and been a lot less work!

Or take the case of the mono system with two 18-inch, 16-Hz resonant-frequency woofers. Each was mounted in a sealed 32-cubic-foot enclosure built of 1¼-inch plywood, internally braced with 12 two-by-eights per enclosure, and internally covered, before the application of sound-absorbent material, with 2 inches of automotive undercoating to damp any resonances that dared to crop up. It was reported that low bass from an organ seemed to flex the abdominal muscles of listeners.

Many of the more inventive do-it-yourself projects were undertaken by money-is-no-object perfectionists willing to spend whatever it took to achieve perfection. But some perfectionists operated on a budget. Take Ernie, for instance, a student at Brooklyn College who regaled me at length, one Saturday morning in the store, about the dodecahedron he'd just constructed from car speakers ripped off from a drive-in movie near Coney Island. Long before Dr. Bose built his first Direct/Reflecting loudspeaker and Design Acoustics its dodecahedron, Ernie had constructed a plywood frame holding twelve 5-inch radio speakers in a roughly spherical configuration. Time has mercifully clouded whatever details Ernie supplied about wiring together these unappetizing elements, but I do remember that there was no bass reproducer. The store was unusually busy that day, but that wasn't my only reason for resisting his invitation to hop over to Brooklyn and hear his creation.

Another customer, named Sid, purchased one of the first packaged component systems, put together by Lafayette Radio. It consisted of a General Electric variable reluctance phono cartridge, Brociner amplifier, Collaro record changer, and Electro-Voice SP12B coaxial speaker. The price was $99.95, a princely sum for many a young audiophile at the time, and the speaker came without an enclosure—although Lafayette would sell you one for an extra $30. Sid wasn't about to pop for the extra money. His fifth-floor Greenwich Village walk-up had a bricked-up fireplace which could be pressed into service. Sid took his purchase home, stopping by a hardware store to pick up a hammer, chisel and some quick-drying cement. That night, he unblocked the fireplace grate, mounted the speaker in the opening, and sealed the wall back up. The perfect infinite baffle, he thought. And it would have been, had not every tenant in the building who shared that chimney started banging on Sid's door to complain about the vibration.

Much of the action in New York audio in the early days took place along the narrow streets of lower Manhattan on Saturday mornings, when the ferries from New Jersey would bring loads of shoppers hunting for bargains along Greenwich and Cortlandt and Liberty Streets. Audiophiles would pick through the parts displayed on open tables on the street or cast lustful glances through the windows of Airex Radio or Terminal-Hudson at the newest in pickups, power amps, or multi-cellular tweeters. On the corner of Greenwich and Cortlandt, a spot now buried beneath one of the twin towers of the World Trade Center, Cantor the Cabinet King was likely to have just what you needed to house that horn tweeter and public-address speaker you'd just rescued from the war surplus bin at East Radio.

Cantor once asked me to help him build a speaker system into his basement. Not for him the petticoats once worn by a Stromberg-Carlson console

Why are loudspeakers considered funny? Maybe it's the mad ingenuity of the early models, maybe just the words "woofer" and "tweeter."

or a Trav-Ler TV receiver, the merchandise he offered his customers. The Cantors, it seemed, loved to dance, so the Cabinet King wanted to create a Make-Believe Ballroom in his basement. We partitioned off one end of the basement, installing studs and a false wall of ¾-inch plywood into which we cut holes for six—count 'em, six—Wharfedale loudspeakers and a Tech Master black-and-white TV set. Long before anybody ever dreamed of integrated audio and video systems, and even before most people had thought of stereo, the Cantors were entertaining their friends with a TV screen mounted in the wall and flanked by identical pairs of woofers, tweeters and midrange units. We channeled the TV sound through an amplifier in the room to both sets of speakers, and Cantor, at least, seemed highly pleased with the results.

Another incident was before my time, but it's still a favorite story among Cortlandt Street veterans. One busy Saturday morning before World War II, when the Sixth and Ninth Avenue elevated transit lines still ran down Greenwich Street, a man and his son huffed and puffed their way to the front of one of the stores, lugging between them an enormous theater-style speaker system. A salesman stepped from behind the parts counter and offered to help them to their car. "We don't have a car," the father explained. "We've got to get it up to the el." The salesman obligingly took up the rear as far as the station steps. On his way back to the store, he saw his boss, red-faced and panting, charging toward him. "Where did those guys go with that speaker?" he demanded. The salesman pointed to the figures now near the top of the structure, where the Ninth Avenue trains pulled in. "They didn't pay for it!" the boss shouted, and together he and the salesman huffed their way up the three flights of stairs—just in time to see the train pulling out with its precious cargo of loudspeaker.

New York City's Transit Authority had a strict rule about what could and could not be carried on the subways. "This isn't a freight service," the exasperated token-seller at the Cortlandt Street station told more than one audio shopper. In fact, nobody in the transit system ever envisioned the kinds of things people would try to squeeze through the turnstiles and onto the trains—console radio-phonographs in the early days, and later on Klipschorns and console television sets. There was a rule that everything had to be wrapped, so we'd throw sheets of newspaper around some of the bulkier items and tie them up with string, in an attempt to conceal what was inside. A favorite ploy of some shoppers was to come down on Saturday morning with a friend and a child. While the child distracted the attention of the man in the token booth, the two adults would try to hoist over the turnstile barrier whatever they had just bought, from a rooftop TV antenna to JBL Ranger Paragons and E-V Patricians.

I sold a particularly elaborate television antenna one day to a resident of one of the farther-out suburbs. With a perfectly straight face, he asked me to cut it in half so he could get it past the turnstiles and onto the subway. I checked with my boss, who suggested we get the man to sign a release, absolving us of any responsibility and noting that we wouldn't take the antenna back if it didn't work. Then I got out a hacksaw and cut a perfectly good deep-fringe antenna into parts small enough for the customer to tuck under his arm. I heard no more about it, but I often wonder how he enjoyed putting it back together again, and what kind of reception he got.

In the 1950s, the customer was always right, and at Harvey Radio we treated ours like kings. A strong seller at the time was the Wharfedale system in a sand-filled baffle. Other shops might fill their baffles with common garden-variety sand, but ours had sand specially cleaned for use in sandboxes. If you bought your Wharfedale SFB (sand-filled baffle) system from one of those other shops, who knew what bugs or other undesirable flora or fauna might be mixed in with the sand?

A frequent problem while I was at Harvey—and probably at a number of other audio salons around the country—was speakers whose voice-coils had melted and whose cones had burned to a crisp. The cause, as often as not, was an audiophile's bright idea to use an ordinary a.c. extension cord to extend speaker lines. In those days, speaker lugs and phono plugs weren't available from every corner hardware store, but a.c. wall plugs were. So some of our customers bought wall plugs, male and female, and attached them respectively to speaker leads and the terminals on the back of the amplifier. Invariably, some well-meaning soul would discover one of these wall plugs unconnected and insert it

Speakers can make funny noises sometimes. But why did two pairs make noise when their stereo systems were turned off?

into the nearest outlet. There would be a terrifying sound and the smell of burning insulation and paper, and one more loudspeaker system would be on its way back to us. Occasionally, the male plug was on the amplifier, instead, and the amp would become a room heater for a very short time.

In the early days of audio, the materials used to make speakers presented some unique problems. Cloth and rubber were favorite materials for loudspeaker surrounds, but each had its drawbacks. Rubber would dry out and become brittle, or would offer too much or too little resistance.

The Lowther, a British speaker, was one of the first to use plastic in its cones. The science of polymers in those early days left something to be desired, and every Lowther system we sold eventually had to be returned to the factory to have the cone remounted when the synthetic material dried out.

We had one customer who complained of a rattling sound inside his Wharfedales even when the stereo system was not in use. I spent the better part of an hour with him on the phone, eliminating first one component and then another as the possible source of the problem. Finally, after we had eliminated everything else, I asked him to bring the speaker in. It turned out that a family of mice had made their home in it, and had been dining on the speaker's cloth surround.

Another speaker which produced distortion even when the amplifier was disconnected belonged to a man who lived in one of the small towns down toward Princeton, N.J. I went through the same kind of step-by-step elimination with him that I had done with the Wharfedale owner. We'd talk during the day and find nothing wrong. That night the problem would be back, and the next day we'd eliminate another component. This went on for some time, and I asked him to bring the speaker in. We checked and double-checked it and still could find nothing wrong. So he invited me out to the house for dinner and an evening of listening to music.

One look at the house, and I had a sneaking suspicion what the trouble might be. It was a masterpiece of Victoriana, straight out of a Charles Addams cartoon—with the exception that it was tastefully, even luxuriantly furnished. After dinner, we got down to business with the hi-fi system. Before long, I could hear it—a distinct knocking in the speaker. We changed program sources, and it came again. As in the case of the Wharfedale, we wound up with the speaker leads disconnected, and still there was a knock. I took the back off the speaker, as I had at the store, and checked it again from stem to stern.

Later, when his wife served coffee, she mentioned casually that the china in the cupboard rattled occasionally, for no good reason. We put both phenomena down to poltergeists.

One of my favorite customers was a South American playboy who had decided to make a career at Columbia University as a perpetual student. Alfredo was dark, handsome and loaded, which may help to explain why he had so many girlfriends. As a token of his esteem, each time he'd move in with a new lady—which seemed to be every three months or so—he'd present her with a new hi-fi system. On one occasion, we delivered his latest system to a townhouse on the Upper East Side. The house had a marvelous old spiral staircase, and the system, which included an Electro-Voice Patrician, was to be installed upstairs on the parlor floor. We tried every which way to get it up the stairs and finally did so by lifting it over the railing, taking skin off our knuckles at every turn. Then came the problem of getting that huge cabinet through the door. In desperation, we cut the corners off the back of the system and eased it through. The mitred corners didn't seem to affect the sound, and Electro-Voice adopted our design in later versions of the system.

Another flight of fancy was the Circle-o-Phonic speaker, which used a revolving midrange-tweeter to create an illusion of omnidirectionality. This ingenious device used an upward-facing woofer and a 6-inch midrange unit with whizzer cone. The latter, driven by a small clock motor, was mounted vertically just above the woofer. I don't recall the number of revolutions per minute, but some listeners complained it was high enough to make them seasick, while others detected a.c. hum in the output.

Speakers may be better now, but they're not so much fun. Even by the end of the 1950s, the do-it-yourself tide had ebbed, and much of the eccentricity had been driven out of loudspeaker design by increased knowledge, the rise of the bookshelf speaker, and the requirements of stereo. To this day, I wonder what Marvin (or later occupants of his house, with its living room horn) did when stereo came in.

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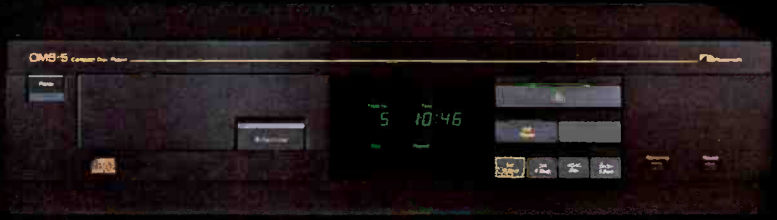

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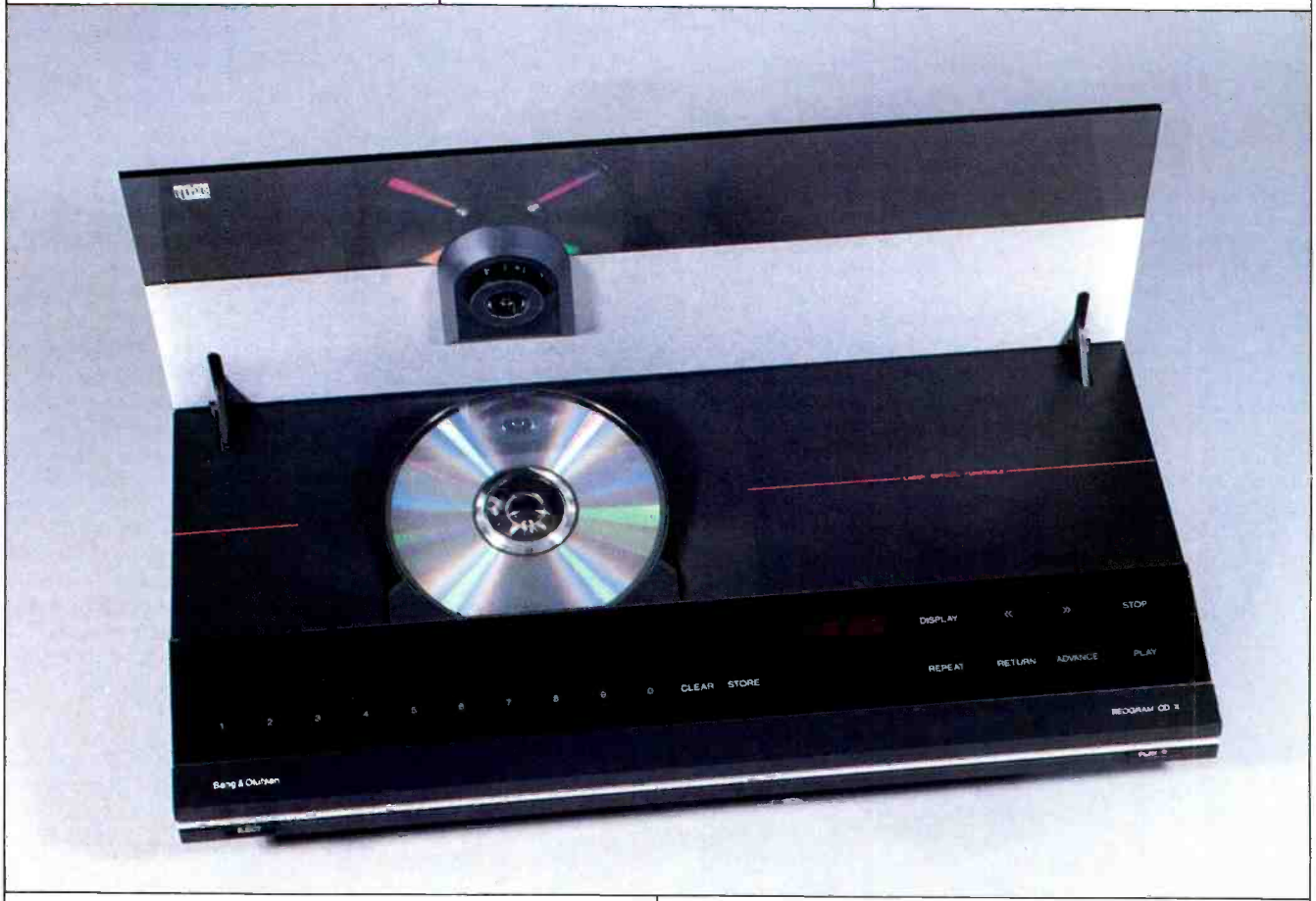
S/N Ratio: Greater than 96 dB.
Dynamic Range: Greater than 96 dB.
Channel Separation: Greater than 94 dB, 20 Hz to 20 kHz.
Channel Difference: Less than 0.5 dB.
Converter System: 14 bit; 176.4-kHz oversampling.
Low-Pass Filter: Digital plus analog.
Number of Programmable Selections: 40.
Output Level: 2 V rms at 0 dB.
Power Requirements: 120 V, 50/60 Hz, 25 watts.
Dimensions: 16½ in. W × 3 in. H × 12¼ in. D (42 cm × 7.6 cm × 31.1 cm).
Weight: 12.4 lbs. (5.6 kg).
Price: $699.
Company Address: 1150 Feehanville Dr., Mt. Prospect, Ill. 60056.
For literature, circle No. 90



Leave it to Bang & Olufsen to come up with a CD player distinctly different from the morass of look-alike models appearing recently. B & O's Beogram CD X is elegantly styled to match other components made by this Danish firm, whose products grace the permanent design exhibit at New York's Museum of Modern Art. But the B & O styling goes far beyond aesthetics. Of course, the CD X is beautiful to look at and is sure to be a conversation piece in any tastefully furnished home. However, it is also one of the easiest players to use, its gently sloping, black-tinted-glass control surface inscribed with words and numerals that need only to be lightly touched to perform various operations. There are no switches, knobs, or other protrusions on the top surface of the unit. As elegant as this arrangement is, I did find that

with continued use, my fingers left marks on the polished glass surface, requiring rather frequent cleaning with a dry cloth. One gets the feeling, after a while, that this player should be approached only when wearing those white gloves that waiters sometimes wear in French restaurants.

Although the CD X has no provision for remote control, you are not likely to miss this feature, given random access to specific tracks and the amount of programmability available. You can program up to 40 commands for a given disc; since few discs contain this many actual tracks, you can ask for several tracks to be repeated.

Control Layout

"Control" is actually a misnomer here, for, as I've mentioned, the CD X has no operating controls in the traditional sense, other than an "Eject" button at the left of the narrow front surface and a "Play" button at the far right. There is also a "Play" on the control surface, with the difference that the button doubles as the on/off switch. If a disc is in place, touching either "Play" makes the CD X scan the disc, display the total number of tracks (up to 20) by a series of green numerals lighting up on the control surface, and begin play. At this point, you can program the CD X (either while the disc is playing or after pressing "Stop" on the panel) to play up to 40 tracks, in any order. Programming is begun by light touches on the control surface, just above the series of white numerals (0 through 9) which, in turn, appear just below the green numbers. Each selection is then completed by a light touch on the word "Store," just to the numerals' right. If you want to hear most, but not all, of the tracks, B & O makes this easy too: After first touching the number corresponding to the *undesired* track, simply touch the word "Clear" to eliminate that track from the playing sequence. With a disc containing many tracks, clearing or omitting one track is much easier and faster than having to store, say, 19 tracks.

If there is no disc in place when you press the "Play" button, a red question mark appears in the main display area to the right of the green or white track and programming numerals. To insert a disc, you press the "Eject" button. Three-quarters of the unit's top surface then gently lifts up, providing access to the CD turntable surface. At the same time, the turntable surface itself tilts up, almost "inviting" you to place a CD on it. Once a disc is in place, gently touching the open lid will cause it to close as quietly and as smoothly as it opened. Alternatively, touching the word "Play" on what B & O calls their "Sensi-touch" panel causes the lid to close and play to begin from the beginning of the disc.

To the right of panel center, the red LED display serves four purposes. Initially, it shows the elapsed time of the track currently playing. Touching the word "Display" replaces this with a readout of total elapsed time from the disc's beginning. Touched again, the display will show the track and index number currently being played. Finally, a question mark appearing in the display indicates that you have done something wrong and the CD X cannot follow your command. For instance, loading a disc upside down or asking for tracks that don't exist result in the question mark being displayed.

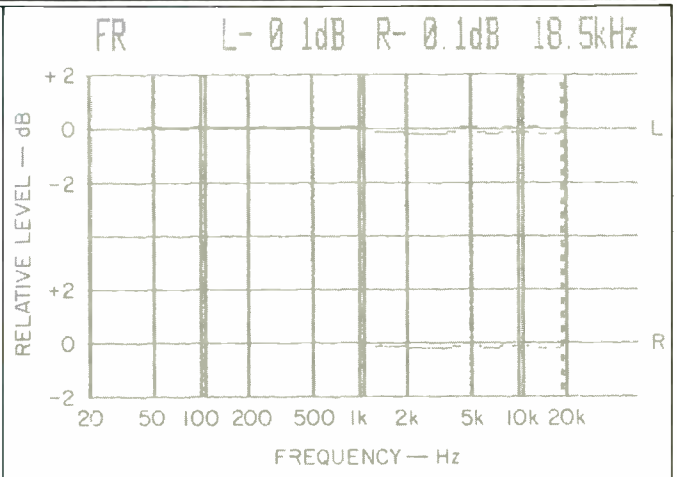


Fig. 1—Frequency response, left (top) and right channels.

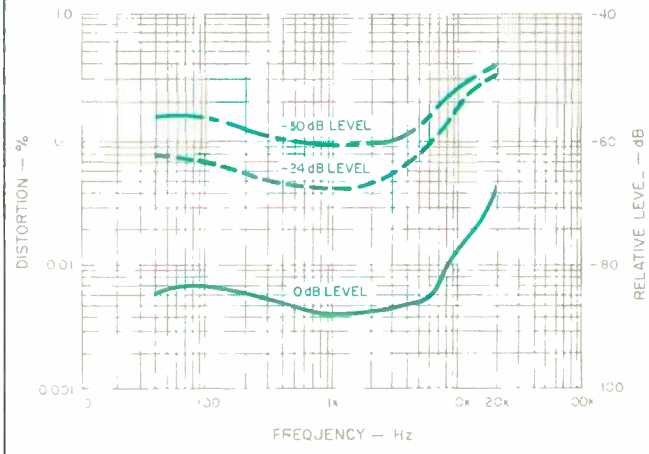
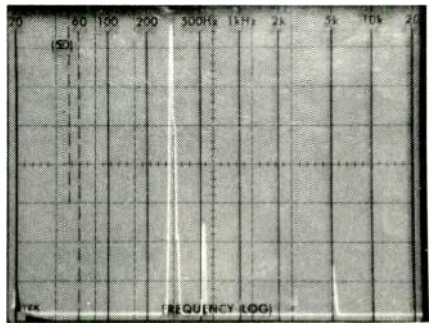


Fig. 2—Distortion vs. frequency at three recorded levels.

Fig. 3—Spectrum analysis of 20-kHz test signal (large spike) shows accompanying out-of-band components at approximately 24 and 44 kHz.



A conversation piece, B & O's CD X is one of the easiest players to use, with its touch controls and high level of programmability.

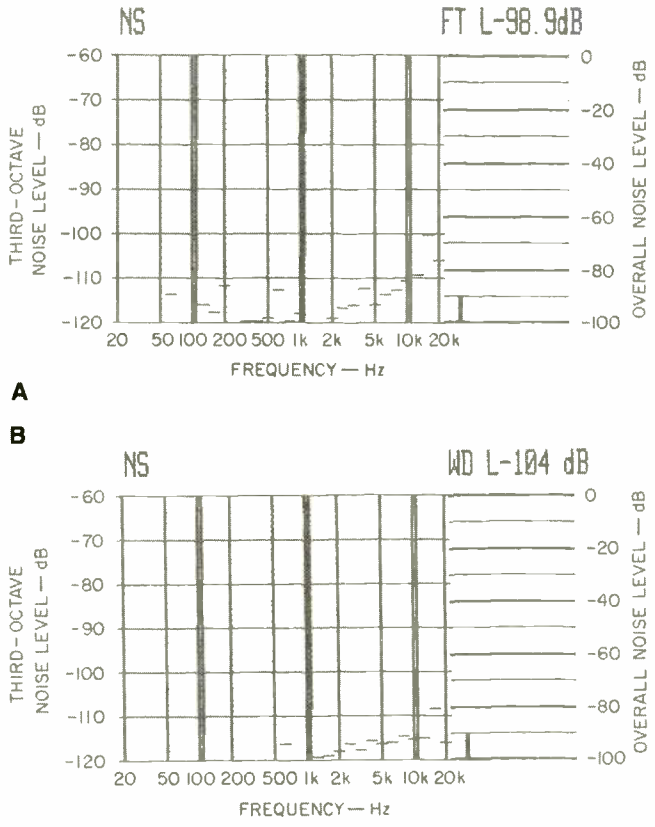


Fig. 4—S/N analysis, unweighted (A) and A-weighted (B).

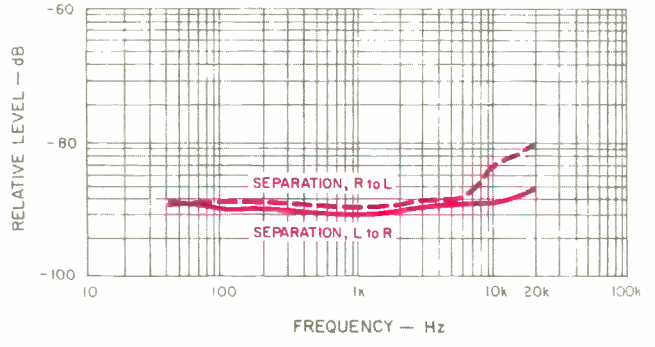


Fig. 5—Separation vs. frequency.

Fast-forward and fast-reverse search are accomplished by touching appropriate nomenclature on the "Sensi-touch" surface, but there is no audible sound while using these modes. The label "Return," touched once or repeatedly, allows you to move backwards, track by track, should you want to hear an earlier selection. Touching the word "Advance" skips tracks in the forward direction. Touching "Repeat" allows you to play a disc up to four times in succession. If you touch the word "Stop" briefly, disc play pauses and can be resumed from the same spot by touching "Play." However, if you hold your finger on the word "Stop" for more than 2 S, play is suspended completely and the disc stops spinning.

Instead of equipping the CD X with conventional female output jacks, Bang & Olufsen has supplied this unit with just over four feet of output cable, terminated in color-coded, male phono-tip plugs. Certainly the length of this cable is adequate for most installations. Even if more distance is needed between player and amplifier or preamplifier, you could always use an audio cable extension. But for the purist who insists upon using special audio cables (such as those equipped with gold-plated plugs), the arbitrary length and grade of the cable permanently affixed to the CD X may prove undesirable.

Measurements

Frequency response of the CD X was flat within 0.2 dB from 20 Hz to 20 kHz (see Fig. 1). I did notice a bit of ripple in the response, just before high-frequency cutoff above 20 kHz, which I can only attribute to the analog filters at the output of the D/A converters. These filters, by the way, are not of the steep, multi-pole type found in some CD players. Since B & O uses the same D/A conversion technique employed by Philips (i.e., four-times oversampling and 14-bit linear conversion), "brick-wall" filters are not required and an analog filter of gentle slope can be used to minimize phase shift.

Output voltage at 0 dB (maximum recorded level) measured almost precisely 2 V, as claimed. Actual harmonic distortion at mid-frequencies measured 0.003%, as claimed, for 0-dB level. However, when I used a distortion analyzer instead of a spectrum analyzer, readings were somewhat higher because of the presence of minute quantities of out-of-band components and, in some cases, negligible quantities of "beats" appearing within the audible spectrum. Figure 2, which shows distortion at various levels over a range of frequencies, includes these nonharmonically related components, which are reflected in the somewhat higher readings. In Fig. 3, a 20-kHz test signal is represented by a tall spike, while the shorter spike to its right is an unwanted component outside the audio range, at about 24.1 kHz. The additional small spike, near the extreme right, seems to be a component at the sampling frequency of the test disc, 44.1 kHz. The sweep in this display was linear, from 0 Hz to just over 50 kHz.

Unweighted signal-to-noise ratio for the CD X measured a very high 98.9 dB; with A-weighting inserted in the signal path, the S/N reading increased to 104.0 dB. Analyses of noise distribution within the audio range are shown for both types of measurements in Figs. 4A and 4B. Channel separa-

The only audible "glitch" heard was when I played the widest "scratch" track on the test disc; other players got by this without any problem.

tion, plotted in Fig. 5, measured a full 90 dB at mid-frequencies and at the bass end of the audio spectrum. Separation decreased to between 80 and 86 dB at the high-frequency extreme, depending upon which channel was measured.

Reproduction of a 1-kHz square wave by the Bang & Olufsen CD X, shown in Fig. 6, corresponds exactly to the results obtained for other players which employ the same type of oversampling and digital filtering. Reproduction of a unit pulse, as seen in Fig. 7, was also typical of the results obtained with other players employing this same kind of D/A conversion. The coincident positive crossing of the horizontal axis of both the 200-Hz signal on the left channel of the test disc and the 2-kHz signal on the right channel, depicted in Fig. 8, shows that there is no measurable phase shift occurring in this player, at least up to 2 kHz.

Tracking of this particular sample didn't quite measure up to some other third-generation CD players I have tested. Specifically, the error-correction circuitry plus the servo-tracking arrangement was unable to get through my obstacle-course defects disc. There was an audible "glitch" while playing the "scratch" track covered with a 900-micron-wide opaque area. Admittedly, that's the widest obstacle on this disc, but several recent players have been able to get by it without any audible problems. I hasten to add that the player had no trouble working its way through the simulated dust particles or the simulated fingerprint smudge on the same disc.

Use and Listening Tests

From the logical, brief, and easy-to-understand owner's manual to the unit's ease of operation, the CD X is a typical Bang & Olufsen masterpiece. I don't know just how much of the internal workings of the machine are built by B & O itself and how much of it is purchased from other sources. I suspect that the D/A conversion circuitry and related parts (or at least the D/A chips) come from Philips, while the transport mechanism, with its unique lift-up disc platter, must have originated with the designers at B & O.

As for sound quality, I had no quarrel whatever with the designers of this unit. In all respects, the sound reproduction was reminiscent of that of the various Philips (Magnavox) players I have tested over the past couple of years, all of which use the same basic D/A conversion approach. In other words, there was none of the harshness sometimes attributed to those machines that use a 44.1-kHz sampling rate and employ steep, multi-pole analog filters at their outputs. Among the newer CDs that I enjoyed while putting the CD X through its paces was a three-disc set of Richard Strauss' opera *Der Rosenkavalier* recorded at the Dresden Semper Opera House (Denon 100C37-7482-84). The naturalness and live quality of this recording were, in my opinion, faithfully reproduced by the CD X.

Another recent acquisition for my CD collection is *West Side Story,* a two-disc set with the composer himself, Leonard Bernstein, conducting and which features an operatic cast. Included is Kiri Te Kanawa, whose lovely, clear voice benefits from the CD technique. (This recording, Deutsche Grammophon's 415253-2, bears the designation "DDD," indicating that it was digitally mastered, digitally mixed and digitally recorded. When, by the way, are other record companies besides the Polygram group going to start using this sensible coding system to let us know how a given CD was produced?)

Getting back to the Bang & Olufsen CD X, its price, in my opinion, is quite reasonable considering its many operating features, the ease with which they're executed and—of course—that magnificent human engineering which has become almost synonymous with B & O designs.

Leonard Feldman

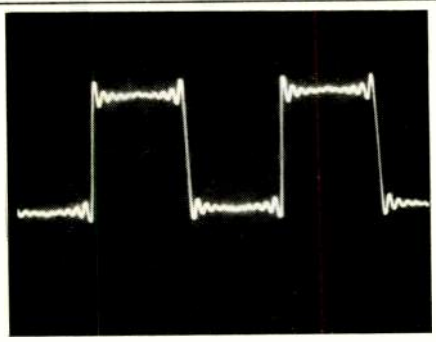


Fig. 6— Reproduction of a 1-kHz square wave.

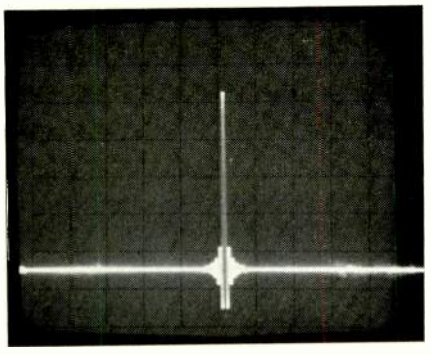


Fig. 7— Single-pulse test.

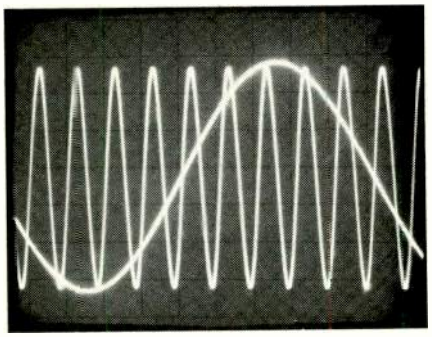


Fig. 8— Two-tone phase-test signal (200 Hz and 20 kHz) shows no phase delay or error.

2

NAKAMICHI TD-700 CAR STEREO

Manufacturer's Specifications

Tuner Section

FM Sensitivity: Mono, 18 dBf.
50-dB Quieting: Mono, 20 dBf.
S/N Ratio: Mono, 65 dB.
THD: Mono, 0.15% at 1 kHz; stereo, 0.3% at 1 kHz.
Frequency Response: 30 Hz to 15 kHz, ±3 dB.
Capture Ratio: 2.0 dB.
Alternate-Channel Selectivity: 65 dB.
Image Rejection: 55 dB.
I.f. Rejection: 80 dB.
Stereo Separation: 35 dB at 1 kHz.

Tape Section

Frequency Response: 20 Hz to 21 kHz, ±3 dB (using Nakamichi test tape).
Wow and Flutter: 0.05% wtd. rms; ±0.1% wtd. peak.
S/N Ratio: 64 dB, A-weighted, with Dolby B NR; 70 dB, A-weighted, with Dolby C NR.
Stereo Separation: Greater than 34 dB at 1 kHz.
Crosstalk: Greater than 60 dB.
Fast-Wind Time: 75 S with C-60 cassette.

Preamplifier Section

Frequency Response: 10 Hz to 50 kHz, ±1.0 dB.
Output Level: 0.35 or 1.1 V, selectable.
THD: Less than 0.005%.
Tone Control Range: Bass, ±18 dB at 20 Hz; midrange, ±10 dB at 200 Hz; treble, ±12 dB at 20 kHz.

General Specifications

Power Requirements: 14.4 V d.c., negative ground (10.8 to 15.6 V allowable), 6.5 amperes maximum.
Dimensions: 7 in. W × 2 in. H × 6½ in. D (17.8 cm × 5 cm × 16.5 cm).
Weight: 4 lbs., 3 oz. (1.9 kg).
Price: $790.
Company Address: 19701 South Vermont Ave., Torrance, Cal. 90502.
For literature, circle No. 91

If you install the Nakamichi TD-700 yourself, you will love the way the unit has been configured. The outputs (two for the front amplifier and two for the rear one) use standard phono-tip jacks—no nonstandard, difficult-to-match, multi-pin plugs here! However, the TD-700 offers a great deal more than just ease of installation. In fact, I was truly amazed at the number of features and controls incorporated in so small a unit. Many of the features are activated by means of multiple-function controls, thereby reducing the number of buttons and knobs that would otherwise appear on the front panel. Nevertheless, the controls *are* very close together, especially those associated with tuner operation. While most of the TD-700's features have been found in competing units, this is the only car stereo I know of that features front-panel adjustment of tape-head azimuth alignment. The importance of this feature will be evident when I discuss the test results.

Both Dolby B and Dolby C noise-reduction circuitry are included in the tape deck section, as are automatic repeat of a cassette side and a program-search function which looks for 4-S silent spots on a tape to identify the start of the next song. You can instruct the program-search feature to skip up to 10 selections in the forward direction during fast wind, and up to nine selections in the rewind mode. The tuner section has six station presets for FM and six for AM, plus manual tuning and "Scan" tuning, which homes in on usable signals and lets you listen for 5 S before going on to the next available signal.

Control Layout

Above the "Azimuth" control at the lower left of the front panel is a concentric pair of controls that actually serve four functions. The rear ring is a front-rear fader control; the front knob, when pushed, serves as a power on/off switch for the tuner section. Rotating this knob adjusts output levels, and pulling the knob forward, until it clicks into a new position, turns it into a channel balance control.

Below the cassette slot (into which cassettes are loaded conventionally, with the tape side facing forward) are buttons that control tape play. These include a large play button, a load button (which also controls ejection), a pause button, and the two fast-wind buttons, which initiate program search when pushed two or more times. Three tiny pushbuttons near the large azimuth adjustment knob turn on noise reduction, select Dolby B or C NR, and choose 70- or 120-μS tape equalization. Three more buttons, symmetrically placed to the right of the fast-wind switches, activate automatic tape repeat, choose local or distant reception, and select AM or FM radio bands.

The upper right section of the panel is dedicated to tuner functions. A display shows selected frequency, stereo reception, and, when applicable, which preset number has been used to call up the tuned-to station. During cassette playback, when the tuner section is off, or when the car ignition is off, the display shows the time of day. If the clock function is not desired, a clock switch on the side of the chassis can be set to "Off" before the unit is installed.

The six preset buttons are just below the display area. Below these tiny buttons are the up and down manual tuning buttons, the "Scan" tuning button, and the memory button used with the six presets to store station frequencies. Finally, below this bank of switches are three rotary tone-control knobs. Once the bass, midrange and treble have been adjusted to your taste, the knobs can be pushed in, out of the way, so that they are flush with the front panel. This not only prevents the settings from being tampered with or accidentally changed, but also makes it somewhat easier for large-fingered people such as myself to get at the tuning buttons. (As cleverly as Nakamichi has laid out all of these controls, things are still pretty tight on this 7-inch by 2-inch panel!)

On the top surface of the chassis is a switch which selects output level. Since this is a one-time adjustment determined by the sensitivity of associated amplifiers, it has been placed, wisely, out of reach of the user once the chassis is installed in a car.

Tuner Measurements

Figure 1 shows the mono and stereo quieting characteristics for the TD-700's FM tuner section, as well as the harmonic distortion for a 1-kHz modulating signal, as functions of signal strength. Usable sensitivity in mono measured 15 dBf, better than claimed. Mono 50-dB quieting sensitivity was 18 dBf, slightly better than the 20 dBf claimed. Stereo sensitivity really cannot be specified, nor can the stereo 50-

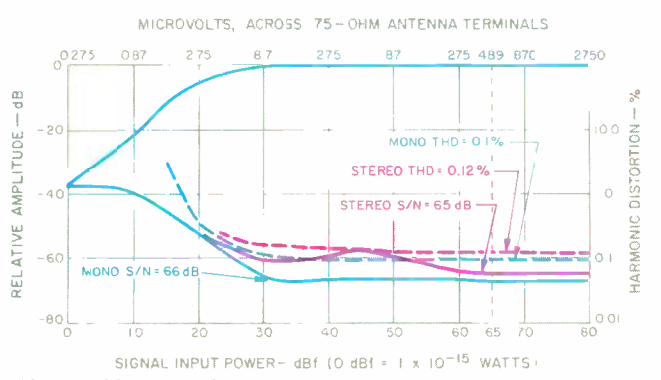


Fig. 1—Mono and stereo quieting and distortion characteristics, FM section.

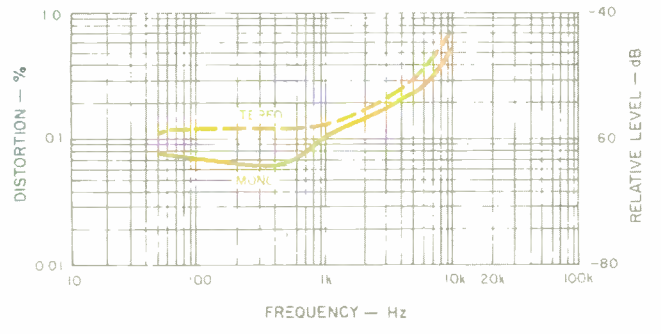


Fig. 2—THD vs. frequency, FM section.

Stereo gradually blends into mono reception as signal strength decreases. For mobile use, that's better than constant switching back and forth.

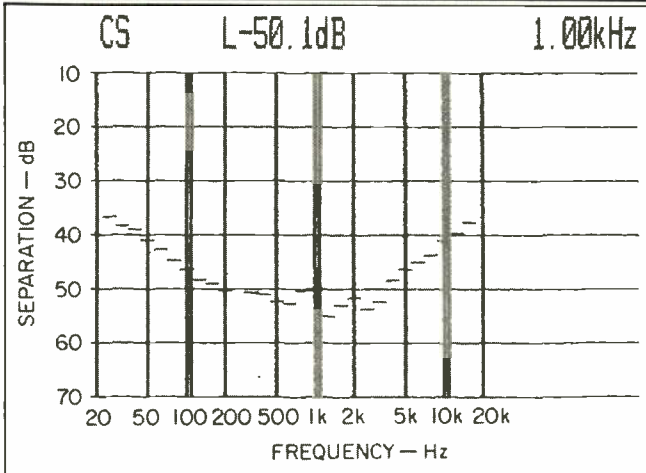


Fig. 3—Stereo separation, FM section.

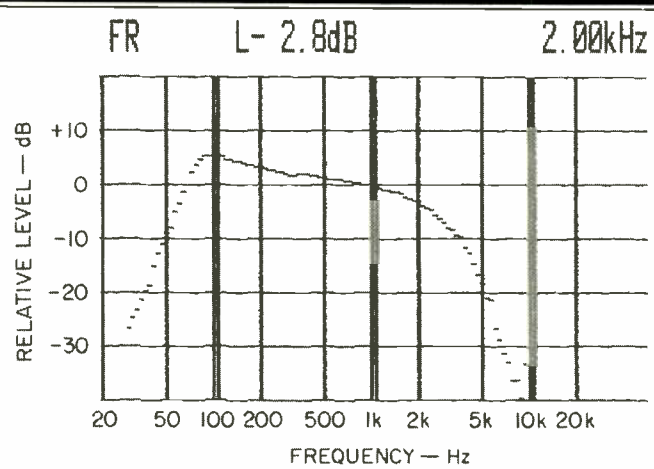


Fig. 4—AM frequency response.

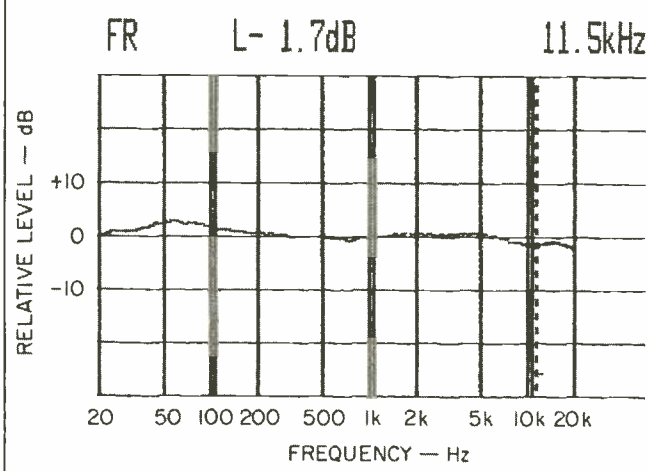


Fig. 5—Frequency response, tape section, using Type I test tape.

dB quieting point. That's because Nakamichi has wisely elected to have stereo separation gradually diminish or blend into monophonic reception as signal strength decreases. For mobile use, that's better than having the system constantly switch back and forth between mono and stereo as signal strength fluctuates. This gradual transition from stereo to mono accounts for the rather odd shape of the stereo S/N curve (Fig. 1) in the region from about 45 dBf down to 30 dBf, where S/N appears to be increasing as signal strength decreases. What's actually happening in this region is that the received signal is becoming more and more monophonic as the signal level decreases. Since mono reception is quieter than stereo reception—especially at weak signal levels—the noise curve actually reverses direction for a while, until the signal is so weak that, even in mono, noise rises steeply again. The THD curves for mono and stereo also eventually blend together as signal strength decreases. At strong signal levels, mono S/N measured 66 dB and stereo S/N was 64 dB. THD in mono was 0.1% for a 1-kHz modulating signal; in stereo it was only slightly higher, 0.12%. Figure 2 shows how THD varies as a function of frequency, with 100% modulating signals and a 65-dBf r.f. signal.

Figure 3 is a plot, in third-octave increments, of FM stereo separation versus frequency. At 1 kHz, separation measured 50.1 dB. At 100 Hz, it was about 46 dB, and it decreased to 40 dB at 10 kHz. Nakamichi might just as well have applied its conservative separation specification of 35 dB to the entire audio band, rather than to 1 kHz alone.

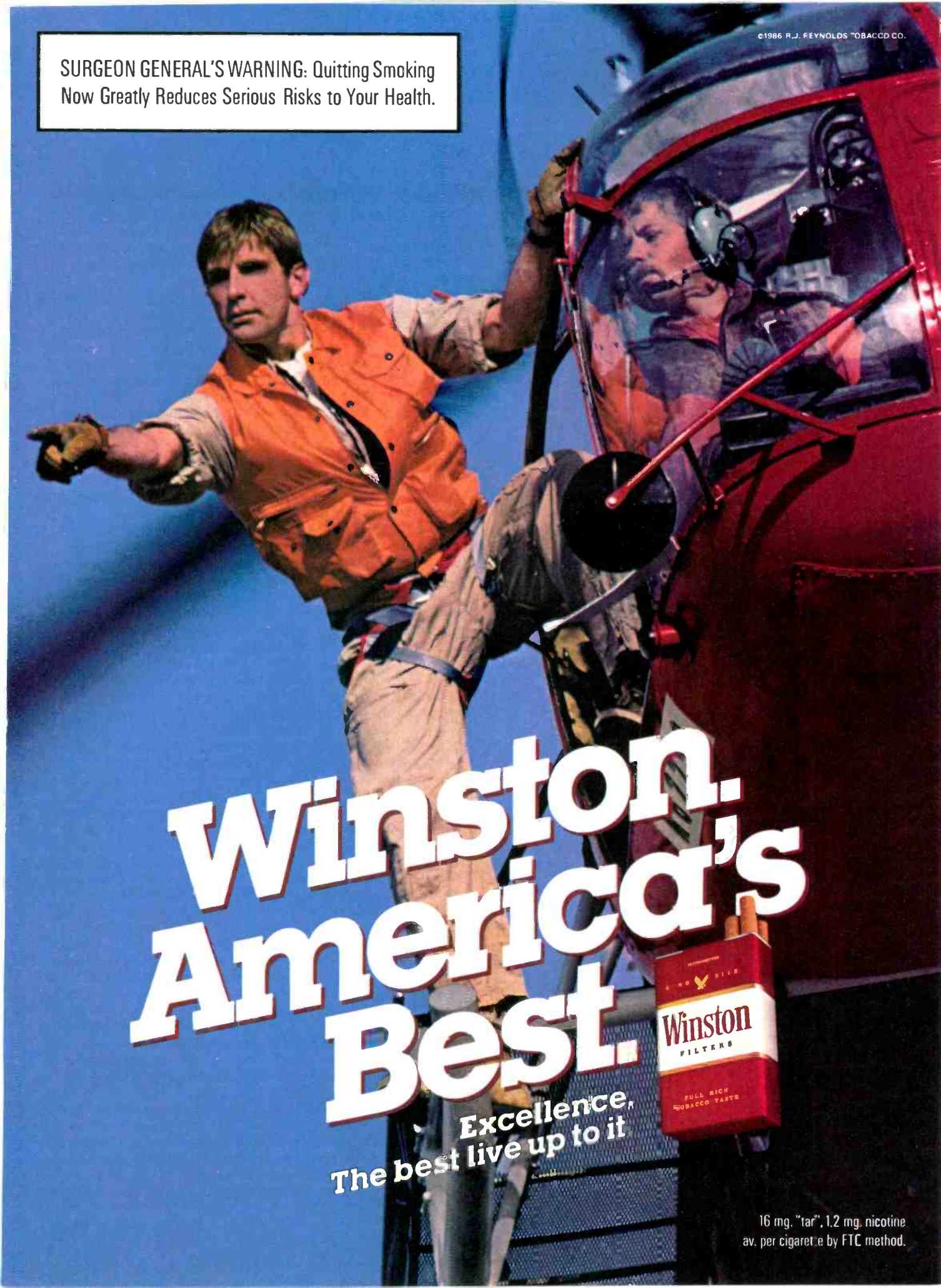
The FM tuner section's frequency response was flatter than that of most home tuners, with no measurable attenuation at 15 kHz and an attenuation of only 0.5 dB at 30 Hz. The same cannot be said for the frequency response of the AM tuner section (Fig. 4), which was down nearly 3 dB at 2 kHz and which had a bass "bump" centered at around 100 Hz. The bump was undoubtedly put there deliberately, to give some sonic weight to what would otherwise be a very thin AM response.

Capture ratio for the FM tuner section measured 1.8 dB, and alternate-channel selectivity was precisely 65 dB, as claimed. Image rejection, measuring 60 dB, was a bit better than claimed; so was i.f. rejection, which on my sample measured 82 dB.

Tape Deck Measurements

Frequency response of the cassette tape player, shown in Fig. 5, was outstanding. It remained flat to above 20 kHz despite the fact that I did not have Nakamichi's Type II frequency-response test tape, and had to use one recorded on Type I (ferric-oxide) tape.

Figures 6A and 6B show the tape section's S/N. Without noise reduction, the A-weighted reading (shown in Fig. 6B) was 59.4 dB. With Dolby B NR (Fig. 6A), the S/N improved to 72.4 dB, A-weighted. With Dolby C NR (Fig. 6B), the A-


SURGEON GENERAL'S WARNING: Quitting Smoking Now Greatly Reduces Serious Risks to Your Health.
©1986 R.J. REYNOLDS TOBACCO CO.
Winston. America's Best.
Excellence. The best live up to it
Winston
FILTERS
16 mg. "tar", 1.2 mg. nicotine av. per cigarette by FTC method.

The best feature of the unit's tape section is the azimuth adjustment. After using it a while, you begin to wonder how you could get along without it.

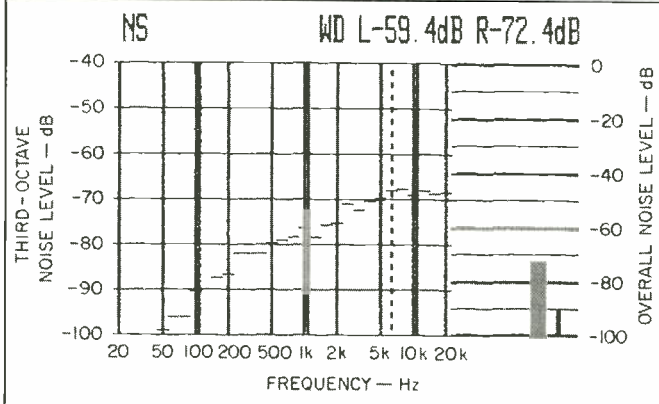


Fig. 6A—Tape section S/N, A-weighted, with Dolby B noise reduction ("R" readout at top).

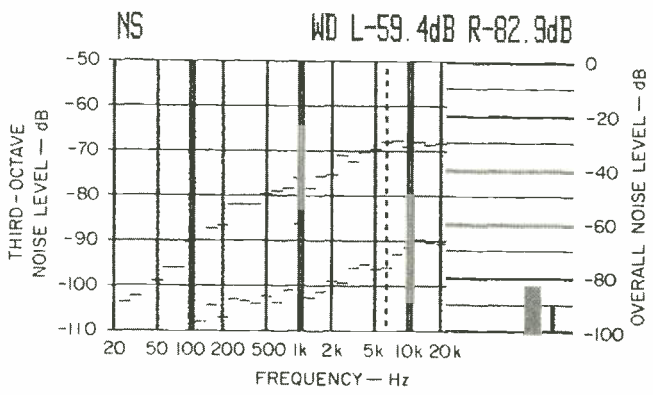


Fig. 6B—Tape section S/N, A-weighted, without noise reduction (upper trace and "L" readout at top) and with Dolby C noise reduction (lower trace and "R" readout at top). Note shift in vertical scales between Figs. 6A and 6B.

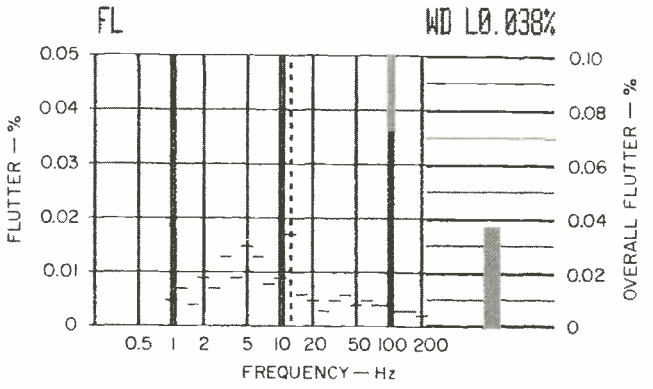


Fig. 7—Wow and flutter, wtd. rms.

weighted overall figure improved still further, to 82.9 dB. The reference level for these tests was 250 nWb/m. I used normal-bias tape that had been previously recorded but with no audio signal applied, so any bias noise produced by my recorder is included in the measurement.

Wow and flutter was far better than claimed. I measured only 0.038% wtd. rms, as shown in Fig. 7. Unweighted wow and flutter, not shown, was also much better than claimed by Nakamichi; it measured only 0.08%.

I've saved the best feature of the cassette deck section for last—that wonderful azimuth adjustment control, which can be fully appreciated only when you use it. Since car-stereo decks play only tapes which have been recorded on other machines, some azimuth mismatch is inevitable. After you've used the azimuth control and hear the difference it makes, you wonder how you could possibly get along without it in a playback-only deck. Figures 8A, 8B, and 8C show in detail the action of the azimuth control. The test signal shown is from the azimuth test tape made for use with a Sound Technology tape tester. The tape has four frequencies, from 0.0 to 15.8 kHz, recorded on both channels. While the unit under test plays this test tape, the instrument compares the phase of the signals on the two channels and displays the degree of difference (phase error) as four vertical lines. When the electronic cursor (the dotted line in Figs. 8A, 8B, and 8C) is positioned on one of these phase-error lines, the error is displayed in degrees.

In my first test, I adjusted the azimuth control to its nominal center. When I played my test tape, the phase error between the two 15.8-kHz signals was 162°. In terms of time error, 162° of a 15.8-kHz signal is about 28 μS. You can, if you like, calculate the angular error of the playback head from this, the tape's speed, and the distance between the head gaps. For myself, it was enough to note that 162° of error at 15.8 kHz is a pretty serious azimuth misadjustment. For Fig. 8B, I flipped the tape over to measure error in the opposite direction and got a reading of 92°, still quite substantial. (The difference between the two numbers may be due to differences in tape orientation in each direction, and to the relative angle of the head and the recorded signal.) However, when I adjusted the front-panel control to obtain minimum azimuth error (Fig. 8C), I managed to get the residual misadjustment so low (12° of phase with a 15.8-kHz sine-wave signal) that it can be regarded as insignificant.

The great thing about this front-panel control is that you won't need any fancy test tapes or test equipment to come just as close with any prerecorded tape. Simply *listen* to the tape. Turn up the treble control all the way, to help you listen for a high-frequency maximum as you slowly turn the azimuth control. (The control is 15 "click stops" on either side of center, each of which shifts playback head alignment by 2.9°.) When you hear the most treble, you've adjusted the playback head for optimum reproduction and minimum azimuth error. It's that simple.

Figure 9 shows the maximum range of the bass and treble tone controls: About ±14 dB at 10 kHz for the treble control, and about +12 and −16 dB at 100 Hz for the bass control. Figure 10, a similar plot, shows the action of the midrange tone control. Its frequency of maximum boost or cut is around 200 Hz rather than the more usual 500 Hz to 1 kHz

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The front panel has been crammed with so many worthwhile features that it may take a while to learn how to operate the unit when driving.

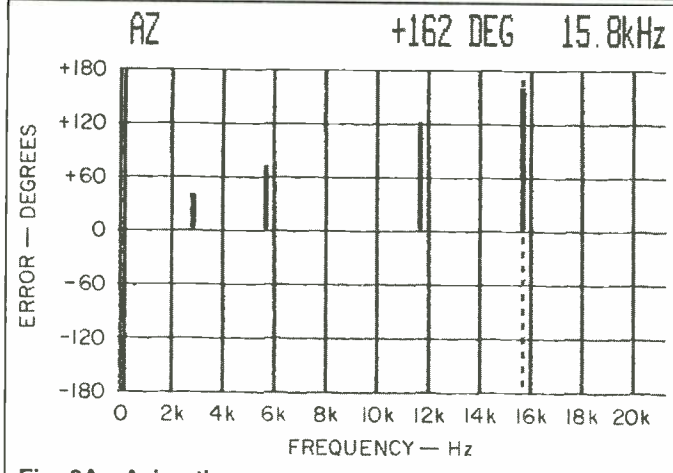

Fig. 8A—Azimuth error before adjustment, with tape in forward direction.

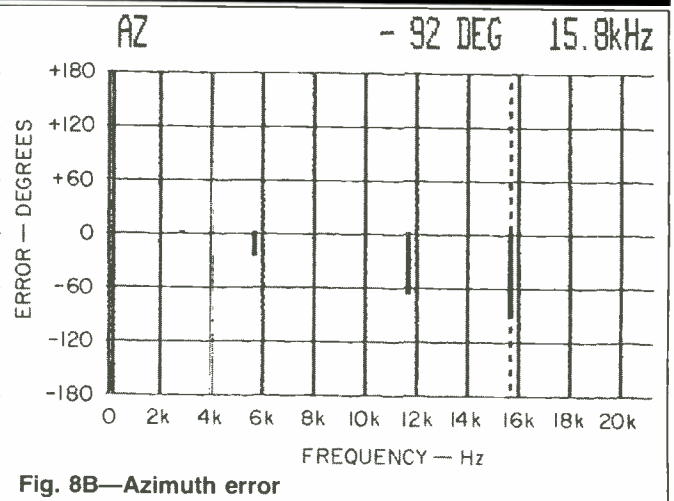

Fig. 8B—Azimuth error before adjustment, with same tape in reverse direction.

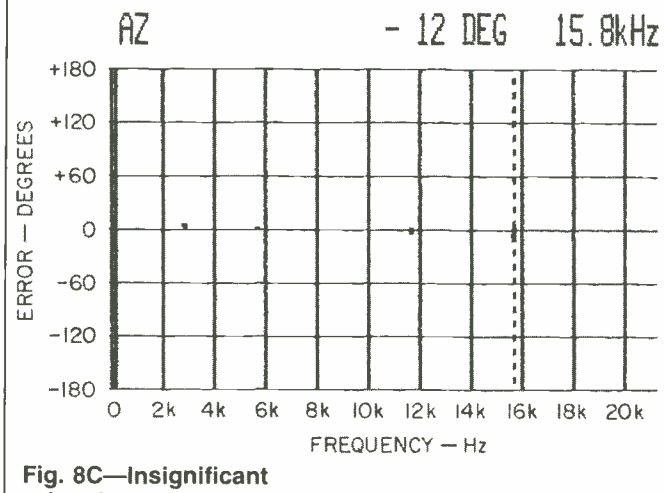

Fig. 8C—Insignificant azimuth error observed after adjustment, with playback of same tape used for Figs. 8A and 8B.

used for midrange controls in home audio components. This center frequency seems more appropriate for car audio, since turning it down helps tame the resonance which most car interiors exhibit at 150 to 200 Hz or so.

Use and Listening Tests

Although I did not conduct my listening tests in a moving vehicle, I can say with reasonable assurance that the TD-700 should do very well in a car. For one thing, the cassette deck's performance was typical of the excellent home tape decks for which Nakamichi is justly famous. The TD-700's important tape-playback characteristics remained constant over a wide range of operating voltages (10 to 15 V d.c.).

The FM tuner section has been ideally designed for use in a car or other moving vehicle. The blend from stereo to mono occurs so gradually and smoothly that you probably won't be aware of it as you drive through areas where signal strengths fluctuate greatly. This should help mask the more serious multipath problems, and even some amount of "picket-fence" noise (which is always more annoying when the tuner is allowed to remain in full stereo mode, as is done with some other units I have tested). The tuner section's performance, like the tape deck's, stays constant with changes in supply voltage. The AM section is just another typical AM tuner.

Nakamichi has combined the best things they know about tape transport and tape electronics with good FM r.f. engineering, and have come up with a very versatile tuner/cassette deck that will not disappoint even the most discriminating car-audio buff. If anything, they have crammed the panel with so many worthwhile features that it may take you a while to be able to operate the unit while driving. Once you've learned how, you'll have a wonderful car stereo for your trouble. Meanwhile, don't be distracted by all those buttons and knobs while you drive. Just listen—and enjoy!

Leonard Feldman

Behind the Wheel

One glance at the TD-700's control panel shows you that tape dominated Nakamichi's thinking in their design of this unit. The tape controls are big, and they cover most of the panel; the tuner controls are small, and mostly squinched up into one corner.

The tape-motion controls give me a bit less tactile feedback than I like. But they're easy to find and to operate by touch, and small LEDs (visible even in daylight) show clearly which functions are in use. I soon began to wish more car-stereo decks had pause controls; the TD-700's proved helpful, letting me shut off the tape to hear directions, listen to funny engine noises, or just concentrate on traffic, without having to eject the tape or turn down the volume (and miss the music while the tape ran on). Like most tape decks with pause controls, the TD-700 releases the pause when you hit

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3

YAMAHA K-1020 CASSETTE DECK

Manufacturer's Specifications
Frequency Response: 20 Hz to 18 kHz; to 20 kHz with CrO_2 tape; to 23 kHz with metal tape.
Harmonic Distortion: 0.5%.
Signal/Noise Ratio: 59 dB; 75 dB with Dolby C NR, 95 dB with dbx NR.
Separation: 40 dB.
Crosstalk: 60 dB.
Input Sensitivity: Line, 40 mV.
Output Level: Line, 360 mV; headphone, 3.6 mW into 8 ohms.
Flutter: 0.03% wtd. rms, ±0.06% wtd. peak.
Fast-Wind Time: 70 S for C-60 cassette; 45 S in high-speed mode.
Dimensions: 17⅛ in. W x 5¼ in. H x 15 in. D (435 mm x 133 mm x 381 mm).
Weight: 16.8 lbs. (7.6 kg).
Price: $599.
Company Address: 6660 Orangethorpe Ave., Buena Park, Cal. 90620.
For literature, circle No. 92

Sitting at the top of Yamaha's line of cassette decks is the K-1020, which has three heads for superior record/playback performance and a dual-capstan drive in a closed-loop configuration for stable, low-flutter tape transport. The record and play heads are made of pure Sendust, and the erase head is made of ion-plated ferrite.

The Yamaha deck is one of relatively few with Dolby HX Pro, which ensures the best possible headroom extension by dynamically controlling bias in response to the signal's spectral content. [See the article on HX Pro in August 1984 *Audio*, by Jensen and Pramanik, for more data.] This is not a noise-reduction system; however, the K-1020 does provide Dolby B and C NR as well as dbx NR, which gives it great flexibility in making recordings, and enables it to play back any prerecorded material. The K-1020 also has the unique ORBiT (Optimum Record Bias Tuning) system, which combines manual bias adjustment with a readout which shows when the bias is best for the tape being used.

The counter reads elapsed time from wherever it is reset. This is not a mere clock, which functions only in record and play modes; instead, it reads even in fast-wind modes, converting tape position into minutes and seconds via a computer chip. Such time indications are very useful when making recordings. The deck also offers memory and auto-play modes in conjunction with the counter. One handy feature is that the recorder will rewind and stop exactly where recording started if rewind is pushed during recording. This location is stored automatically, and the counter does not have to be reset first. Pressing and releasing the fast-forward or rewind button initiates normal fast winding, but holding down either fast-wind button raises the winding speed an additional 35%. This speed bonus is also available—and especially helpful—in auto-search mode, which finds the beginning or end of the piece being played. Fast-winding automatically slows near the tape's ends to prevent tape breakage.

The K-1020 features a fluorescent, peak-responding, wide-range stereo meter. Surrounding annunciators indicate monitor, memory and auto-mode status, tape type, whether recording is being done, NR system, multiplex filter, and bias-test status. These all make operation more convenient and help to minimize mistakes.

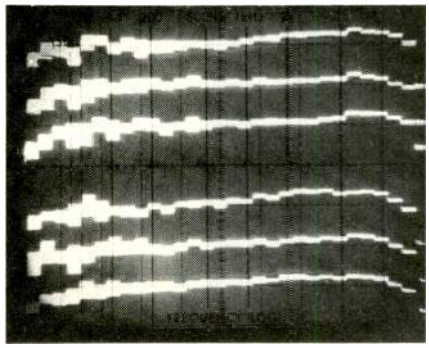

Fig. 1—Record/playback responses using Dolby C NR, at Dolby level (top three traces) and at −20 dB (bottom three traces), for Yamaha NR (Type I), Sony UCX-S (Type II) and Maxell MX (Type IV) tapes (top to bottom in each set). Vertical scale: 5 dB/div.

Control Layout

The K-1020's front panel helps make the deck easy to operate in most lighting conditions, not only because of its good displays but because its designations stand out in white against the black background. At the upper left of the panel is the large "Power" on/off switch. The "Eject" button, just below, is similar in shape, but because it's smaller and its surface is knurled, and because this layout is now common, users probably won't confuse them. There is a useful "Output Level" control further down, just above the "Phones" jack.

The cassette carrier tilts out briskly with a push of "Eject," but the stop is fairly gentle. Access for cleaning and demagnetizing is quite good, and with the door cover snapped off, it is excellent—among the best I've seen. The transport will not go into play mode without a cassette in place, so the deck won't rotate the pinch roller for you while you're cleaning it. I would prefer to have the roller driven during cleaning, but it is true that, if it did rotate, a cotton swab could get wrapped around the capstan if you weren't careful. With a tape in place, tape slack is automatically taken up when the door is closed, and also when power is first turned on.

To the right of the cassette compartment is the "Master Fader," which is used only during recording. Yamaha recommends that this control be used just for fades from full-off to full-on, and for fade-outs; otherwise, they recommend leaving this vertical slider all the way up, at "0." A scale along the slider's left shows, in dB, how much the fader attenuates the stereo signal at various positions. (The controls which adjust individual-channel recording levels will be discussed a bit later.)

Across the top right side of the K-1020 is the display panel with the meters, counter and annunciators referred to earlier. At the left of this display is the four-digit elapsed-time counter, which has red LED numerals and a minus sign that lights if the tape is rewound past counter zero. The counter can be reset at any time, but it should, of course, be reset at the very beginning of a tape if you need to keep track of the *total* time (position) to any point on the tape. This counter has two valuable characteristics: It keeps its basic time calibration even with fast winding, and it maintains its reading (unless purposely reset) even when a cassette is ejected, so the user can note the time from the counter and write it on the cassette label.

The annunciators below the counter are "Rec" (which glows during record and record/pause modes and flickers when the auto rec mute is operating), "Test" (which lights when the ORBiT circuit is in use and flickers when ORBiT is in standby), and the "Tape/Source" indicator.

To the right is the memory-mode annunciator panel, with lights to indicate when the memory is in use and when either

This deck is one of the few with Dolby HX Pro, which ensures the best headroom extension by dynamically controlling bias.

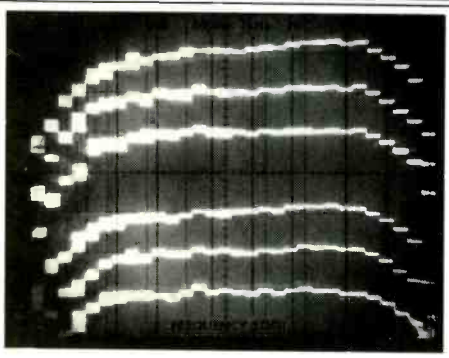

Fig. 2—Record/playback responses using dbx NR, with bias set with ORBiT circuit, at Dolby level (top three traces) and at −20 dB (bottom three traces), for same tapes as in Fig. 1. Vertical scale: 5 dB/div.

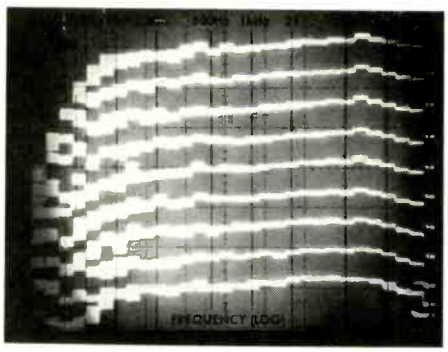

Fig. 3—Record/playback responses using dbx NR, with bias decreased slightly from amount set with ORBiT circuit, for Maxell MX (Type IV) tape. Dolby-level response is centered vertically, with responses measured from −16 to +16 dB. Vertical scale: 5 dB/div.

of the two repeat modes is active. One of these two modes, "0-M Repeat" (zero-to-memory repeat), plays the section of the tape between counter zero and any point the user enters into memory, up to eight times. The second, "Full Repeat," plays the entire side of the tape, then rewinds and replays it, also up to eight times. (That eight-time limit seems like more than enough to me!)

The recording-level meters are horizontal, fluorescent bar-graphs with a bluish-white center scale that extends from "−30" to "+20." Little dot lights above and below these scale numbers serve as guidelines for maximum record levels; the dots extend to "+6" for normal and chrome tape, and to "+8" for metal tape—except when dbx NR is used, in which case the dots extend to "+16" for all tape types. These guidelines are a good idea and are easy to read from any distance which would leave you within reach of the controls.

Segments light to show up to 18 different recording levels within the meter's range. (There are actually 19 segments, but the first, just to the left of "−30," is on all the time.) The meter segments covering the range up through "0" are bluish white, and the ones from "0" to "+20" are red. The meters are classified as peak-responding, but confirmation of that was left to the actual testing. I found it slightly irksome that the single-digit scale numbers are just to the right of the corresponding scale segments, rather than centered on them. But in actual recording, where levels change rapidly, this objection proved trivial.

Below the bar-graphs, from left to right, are these annunciators: "Bias," with adjustment-direction arrows; "Filter"; symbols for Dolby B, Dolby C and dbx noise reduction, and indicators for "I/Norm," "II/CrO_2" and "IV/Metal" tape types. All of these annunciators are bluish white, except for "dbx," which is red in color.

Below the left portion of the display area, just to the right of the "Master Fader," are the transport control switches, all with good-sized, rectangular pushbuttons. Along the bottom, from left to right, are "Rec/Pause," "Stop" and "Mute/Search." Just above, from left to right, are rewind, "Play" and fast forward. Above these buttons are narrow-bar pushbuttons for "Reset," "Memory" and "Monitor." The functions of most of these are self-explanatory or have been mentioned before, but some additional comments are in order: Pushing "Rec/Pause" once readies the deck for recording, and recording is initiated by pushing "Play." A push of "Mute/Search" during recording will gain an automatic 4-S blank interval and a stop in "Rec/Pause." Holding the button in will get a longer blank time.

Holding in either of the fast-wind buttons gets a faster-than-normal winding. Pushing "Mute/Search" along with the wind button will get a fast rewind and a stop at the beginning of the present song; pushing "Mute/Search" with fast forward takes you quickly to the start of the next song. There are no status lights associated with any of the transport control buttons, but there is the red "Rec" annunciator that appears under the counter. A few simple checks showed that punch-in recording was possible from any mode as long as "Rec/Pause" and "Play" were both held in at the same time. This is a good feature, and I didn't see it mentioned in the manual.

To the right of the transport switches is a collection of controls, hidden behind a small swing-down panel. At the top, from left to right, are six pushbuttons, interlocked as needed, for "NR-Off," "Dolby B," "Dolby C," "dbx," "MPX Fil" and "Bias Test." All of the buttons are black, with the exception of "Bias Test," which is red. The designations above the buttons are hard to see when the deck is below eye level, but Yamaha comes to the rescue by printing a legend—quite easily seen—near the edge of the swing-down panel. As mentioned earlier, these buttons have associated annunciators in the display area.

The evolution continues...

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Playback responses for both equalizations were excellent, with most points accurate to within a fraction of a dB.

When "Bias Test" is pressed, the "Test" annunciator below the counter begins flashing; it lights steadily when "Rec/Pause" and "Play" are pressed to initiate recording of the test signal. When testing begins, the "Bias" annunciator below the record-level meter lights, with arrows showing which way to turn the "Bias Adjust" knob (just below the test switch) to set correct bias for the tape in use. When both the right- and left-pointing arrows are illuminated equally, bias is set correctly. When the "Bias Test" button is released, the tape is automatically rewound to the point where the test started. Overall, this is a simple and effective operation.

To the left of the "Bias Adjust" knob are the left and right "Preset Rec Level" pots with small, finely knurled knobs. Friction was not high, and adjustments were made easily. Further to the left is the "Auto Mode" rotary switch with positions for full repeat, zero-to-memory repeat, off, timer play, and timer record.

On the rear panel are the stereo input/output phono jacks, which are gold-plated, a nice touch. Also on the back is a DIN-type socket for the optional remote control.

Removing the top and side cover revealed a neat and well laid-out combination of p.c. boards. The main circuit board occupied more than half the chassis, and served as a motherboard for the smaller p.c. boards containing the Dolby and dbx NR circuitry. The power supply was on a separate board. The soldering was excellent; interconnections were made with multi-pin plugs. Adjustments were very clearly labelled, both with functions and with part numbers. The shielded, separately mounted transformer was just warm in operation. The transport looked good and was very quiet in operation. Overall, it was an impressive scene.

Table I—Record/playback responses (−3 dB limits).

	With Dolby C NR				Without NR			
	Dolby Lvl		−20 dB		Dolby Lvl		−20 dB	
Tape Type	Hz	kHz	Hz	kHz	Hz	kHz	Hz	kHz
Yamaha NR	16.3	10.2	15.5	16.5	16.2	8.7	15.5	18.6
Sony UCX-S	16.3	10.6	16.3	18.8	16.3	9.1	15.5	20.3
Maxell MX	17.1	20.2	17.4	19.8	17.2	14.2	16.0	22.2

Table II—Miscellaneous record/playback characteristics.

NR Type	Erasure At 100 Hz	Sep. At 1 kHz	Crosstalk At 1 kHz	10-kHz A/B Phase		MPX Filter At 19.00 kHz
				Error	Jitter	
Dolby C	62 dB	60 dB	−94 dB	50°	10°	−35.2 dB
dbx	87 dB	56 dB	−108 dB			

Table III—400-Hz HDL_3 (%) vs. output level (0 dB = 200 nWb/m).

Tape Type	NR	Output Level						HDL_3 = 3%
		−10	−8	−4	0	+4	+8	
Yamaha NR	Dolby C	0.09	0.11	0.20	0.63	2.3		+4.7 dB
	dbx	0.07	0.09	0.10	0.14	0.22	0.45	+17.1 dB
Sony UCX-S	Dolby C	0.14	0.20	0.40	1.0	3.0		+4.0 dB
	dbx	0.16	0.19	0.24	0.34	0.45	0.75	+17.3 dB
Maxell MX	Dolby C	0.16	0.21	0.38	0.79	1.7		+6.4 dB
	dbx	0.15	0.19	0.24	0.32	0.42	0.60	+17.9 dB

Measurements

Playback responses for both equalizations were excellent, with most points accurate to within a fraction of a dB. Meter indications for playback of a standard level were very close, within the limitations of segment resolution. Tape-play speed was just 0.1% fast. Record/playback responses were checked for a large number of tapes using pink noise, rolled off at 6 dB/octave above 2 kHz to make it more music-like. The adjustable bias permitted good matches to a large number of tapes. ORBiT (Optimum Record Bias Tuning) was very speedy in use and acceptably accurate, in general. (More on this later.)

Based upon the overall response curves obtained with the use of ORBiT, Yamaha NR (Type I), Sony UCX-S (Type II) and Maxell MX (Type IV) tapes were selected for the detailed tests to follow. Other very good performers were Fuji GT-I, Maxell XL I, and TDK AD for Type I; Denon HD7 and HD8, Fuji GT-II, Maxell XL II, Memorex CDX II, TDK HX-S, and Yamaha CR-X for Type II, and Scotch XSM, Sony Metal-ES, and TDK MA and MA-R for Type IV.

Figure 1 shows the record/playback responses for the three selected tapes at Dolby level and 20 dB lower, all with Dolby C NR. All of the responses are very good, even with the high-end roll-off at −20 dB and the slightly elevated responses from 2 to 10 kHz with Yamaha NR tape. Table I lists the −3 dB limits obtained using a sine-wave tone. Particularly noteworthy is the Dolby-level high-end limit of 20.2 kHz with Maxell MX and Dolby C NR. A slight decrease in bias, below that which was set with ORBiT, raised the high-end limits but also added another 1 or 2 dB to the slight elevation which already existed in the 2- to 10-kHz region.

Figure 2 shows the record/playback responses for the same three tapes, using dbx NR and with the bias set using ORBiT. Results were disappointing, and a slight decrease in bias was made to reduce the high-end roll-off. (The low-end roll-off is characteristic of dbx NR, not restricted to the K-1020.) The reduction in roll-off was accompanied by some elevation in response from 2 to 10 kHz; some users might like this, others might not. The assessment: ORBiT did an excellent job of getting responses very close to the best possible, but minor bias trimming might be in order for the very most critical listening.

Table II lists record/playback test results, using both Dolby C and dbx NR. All of the figures are excellent, among the best ones I've seen to date. Note that use of dbx NR improves erasure and reduces crosstalk, albeit with some reduction in separation. There was some low-level bias in the output during recording.

Third-harmonic distortion of a 400-Hz tone was measured for the three tapes, both with Dolby C and with dbx NR. For these tests, the level was gradually increased from 10 dB below Dolby level to the point where HDL_3 reached 3%. The data in Table III shows low distortion at the lower levels for both NR systems, and also shows that a much higher maximum level is possible with dbx NR. Table IV lists the HDL_3 figures obtained with Maxell MX at −10 dB with Dolby C and dbx NR from 50 Hz to 5 kHz. The rise in distortion at the lower frequencies is much greater for dbx NR than it is for Dolby C NR. The distortion at the higher frequencies is

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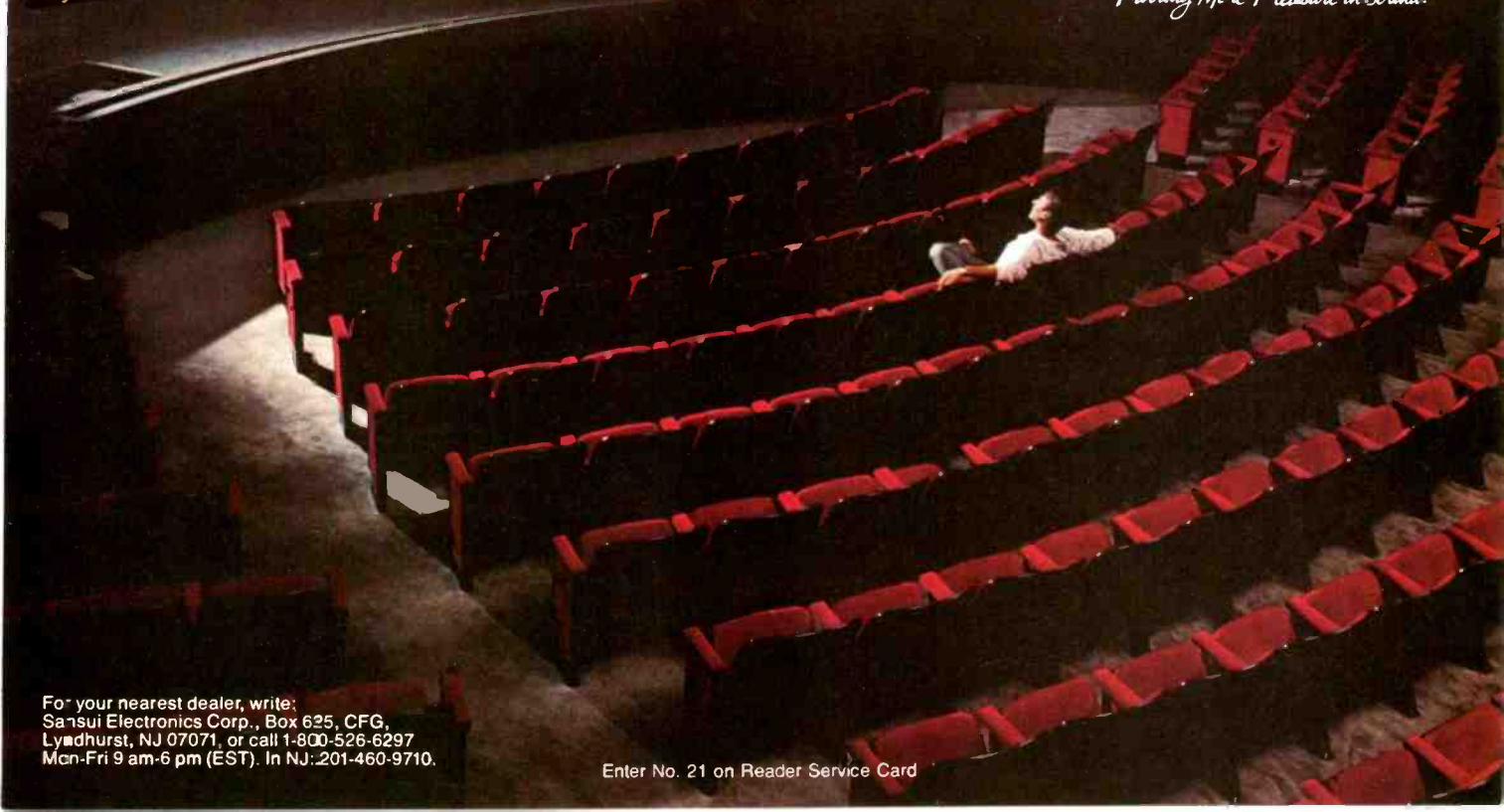

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I found ORBiT and the excellent metering and displays to be my favorite features, particularly when switching tapes.

Table IV—HDL_3 (%) vs. frequency at 10 dB below Dolby level.

Tape Type	NR	Frequency (Hz) 50	100	400	1k	2k	4k	5k
Maxell MX	Dolby C	0.32	0.36	0.16	0.15	0.14	0.27	0.29
	dbx	2.7	1.2	0.15	0.18	0.15	0.16	0.15

Table V—Signal/noise ratios with IEC A and CCIR/ARM weightings.

	IEC A Wtd. (dBA)				CCIR/ARM (dB)			
	W/Dolby C NR		With dbx NR		W/Dolby C NR		With dbx NR	
Tape Type	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%	@ DL	HD=3%
Yamaha NR	69.0	73.7	74.1	91.2	67.7	72.2	70.2	87.3
Sony UCX-S	72.0	76.0	78.7	96.0	71.9	75.9	74.5	91.8
Maxell MX	70.8	77.2	77.0	94.9	69.9	76.3	73.2	91.1

Table VI—Input and output characteristics at 1 kHz.

Input	Level Sens.	Overload	Imp., Kilohms	Output	Level Open Ckt.	Loaded	Imp., Ohms	Clip (Re: Meter 0)
Line	42 mV	>31 V	23	Line	340 mV	299 mV	1.6k	+21.8 dB
				Hdphn.	3.0 V	0.67 V	203	

lower with dbx NR, but it is also low with Dolby C NR; all of the figures show the benefit of HX Pro, which is incorporated in this deck.

Signal-to-noise ratios were measured for the three tapes with Dolby C and dbx NR systems, using both IEC A and CCIR/ARM weightings. The results, shown in Table V, are all excellent, with Type II (UCX-S) figures superior to those for Type IV (MX) most of the time.

The input and output characteristics listed in Table VI are in general agreement with Yamaha's specifications, with some minor disparities. The headphone output, with an 8-ohm impedance instead of the more usual 50 ohms, delivered 2.1 mW per side. This was a bit less than specified, but maximum listening level at 0 dB was very high with all of the headphones tried, proving the value of the K-1020's output-level control.

The two sections of the master fader tracked each other within a dB at settings from full to 60 dB of attenuation, and most of the scale markings were accurate within a dB. This is excellent performance, and would enable you to make exact level shifts for both channels at once. The output-level control had more deviation between its sections—just over 1 dB at 20 dB of attenuation, and 2 dB at 40 dB down. The output polarity was the same as the input in "Source" mode, but was reversed in "Tape."

The frequency response of the bar-graph meters was approximately 3 dB down at 22 Hz and 21 kHz. The great majority of the meter scale calibrations were accurate to within a dB, including "−30" (−31 actual). From "−10" to "+4," errors were 0.6 dB at most. The meters' response time met the requirements for those classified as peak-responding, but the decay time of 0.87 S was short compared to the standard minimum of 1.4 S. Adding either a positive or negative d.c. offset to the test tone burst did not raise the meter indication, which is as it should be for true peak-reading meters.

The average tape-play speed did not vary with changes in line voltage from 110 to 130 V. There were fairly regular short-term speed changes up to ±0.015% or so. Flutter was somewhat dependent upon the cassette used: It measured 0.045% wtd. rms and ±0.065% wtd. peak on the average, but just 0.025% wtd. rms and ±0.045% wtd. peak with the Yamaha NR tape. The fast-wind time for one side of a C-60 cassette was 68 S for normal fast wind, but only 48 S with the button held in for the higher speed. The time to change modes was 1 S or less.

Use and Listening Tests

The owner's manual presents considerable detail and good technical exposition on the K-1020's features, especially HX Pro and the Dolby and dbx NR systems. There are good illustrations and an excellent block schematic, helping to make it one of the better user manuals I've seen.

All of the controls and switches were completely reliable throughout the testing. The resistance to movement of the master fader's slider was high for fast fading, but the control's action was very smooth nonetheless. The right record-level pot knob was not snug on its shaft, but it never did come off.

I found ORBiT and the excellent metering and displays to be my favorite features, particularly when switching from tape to tape. I also found that I used the higher winding speed more than I thought I would. Timer start, mute, memory, and repeat modes all worked as they should. Going into record mode caused only a small click on the tape, down at the tape-noise level heard with Dolby C NR; I detected no sounds created by entering pause or stop modes.

Most of the listening tests were conducted using dbx-encoded discs from digital recordings, such as Rachmaninoff's Symphony No. 2 with the Scottish National Orchestra, Alexander Gibson conducting (Chandos ABRD 1021/dbx PS-1074). Switching to Dolby C NR made an obvious improvement in the noise level, but with Yamaha NR tape there was then too much added presence. With Sony UCX-S tape there was only a little additional presence, which was much more to my liking. Maxell MX was best of the tapes at the highest levels. With all three tapes, reducing bias slightly when using dbx NR improved the sound, to my ears. I still missed the deep bass of a number of LP sources, but there was no doubt about the K-1020's ability to record at very high levels with dbx NR. The elapsed-time readout was quite accurate, within 30 S over a 90-minute period.

The Yamaha K-1020 does not have a long list of special features, such as music programming, but it does have conveniences that are useful all of the time: Elapsed-time counter, ORBiT, wide-range metering, Dolby and dbx NR, master fader, output-level control, and extra-high-speed winding on demand. The internal construction is definitely above average, and its arrangement should minimize any required service time. The K-1020 offers a nice combination of features and performance for its price, and should compare favorably with other decks in its range.

Howard A. Roberson

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4

AKAI CD-M88 COMPACT DISC PLAYER

Manufacturer's Specifications
Frequency Response: 5 Hz to 20 kHz, ±0.5 dB.
THD: 0.005%.
Dynamic Range: 90 dB.
S/N Ratio: 90 dB.
Number of Programming Commands: 16 (see text).
Channel Separation: 85 dB.
Line Output Level: 2.0 V.
Access Time: 2.6 S.
Power Requirements: 120 V, 60 Hz.
Dimensions: 13.8 in. W × 2.8 in. H × 10 in. D (35 cm × 7.1 cm × 25.4 cm).
Weight: 14.3 lbs. (6.5 kg).
Price: $499.

Company Address: 800 West Artesia Blvd., Compton, Cal. 90220.
For literature, circle No. 93

With all of the "me too" CD players currently available, it has become difficult for a company to come up with a player offering something different from the rest. Akai, however, has managed to do just that with a new, extremely easy and logical way to program via the "Unique Program Order Selector," a main feature of their CD-M88.

The front panel of this mid-sized CD player is equipped with the usual numeric keypads for designating desired tracks and even index points within a given CD selection (if such index points have been encoded onto the disc). But, in addition, there are keys labelled "To," "And" and "Without." The addition of these extra buttons on the front panel makes for a simpler layout while adding versatility to the way in which programming can be done. Suppose you were playing a CD that had 20 tracks and wanted to hear tracks 1 through 5 as well as tracks 10 through 20 but omitting track 17. With most programmable players, you'd have to key in at least 15 individual numbers—assuming the deck was able to accept that many individual instructions. With the Akai CD-M88, you would press the following keys in the following order: "1," "To," "5," "And," "10," "Tc," "20," "Without," "17." Reading that back as a complete sentence, it makes perfect sense, doesn't it?

Other features of the Akai player include direct access to any given track, full-function wireless remote control, repeat play of a specified portion of a track or tracks, and repeat play of an entire disc. It is possible to have a disc repeat-play up to 99 times!

Control Layout

At the extreme left end of the front panel is the usual slide-out disc drawer. Just below are a phone jack and an unusual output-level control. Instead of being adjusted by a protruding rotary knob, this control is configured as a flush-mounted disc which has two tiny bumps on its flush surface. As your finger tip touches it, there's enough friction between your finger and the flat, flush-mounted knob to enable you to twist the disc and thereby adjust for more or less output level.

An elaborate and informative fluorescent display, also situated below the disc drawer, shows track and index numbers, time elapsed for the current track and total elapsed time from the beginning of a disc. In addition, all programming instructions are displayed as they are entered, including the novel "To," "And" and "Without" designations as well as "Repeat" notations when applicable. A "Display Select" button adjacent to the display area is used to choose the various track or time displays in sequence. The "Power" on/off and the disc drawer "Open/Close" switches are near the center of the front panel, while further to the right are the disc operating controls: "Play," fast forward and reverse, and "Pause/Reset" (stop). Bridging the first three controls is an unusual acronym—"IPLS"—which took a fairly careful search in the owner's manual to locate. On page 12 I finally discovered that it stands for "Instant Program Location System," by which Akai means that the beginning of the previous, the current or the next selection on the disc being played can quickly be selected by pressing the play button simultaneously with either reverse or fast forward. This method of advancing or reversing

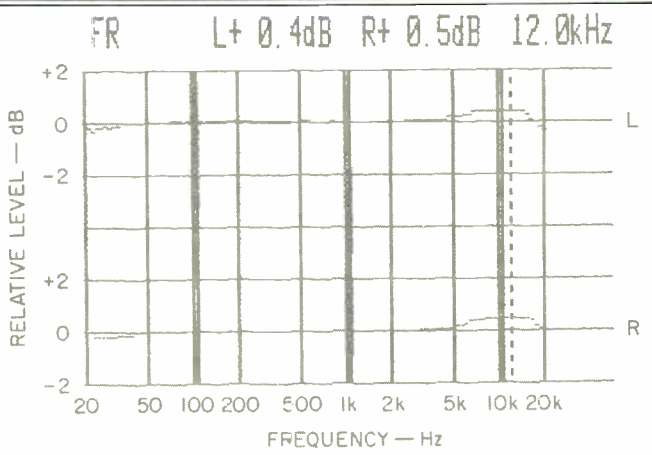

Fig. 1—Frequency response, left (top) and right channels.

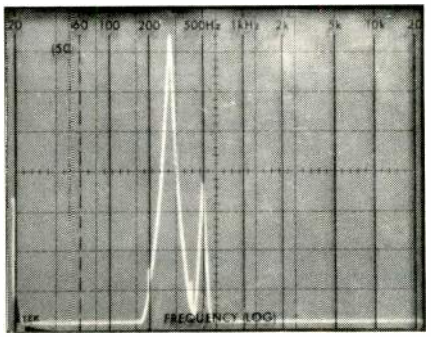

Fig. 2—Frequency sweep from 0 Hz to 50 kHz shows "beat" output at 24.1 kHz to the right of 20-kHz signal.

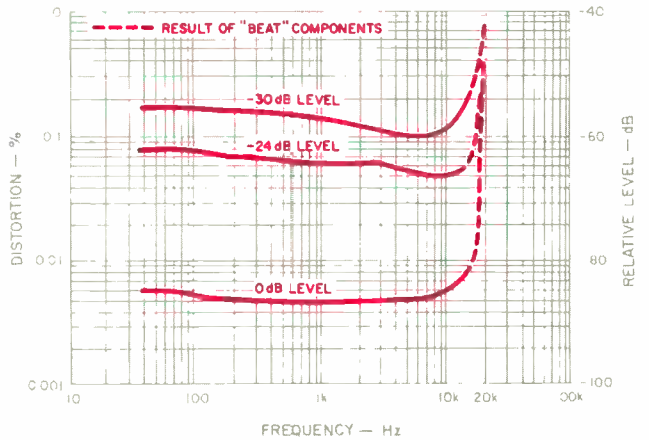

Fig. 3—THD vs. frequency at three signal levels. (High-frequency dashed lines indicate super-audible beats; see text.)

Akai's CD-M88 uses an analog filter at the output of its D/A converter, rather than the digital filter used by most of the second- and third-generation units.

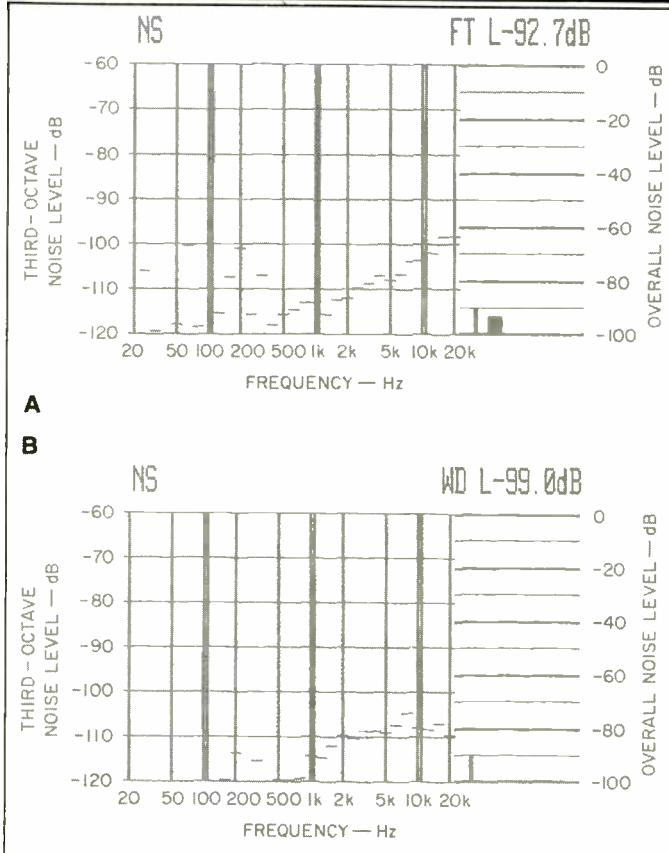

Fig. 4—S/N analysis, both unweighted (A) and A-weighted (B).

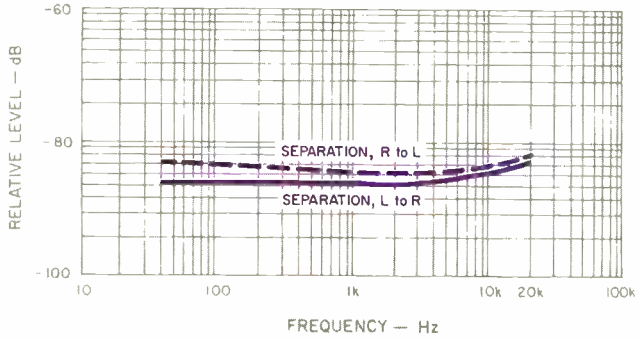

Fig. 5—Separation vs. frequency.

the laser pickup, though unusual, reduces the number of front-panel controls, an important consideration for a CD player in the mid-sized category.

All of the remaining touch controls at the right end of the panel are involved with programming for specific play routines. Here are found the numeric keys as well as the repeat key, the index key, and those special "To," "And" and "Without" keys. The routine needed to get to a specific track at the beginning of play is a little unusual. Instead of just keying in the track number and then (perhaps) pushing the play button, you treat this request as if it were part of the Akai's programming routine, first keying in the desired track and then pressing the separate "Program Start" button. Having become accustomed to the other approach, which is used on most machines, this took a little getting used to. On the other hand, when doing multiple-programming of tracks, the more-logical routine of the Akai's special word keys more than made up for the differences in the CD-M88's single-track access procedure.

Measurements

Frequency response of the Akai CD-M88, shown in Fig. 1, was flat to within the claimed ±0.5 dB over the entire audio range. A slight rise in response near the high end suggests that the steep analog filters employed after D/A conversion may not have been precisely optimized for the impedance into which they were terminated. Still, the rise amounted to no more than 0.5 dB in one channel and 0.4 dB in the other. Bear in mind that the vertical scale in Fig. 1 is only 2 dB per division.

As with so many other players, the apparent "high" harmonic distortion readings observed when checking THD of high-frequency signals (16, 19, and 20 kHz) on my test disc are not really the result of harmonic-distortion components. This is obvious if you look at the spectrum-analysis photo of Fig. 2, in which the sweep extends from 0 Hz to 50 kHz. The large spike near the left is the desired 20-kHz test-signal output, while the lower amplitude spike is a "beat" occurring at around 24.1 kHz. Figure 3 shows harmonic distortion versus frequency for three different recorded levels, but the measurement is valid only to around 10 kHz. That's why I used dashed lines above this frequency, to show that the sudden rise in apparent THD is really caused by the appearance of those out-of-band "beats."

Unweighted signal-to-noise ratio measured 92.7 dB (greater than Akai's claimed 90 dB), while the A-weighted measurement was an even higher 99.0 dB (see Figs. 4A and 4B). SMPTE-IM distortion measured 0.005% at maximum recorded level, increasing to 0.055% at −20 dB recorded level. CCIF-IM distortion (twin-tone, using 19- and 20-kHz tones at the equivalent of highest recorded level) measured a very low 0.0028% at maximum recorded level and 0.003% at −10 dB recorded level. Stereo separation, plotted as a function of frequency in Fig. 5, ranged from 81.4 dB at the high-frequency extreme to 85.4 dB at mid-frequencies.

Reproduction of a 1-kHz square wave by this player is shown in the 'scope photo of Fig. 6. I was surprised to discover that Akai is still using so-called analog (or sharp-cutoff, "brick-wall") filters at the output of the player's D/A

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The chief attractions of this player are its great programming flexibility and that a user doesn't have to take a course to learn how to operate it.

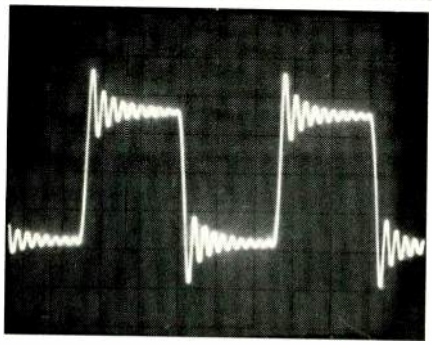


Fig. 6—Reproduction of a 1-kHz square wave.

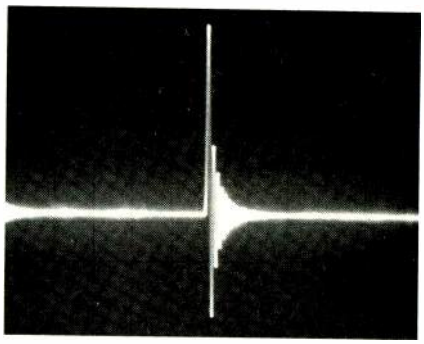
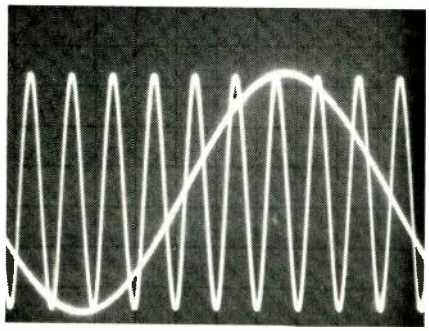
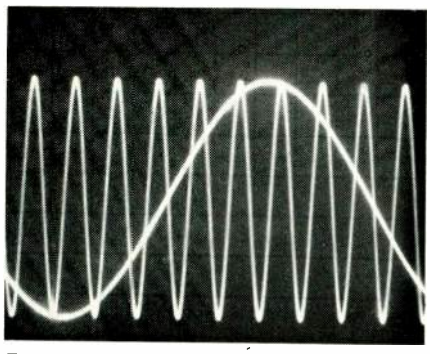


Fig. 7—Single-pulse test.



A



B

Fig. 8—With a 200-Hz signal on left channel and a 2-kHz signal on right (A), little or no phase shift is observed. Using 2- and 20-kHz signals, considerable time delay is noted (B).

converters, whereas most other second- and third-generation CD players have gone over to digital filtering and oversampling. As I've stated on several occasions, many listeners will probably be unable to tell the difference between these two approaches, but there are those who do prefer the digital filtering approach and can hear a slight improvement in sound quality when it is used. The appearance of the unit pulse in Fig. 7, as reproduced from the Philips test disc, further confirms the use of analog filtering in this player's D/A circuitry.

As is true of most recent CD players, the Akai unit had no trouble tracking through the simulated-defects disc. The CD-M88 totally ignored the widest portion of the opaque wedge inscribed on that disc as well as the increasingly wide "dust" specks and the simulated fingerprint smudge. Resistance to mild vibration and external shock was even more gratifying, for the unit continued to play without missing a beat every time it was tapped on its top or sides. The smaller size of this player seems to make for a sturdier and more shock-resistant housing.

Use and Listening Tests

The Akai CD-M88 is a pleasure to use. Programming is easy and logical, whether performed at the front panel or by means of the wireless remote control (which duplicates all of the programming and disc-transport controls). As for sound quality, if it didn't quite measure up to the level of more expensive CD players or those that use digital filtering and oversampling, it was certainly acceptable.

The chief attractions of this model, to my mind, are its great programming flexibility and the fact that a user doesn't have to take a long course to learn how to operate it. At a suggested retail price of just under $500, this Akai CD player should find favor with many music lovers who aren't as interested in technical circuit details as they are in functional integrity and good human engineering.

Leonard Feldman

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This Compact Disc of piano concertos by Schumann and Chopin is superbly balanced, and musical and natural in its perspective.

natural, rather than the result of compression. The instruments sound convincingly realistic in terms of timbre, and the recorded accents and phrase shadings have exactly the scale and proportion the performers put there. However, the piano suffers from the strike-tone distortion of analog recording. I hope that Bolling will use a digital recorder for his next album. His piano, in particular, would benefit from a digital recorder's extended dynamic range and negligible wow and flutter.

What the album lacks is a sense of a specific place. The trio is playing in an acoustical no man's land, neutral and characterless. This style of production works quite well for an LP, but for a CD it's boring. The art of producing a CD for a small jazz ensemble is to find an appropriate room quality for the music and its style, as John Lewis did for his album of Bach preludes and fugues, recorded in a church.

Clearly, producer Bolling has not given much thought to the potential of the CD medium. (He is not alone in this; everyone is still learning how to produce CDs.) When Bolling discovers the way CDs can convey a sense of room acoustics, I think he will begin incorporating those sounds into his compositions—using different acoustic places for different kinds of pieces. When he turns his creative energies in that direction, the results will be as tastefully beautiful as his compositions. In the meantime, *Jazz a la Francaise* is still a delightful, savory musical treat.

Steve Birchall

Chopin/Schumann: Piano Concertos. The Concertgebouw Orchestra, Antal Doráti; András Schiff, piano. **London 411 942-2.**

Much to my surprise, when I searched through all the CD catalogs available to me, I found that apparently this is the first CD recording of the popular Schumann Piano Concerto and only the third recording of the Chopin Second Piano Concerto.

This certainly is a good reason for acquiring these works. More to the point, the performances—especially of the Schumann—by the brilliant young pianist András Schiff are extremely vivid and immediately ingratiating. Schiff provides exciting readings, with the Schumann very propulsive and highly dynamic.

Schiff has the benefit of the sure and steady Antal Doráti at the conductorial helm of the great Concertgebouw Orchestra, and he is provided with a superbly balanced recording by master Decca engineer John Dunkerley. As in his marvelous Montreal Symphony recordings, Dunkerley gives us a sound that is, above all, musical and natural in its perspective.

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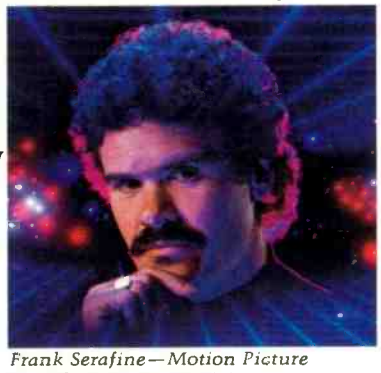

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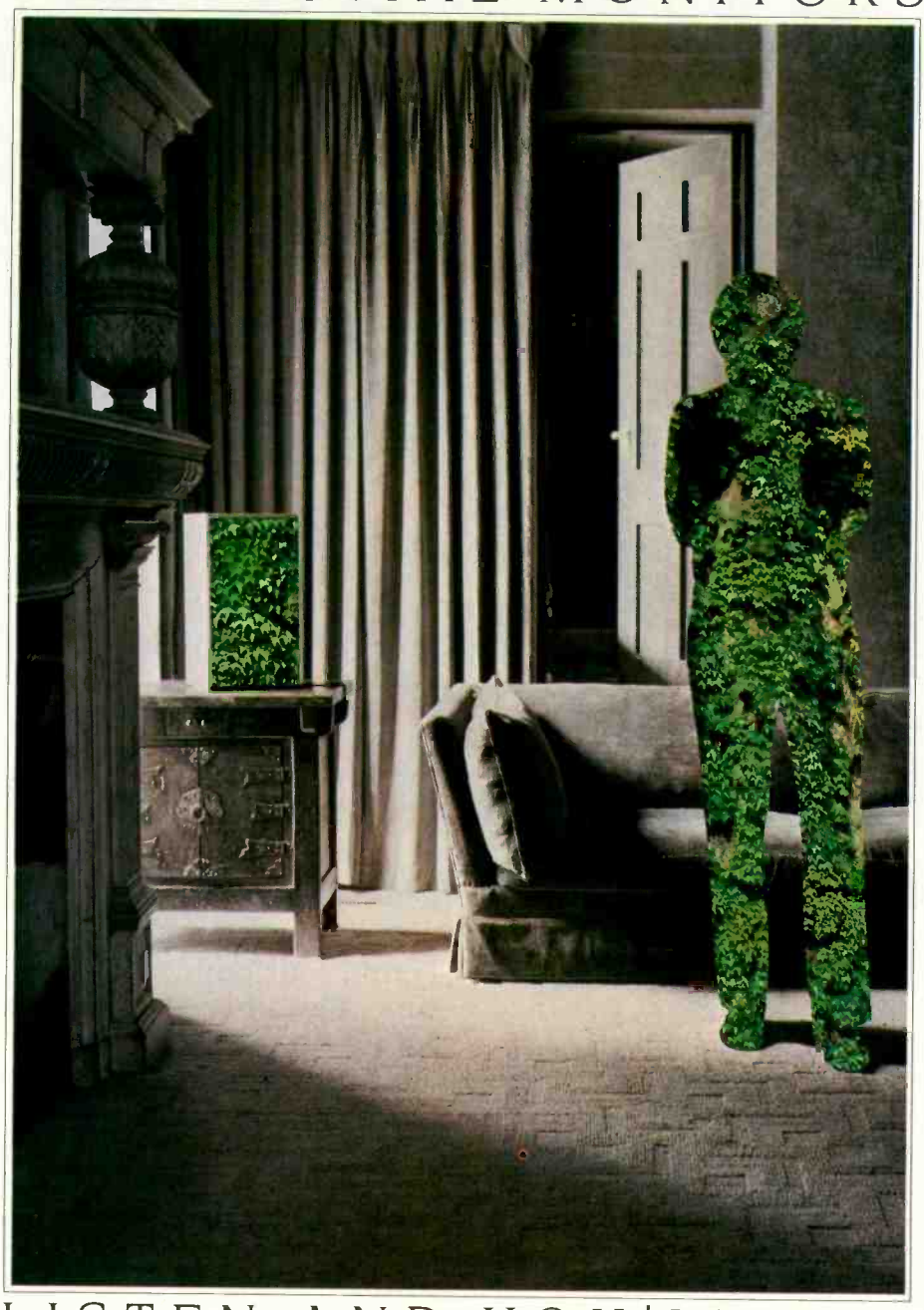

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Every subtle shading of tone color, phrasing and dynamics makes its point with exquisite perfection on John Lewis's disc of Bach preludes and fugues.

Voices Carry: 'til tuesday
Epic EK 39458.

Only the presence of beauteous lead singer/songwriter Aimee Mann, and one good cut buoyed up by an arresting video, make 'til tuesday's debut album, *Voices Carry*, worth notice. The title cut is a good little tune, rendered more powerful by Mann's emotional delivery, but most of the rest of the material is skeleton-thin, repetitious, and unimaginative. Mann comes through with a fairly broad vocal range, going from a kittenish whisper ("No More Crying") to a throaty, tough delivery ("Looking Over My Shoulder"). But her lyrics tend to wallow in an atmosphere of tragic suffering so much that, before the album is halfway over, you have an urge to tell her to cut it out and lighten up a little.

The production varies from yeomanly to poor. The digital encoding of the original analog disc here serves largely to expose the mediocrity of the original recording. This Compact Disc cannot help but sound clean and silent between cuts, but the 11 selections are hazy. (A note for the detail-oriented: Only 10 cuts have their lyrics printed on the mini-jacket; the lyrics for "Are You Serious?" have, for some reason, been omitted.)

I'd wait 'til 'til tuesday's next CD, if I were you. *Paulette Weiss*

J. S. Bach: Preludes and Fugues from the Well-Tempered Clavier, Book I. John Lewis, piano; Joel Lester, violin; Lois Martin, viola; Howard Collins, guitar; Marc Johnson, bass.
Philips 824 381-2.

Bach would enjoy John Lewis' performances of these pieces. Set aside all those stuffy period-instrument performances with their "historically correct" but unimaginative style: John Lewis plays Bach's music with loving admiration. But he also improvises around the existing musical structures, infusing them with just the right amount of 20th-century style and feeling.

Put your letter-writing pens down and relax. Yes, I do admire what Harnoncourt, Leonhardt, and Pinnock do with Baroque music and style. Nonetheless, Bach, more than anyone else, would feel cheated if a 20th-century musician didn't bring his own style and personality to a performance. The early-music specialists are trying to recreate how a performer in Bach's time might have played the music, but when they succeed it is because of their own personalities and vitality.

John Lewis succeeds because of his warmly humane musical personality, and because he interacts with Bach at the creative level. Lewis approaches Bach with quiet understatement, always gentle, always elegant, letting the jazz elements sneak in. A subtle change of rhythm in a repeated figure makes a reference to swing. A modulation to a distant key provides a blues feeling. An unexpected melodic turn evokes a well-known jazz tune. A Baroque ornament becomes a blues ornament with just one chromatic change. Using such simple musical gestures as these, John Lewis manages to say a great deal.

When he departs from Bach significantly, you are prepared for it. Lewis' improvisations have their own special beauty, and frequently have the sophisticated, wistful feeling of a Bergman or Fellini film (especially "Prelude No. 2" and "Fugue No. 7").

Listen to Lewis' careful and sensitive phrasing, articulation, and pedalling when he is within the Bach style. Few pianists, other than Glenn Gould, have played Bach with this degree of expressive control.

Although these are keyboard pieces, Lewis adds violin, viola, bass, and guitar in the fugues. Again Bach would appreciate the clear texture this very Baroque chamber ensemble brings to his music. Lewis, as arranger and coproducer, takes the extra step that Bach would have taken, too. He gives each melodic line in the recording the independence it needs in order for its logic to be followed, while allowing the strength of Bach's musical conception to hold all these elements together.

This CD was coproduced by Kiyoshi Koyama, with E. Alan Silver credited with "recording supervision." The sonic atmosphere feels comfortably intimate, and never does the hall's reverb intrude on the linear clarity of Bach's music. Marc Aubort and Tom Lazarus engineered the all-digital sessions, which took place in New York's Rutgers Church. Aubort's keen ear for open, relaxed sound lets the recorded music sound completely natural and real. Every subtle shading of tone color, phrasing, and dynamics makes its intended point with exquisite perfection. Played back on a good system, this CD easily creates the illusion of hearing the group live.

If Bach could hear these beautiful performances, he would probably want to sit in and jam with John Lewis. *Steve Birchall*

Joel Lester, Lois Martin, John Lewis, Marc Johnson, and Howard Collins

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JON & SALLY TIVEN

HOORAY FOR THE TAMBOURINE MAN

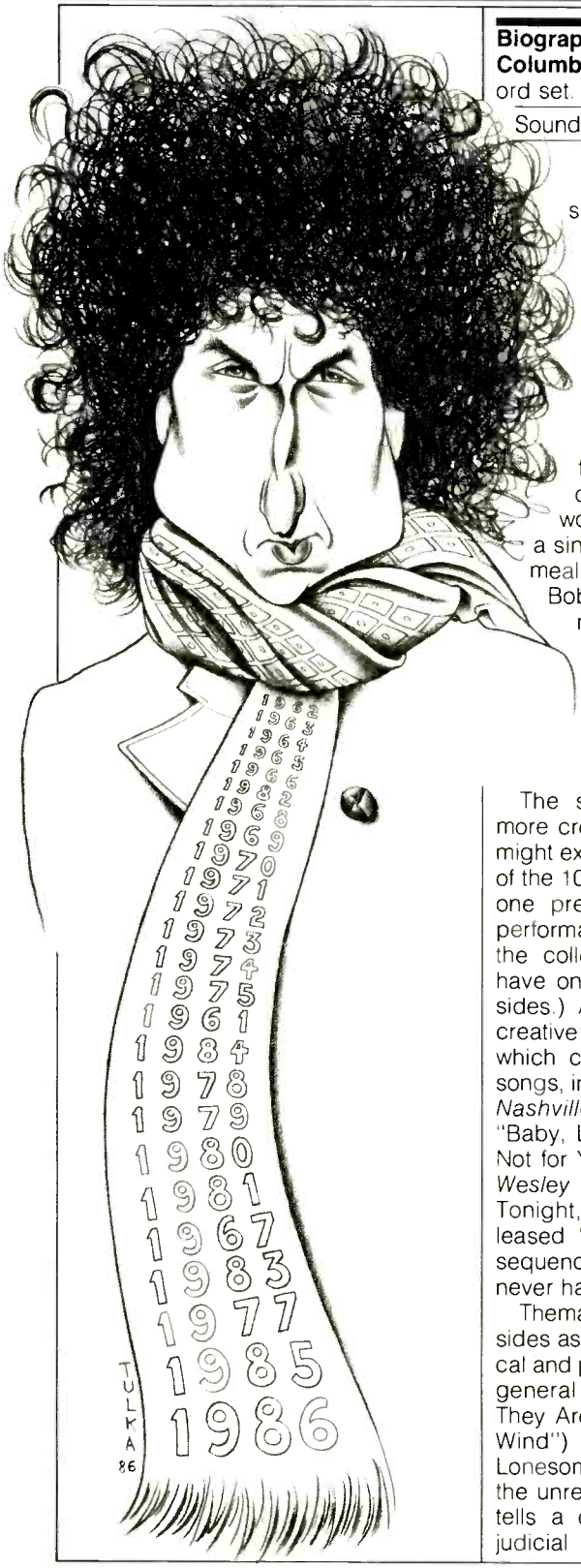


Illustration: Rick Tulka

Biograph: Bob Dylan
Columbia C5X 38830, digital, five-record set.

Sound: B Performance: A+

Biograph, which many hoped would be the definitive retrospective of Bob Dylan's career, has finally been released. To put it simply, the set easily lives up to my hopes and in many ways exceeds them. I had anticipated a collection that would move chronologically. *Biograph* does not do that. Instead, it cleverly juxtaposes songs from different points in Dylan's development. So arranged, his work can at last be observed as a single body, rather than a piecemeal succession of styles—the folk Bob, the protest Bob, the paranoid Bob, the rock 'n' roll Bob, the country Bob, the mystical Bob, the spiritual Bob and so on. In their place is a Bob Dylan who encompasses all of them, and that alone is a crucially important revelation.

The sequencing of selections is more creative and revealing than one might expect, especially so since each of the 10 record sides includes at least one previously unreleased song or performance. (There are 18 of these in the collection, plus three more that have only appeared on singles or B-sides.) An excellent example of this creative programming is the first side, which consists more or less of love songs, including "Lay, Lady, Lay" from *Nashville Skyline,* the first album's "Baby, Let Me Follow You Down," "If Not for You" from *New Morning, John Wesley Harding*'s "I'll Be Your Baby Tonight," and the previously unreleased "I'll Keep It with Mine." This sequence brings together songs I'd never have thought of as related.

Thematic groupings govern other sides as well. Side two consists of topical and protest songs, moving from the general and anthemic ("The Times They Are A-Changin'," "Blowin' in the Wind") to the more specific ("The Lonesome Death of Hattie Carroll" and the unreleased "Percy's Song," which tells a chilling story of an unfeeling judicial system). Side three contains raucous rock 'n' roll, side four includes some of Dylan's more visionary songs, side six is about romantic entanglements, and side eight looks at the animal aspects of the same subject. The final side acts as a kind of summing-up and valedictory, with "I Shall Be Released," "Knockin' on Heaven's Door," a live "All Along the Watchtower" from *Before the Flood,* "Solid Rock" from *Saved,* and an unreleased solo version of "Forever Young," recorded as a demo.

I think it is important to look more closely at some of the previously unreleased and rare material here. "Percy's Song" and "Lay Down Your Weary Tune," a song that has always reminded me of William Butler Yeats, were recorded for *The Times They Are A-Changin'* and then squeezed off. The 1962 "Mixed-Up Confusion" was Bob's first session with an electric band and, I believe, was released in early '63 only in England, where it sank without a trace. The '65 single "Can You Please Crawl Out Your Window?" was recorded with The Band (then known as The Hawks). It has never been on an album until now. "Up to Me," a terrific song that contains more direct comment on Dylan's inner feelings than most, was recorded for *Blood on the Tracks.* "Abandoned Love" and "Caribbean Wind" were recorded for *Desire* and *Shot of Love,* respectively. "Jet Pilot" is a fragment that grew into "Tombstone Blues," and both are included here, on the same side, for a telling insight into the creative process. "I Wanna Be Your Lover" is a screaming rocker taken down between *Highway 61 Revisited* and *Blonde on Blonde.* The very early "Baby, I'm in the Mood for You" was from the *Freewheeling* session.

Songs that appear in newly released live versions include an electric "I Don't Believe You," a lovely acoustic "Visions of Johanna," "It's All Over Now, Baby Blue," a thunderous "Isis" and "Romance in Durango" (both from the film *Renaldo and Clara*), and a recent "Heart of Mine." Alternate versions of previously released songs include "Quinn the Eskimo" and "You're a Big Girl Now."

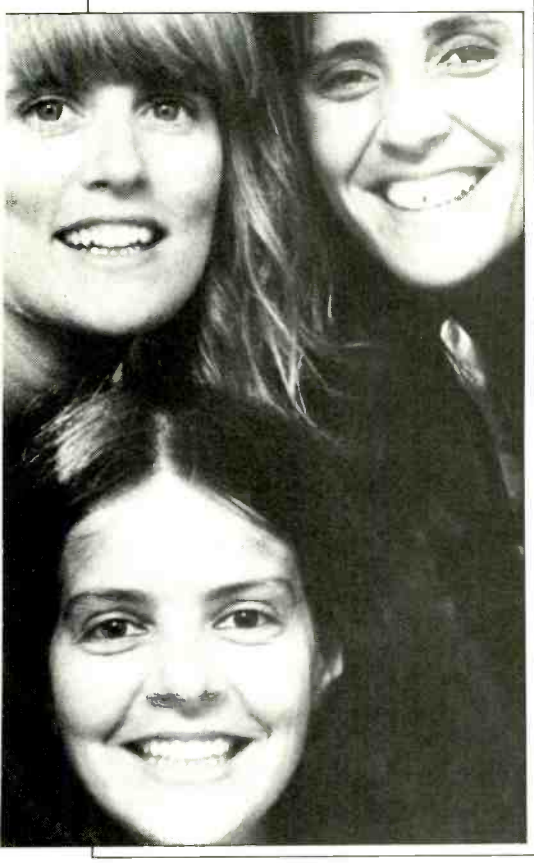
Sound throughout is actually very good. Many of these songs were done long enough ago that the technology was relatively primitive, but Greg Cal-

bi's digital mastering job allows the best sound achievable. The only spot where quality unavoidably dips is that demo of "Forever Young," but the intimacy of the solo performance more than makes up for the lesser sound.

With the music comes a lavish 36-page booklet with lots of photos, many of them candids, and an excellent essay by Cameron Crowe. Columbia does not offer a list price on its releases, so I looked around and found retails from $21.99 to $35, with the three-CD set at around $40. As Smokey Robinson once sang, "You'd better shop around."

Biograph is firm testimony to the impact of Bob Dylan's genius. Virtually by himself he reshaped the concept of what pop music could be. When Dylan is quoted as saying "Tin Pan Alley is gone. I did away with it," you could read it as enormous egotism if it weren't so very true. This collection is a monument for the ages, and even that is a dramatic understatement.

Michael Tearson



Another World: The Roches
Warner Bros. 25321-1, $8.98.

Sound: C– Performance: C

Have you heard that we're in the midst of a folk revival? Most artists under this new umbrella either abhor its shadow (as in the case of Suzanne Vega) or gratefully hide in it (like The Washington Squares). The Roches, with their spotlit harmonies and gentler-than-mainstream melodies, have arguably been folky for years, but they have always spruced up their sound with assorted elements of quirkiness. Whether they're trying to bank on this "new folk" business or just mellowing out, on *Another World* the three Roche sisters opt for their most conventional tone to date.

Perhaps it's the influence of hit-making producer Richard Gottehrer. Responsible for five cuts here, he presents a striking contrast to former producer Robert Fripp. Fripp coaxed some of the most appropriately unearthly caterwauling from Terre Roche on his own landmark album, *Exposure*, and always made The Roches glisten by offsetting the purity of their voices against imaginative arrangements and Frippertronics.

Another World's arrangements are stock, and even worse, there's something compressed about the overall mix. The songs are like scenes viewed through a telescopic lens—flat, without depth. The Roches' subject matter is by no means bland; how many songs about vomiting in a New York City hot spot can *you* hum? "Face Down at Folk City" paints a stark portrait of being trapped by the trappings of "the scene," but, like many cuts from *Another World*, it is watered down by sheer musical convention.

The Roches haven't smoothed out all their kinks, however. Along with eccentric visions of "Older Girls," who "have a language all their own," and life as pizza ("Gimme a Slice"), there are quirky vocal deliveries—Mideastern melismas rising from their Midwestern drawls, sprung rhythms, and a few moments when they just cut loose. The phenomenon often heard when siblings sing—a fringe of difference among closely matched voices that only nature can make credible—is given an '80s stamp when the sisters'

harmonies produce an eerily synthetic, warmly robotic effect.

As it skittish about being anchored too long to any vantage point, The Roches come at life from many different angles here. Their counsel rises from the discouraged protagonist's cornfield on "Weeded Out," but their spirits just as easily sink in the title track, where bad habits push them into lethargic musing about "Another World."

"Think how good just normal feels," they suggest, but for *Another World*, at least musically, normalness surrenders to mediocrity. The Roches are still offkilter, but not enough. *Susan Borey*

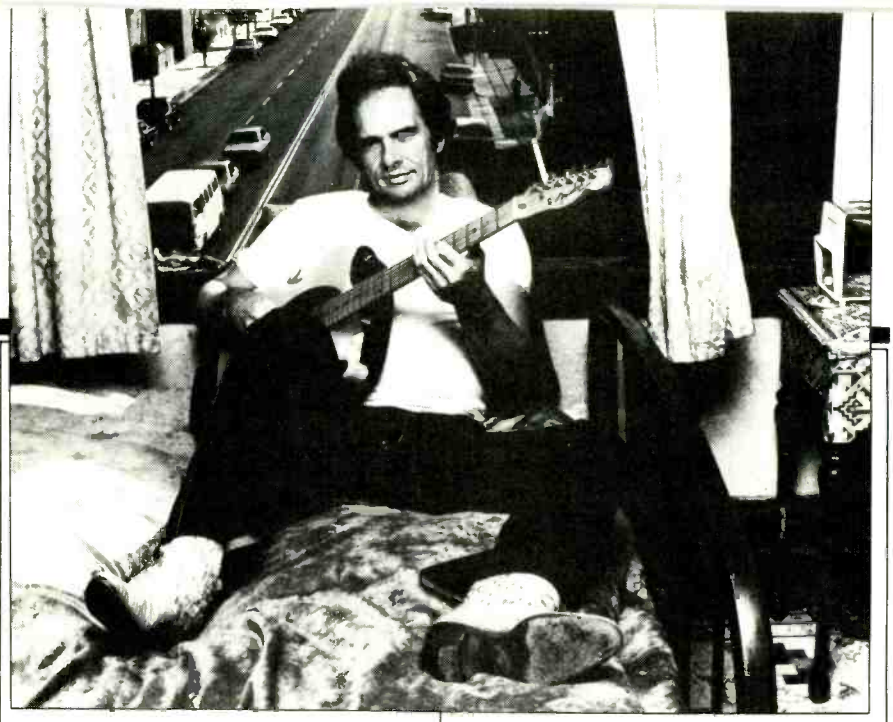
Riptide: Robert Palmer
Island 90471-1, $8.98.

Sound: B Performance: B–

I'm not sure what I expected from *Riptide*, Robert Palmer's first solo album in a long time and a quick follow-up to his successful appearance as The Power Station's vocalist. Whatever, I found that I liked *Riptide* more than I anticipated.

Production is by Bernard Edwards, who also helmed The Power Station's LP, and he steers *Riptide* through some tricky terrain. The title cut, a 1935 Gus Kahn torch song, opens and closes the album. Here, and on Palmer's own torcher, "Get It Through Your Heart," Robert gets to show off some nice, slick nightclub singing. The rest

Merle Haggard does some heartfelt singing on his latest live LP, and the clarity of the digital recording is very fine.



is varying shades of modern material; there's also a wicked little run at Earl King's 1965 New Orleans hit, "Trick Bag." Palmer's smart singing is the cornerstone of the album. He is nothing if not stylish.

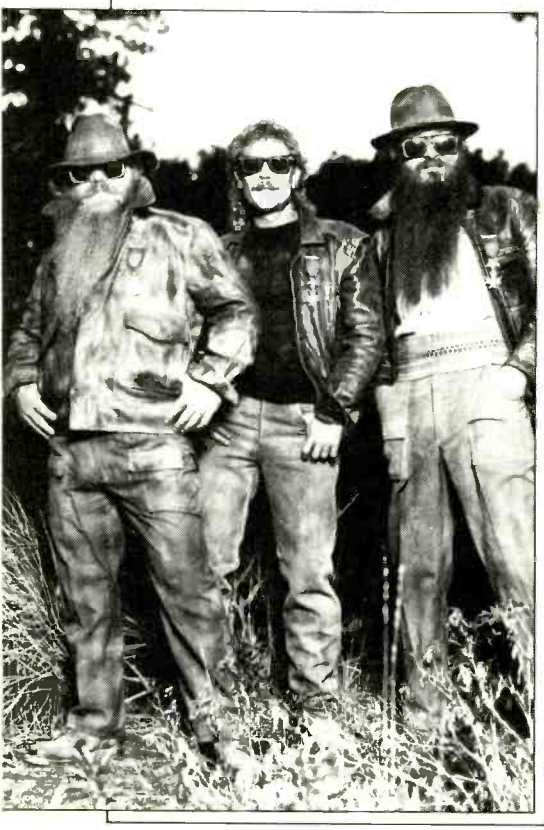
Edwards' production is intelligently spare to allow plenty of breathing space in the arrangements, something Palmer has thrived on since *Sneaking Sally Through the Alley*. Edwards has also used wide stereo separation, especially for percussion, to give a feeling of scope, and he delivers good, energetic sound that seems loud even when played softly.

There's nothing here to make you think too hard, just breezy, fun-time stuff. *Michael Tearson*

Afterburner: ZZ Top
Warner Bros. 25342-1E, $8.98.

Sound: B Performance: A

Some people are going to write this off as Son of *Eliminator*, the most successful ZZ Top album ever, but those same people probably thought *that* album was just like everything else ZZ had done. In some respects it was. Billy Gibbons is like a guy who writes a new novel every couple of years; they're all eminently engaging but basically formulaic. He does make his token use of technology; on the last album it was drum machines, on the new one it's the Fairlight synthesizer. Still, while he may have dotted his i's a little differently or discovered a radical use for the semicolon, don't expect haiku from him.



Why tamper with success? Gibbons will rewrite previous tunes ("Gimme All Your Lovin' " comes out for a second bow here), previous licks, and previous rhythm tracks. Hey, the name of the game is not who works the hardest, it's who makes the best records, and nobody can touch ZZ Top when it comes to modern Southern boogie or blues. Jeff Beck endorses them, fickle British audiences are finally crowning them the Kings of American rock, and we've been saluting them since way back when.

There are a few moments that are less than inspiring on *Afterburner*—ballads are not Gibbons' forte, and "Rough Boy" is no exception—but for the most part it's yet another chapter in the saga of today's most popular trio. Not much more, but nothing less.

Jon & Sally Tiven

Live in London: Ricky Skaggs
Epic FE 40103, digital.

Sound: B+ Performance: A

Amber Waves of Grain:
Merle Haggard
Epic FE 40224, digital.

Sound: B Performance: C+

These are a pair of very fine in-concert country releases, each bolstered by excellent digital recording and, in Ricky Skaggs' case, by digital mastering as well.

Ricky Skaggs' *Live in London* is an absolutely top-rate record. Its sound is as clean as vinyl can deliver, the recording crystal-clear and close. Skaggs leads his crackerjack band through a program that includes a couple of new songs, "Cajun Man" and Peter Rowan's "You Make Me Feel Like a Man," plus the expected quota of Ricky's hits, including Bill Monroe's "Uncle Pen," "Heartbroke," Albert Lee's "Country Boy," "I've Got a New Heartache," and "Honey (Open That Door)." For the finale, the Flatt & Scruggs oldie "Don't Get Above Your Raising," Ricky brings out Elvis Costello to sing along. *Live in London* is just one terrific album.

Merle Haggard's latest live LP features the song he wrote for the Farm Aid benefit, the intense and moving "Amber Waves of Grain." The rest of the program takes the cue and follows a topical vein, reprising such Haggard standards as "Mama Tried," a medley of "The Okie from Muskogee's Comin' Home" and (naturally enough) "Okie from Muskogee," "Working Man's Blues," and "I Wish Things Were Simple Again." Troy Seals' "American Waltz" is an eloquent and appropriate finale.

Hag's performance is clearly heartfelt and moving, as is that of his band, which is excellent except when the unnecessary horn section kicks in. The digital recording is very nice, if not quite as brilliant as on the Skaggs album. Still, the clarity is very fine, indeed. The only complaint is a substantial one. At barely 27 minutes, *Amber Waves of Grain* is pretty skimpy, and it is this that has held the performance grade down. *Michael Tearson*

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Richard Goode

Schubert: Piano Sonata in B Flat; Allegretto; Impromptu No. 2. Richard Goode.
Nonesuch 79124, $8.98.

This last of the Schubert piano sonatas is one of the Great Works of Man, as they say. A veritable musical Parthenon, huge in length for its time, 1828, flawed in many pianistic ways, but under the right fingers, with the right mind, an overpowering work. It is too much for most listeners—indeed, it is too much for most pianists—not the finger work but the vast scope and the sense of the music. All the big pianists have a try at it; many fail. It is not predominantly showy, for all its millions of notes. I first heard it, and was bowled over, when the Viennese pianist Ruth Geiger did it on early, low-band FM radio, in 1946.

After that, disappointment followed disappointment. Was it just my prejudice, liking Geiger so much? All the later versions left me cool or chilled. They just did not "get" the music, and so were not communicative of it. Even now there are 14 recordings listed in the latest *Schwann*. The version by Serkin, which I found a disaster, has been reissued. The best I'd heard, though a relatively gentle and undemonstrative playing, was by Lili Kraus, who was a saint to play it; she was, I understand, fighting arthritis.

So—Richard Goode? This version, made for Nonesuch in RCA's big old Studio A in New York, in 1978, is the greatest recording I have ever heard of the music. Unbelievably powerful. I was shaken—that's the only word. If you turn up your volume for "big piano" and keep your trap shut, so to speak (this is no background music!), you cannot help but be hit hard too.

No, not digital, but an excellent analog piano recording which plays an important part in the experience.

Electronic Music and Tar: Dariush Dolat-Shahi.
Folkways FTS 37464, $10.98.

Folkways, under Moses Asch in New York, was one of the first new record labels after WW II, along with Vox—both, of course, on 78-rpm shellacs. This venerable and largely one-man label is into what might be called international folk music or ethnic music. It is an interesting field, notably when tied into assorted contemporary sounds such as synthesizer—as on this disc, which is a lot more fun than the austere title might imply. In fact, there's a technical surprise that had me dumbfounded.

Darius Dolat-Shahi is Persian but is a musical product of the Dutch and then the venerable electronic music center at Columbia University in New York City. Understandable that he should combine traditional musical instruments of his own land with the heady stuff that comes out of electronics these days. He is a full-fledged academic, with the required doctorate, but that doesn't necessarily mean he is humorless in his composing.

So—forget the doctorate and the long words and titles. The music will intrigue you from the start, an *almost* pop-style synthesis of disparate elements. These include two Persian stringed instruments (plucked, not unlike the Indian sitar); assorted Japanese instruments that can produce expressive, sliding pitches and strange non-Western intervals, and a very modern synthesizer setup. Some "sound effects" too—bird songs, barking dogs. The birds sound real but I bet they're synthetic, like the dog. Also a very definite touch of the minimalist sound, which is best-selling these days. I'd say this artist is not missing any opportunities. His minimalist stuff, too, is tempered to the shorn sheep, by which I mean he does it for not too long, then moves casually on to something different, never straining the mind even a little bit. In other words, if you get my drift, *Electronic Music and Tar* could almost be considered a pop record. Ph.D. pop, no less.

More. To my real surprise, I suddenly found that the synthesized effects, particularly on side two, were, on my good old surround-sound system, quite highly directional—and selectively so. The bird tweeted off to the left rear, the dog barked middle-front. Sharp differences in apparent source. For your info, this was played through the QS decoder of the Sony 2010 four-channel control center, which also has SQ, with logic, and a proprietary matrix as a third choice—plus, of course, plain old two-channel stereo. The QS, I have long since observed, produces the best surround sound with regular two-channel stereo recordings, whatever the format. (I add to it some synthesized delay of the front channels via two more channels; this definitely enhances the surround effect.)

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BRASS TRACKS

I Only Have Eyes For You: Lester Bowie's Brass Fantasy
ECM 25034-1.

Sound: B Performance: B+

Lester Bowie can usually be found centering the Art Ensemble of Chicago, bouncing on stage in his white lab coat, alternating blistering trumpet blasts with comical farts and warping crisp ensemble lines with hysterical gurgles. Listening to Bowie's Brass Fantasy reveals the New Orleans connection for the Art Ensemble's synthesis of black music traditions.

The Brass Fantasy, with eight horn players and drummer Phillip Wilson, navigates a mélange of influences with tightly knit, though sometimes rubbery, arrangements. Continuing the "world music" trends of the Art Ensemble, Bowie effects an aboriginal choir, with horns growling and breathing, on "Lament." A slow flamenco rhythm emerges, and trumpeter Stanton Davis' whirlybird solo builds into an ensemble of blaring trumpets and sinewy sustains from the trombones and tuba.

The ghost of John Philip Sousa is united with Bob Marley on "Come Back, Jamaica," with its reggae lilt and bright horn charts. Phillip Wilson's reverberated snare has a distant, dreamy feel, snapping under Bob Stewart's tuba. People might object to the ambient echo that's the ECM recording trademark, but I think it lends an aura and adds to the slipstream of Bowie's music, which plays both with history and with contemporary music boundaries.

The title track stretches out the Al Dubin/Harry Warren standard in a campy fashion replete with wah-wah trumpets. Bowie's solo on this track spits, sputters, and slurs like an eloquent drunk slobbering over the piano bar. His humor is the gateway to his pathos, and he proves again to be an adept and distinctive leader. On each of his infrequent solo recordings, new facets emerge out of the synergistic collective that is the Art Ensemble of Chicago. *John Diliberto*

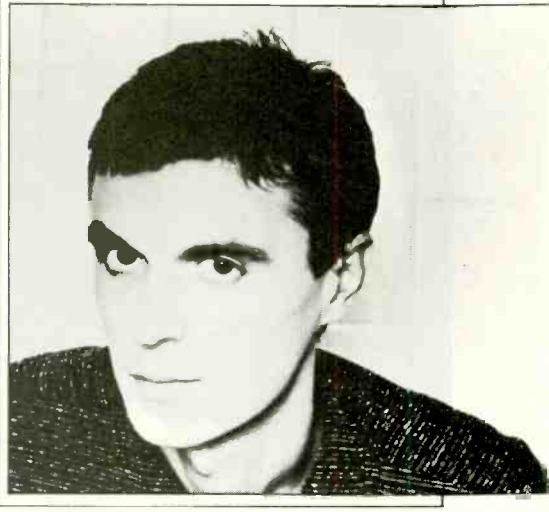
Music for "The Knee Plays": David Byrne
ECM 25022-1, digital, $9.98.

Sound: B Performance: A–

David Byrne's latest solo project is a wonderfully peculiar record. The music here was generated for the Robert Wilson opera *The Civil Wars*—more precisely, for the passages Wilson calls "The Knee Plays." Conceived with New Orleans' fabulous Dirty Dozen Brass Band in mind, the album is full of herky-jerky rhythms and funky huffing and puffing, plus, here and there, Byrne's bizarre and often funny recitations. Some of the melodies come from traditional and gospel sources while some are wholly original. It makes for some wild, fun, adventurous listening.

The sound here is gorgeous, even by ECM standards—warm and gracious with glowing saxophones. The album was digitally mastered with Teldec's DMM system and has received a superb English pressing with exceptionally quiet, true surfaces.

Michael Tearson



It's About Time: McCoy Tyner and Jackie McLean
Blue Note BT 85102, digital.

Sound: B Performance: B–

It's About Time, the first genuine pairing of virtuoso pianist McCoy Tyner and post-bop alto player Jackie McLean, is a mixed bag of light-bop blowing and middle-of-the-road funk with chops. Tyner, one of the most distinctive pianists of the last 25 years, ignores the modal turf he's trod upon since his tenure with John Coltrane in the '60s. Instead, he's written some pleasant bop changes for his solos and those of McLean and trumpeter Jon Faddis.

It is Faddis who's the biggest surprise here. On the opening gallop of "Spur of the Moment" he starts the exchange with a smeary, high-register run of squeals and trills. McLean follows with the energized style he perfected on a series of memorable Blue Note records in the '60s, alternating blues growls with scalar spurts and runs on his saxophone. Tyner takes it out with his patented, thundering left-hand orchestrations.

It's About Time features two contrasting rhythm sections, with electric bassist Marcus Miller (formerly with Miles Davis) in one and the stalwart acoustic bass of Ron Carter in the other. Al Foster drums in both, but the differences are like night and day. Carter charges "Spur of the Moment," and the subtle nuance that informs his blues, "No Flowers Please," is a sharp departure from the overbusy playing of Miller on the ballad "You Taught My Heart to Sing."

Tyner's compositions are unusually forgettable, but they're saved by some inspired soloing. Tyner elevates the light funk of "Hip-Toe" out of the groove, countering triplets in the right hand with chordal washes in the left. Carter opens his "No Flowers Please" with an eloquent bass lament. McLean seems restrained, however, perhaps uncomfortable in the calculated potpourri programming of the disc: Some funk, a ballad, a blues, a Latin lilt, and some hard-bop, most with artificial studio fades.

The album, recorded direct to two-track digital, captures the session's casual feel. It has an unprocessed, natural ambience which gives Miller's electric bass an acoustic warmth. However, it lacks the fire, passion and adventure that I've come to expect from all of these musicians.

John Diliberto

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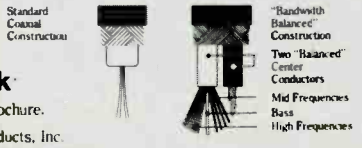

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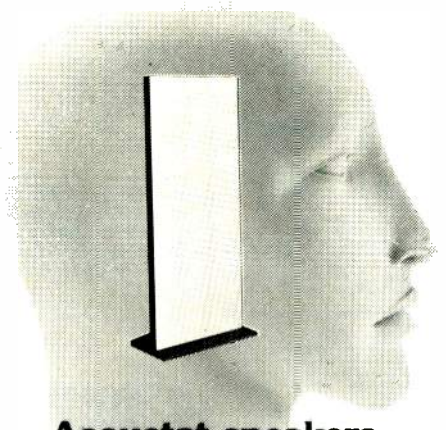

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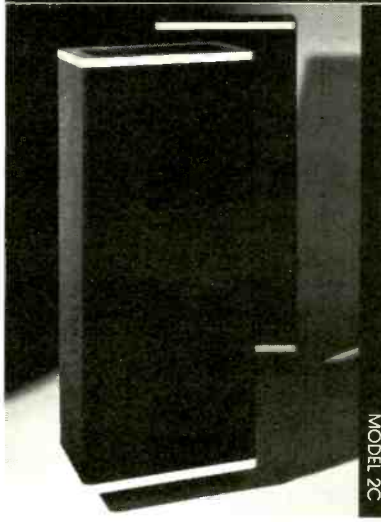

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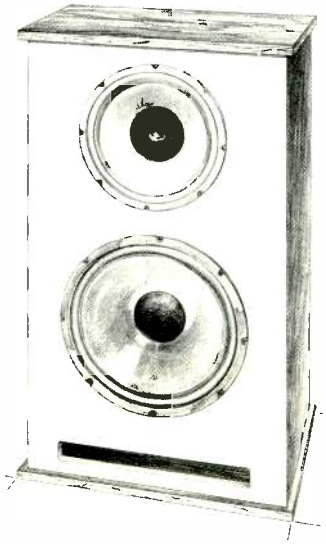

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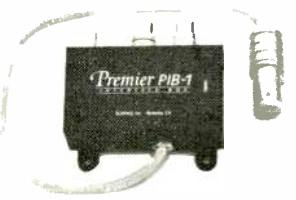

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NAKAMICHI, CARVER, REVOX, CROWN, BANG & OLUFSEN, TANDBERG, KYOCERA, N.A.D., THORENS, HARMAN-KARDON, B & W, E-V, A.D.S., DCM, KLIPSCH, AND OTHER QUALITY COMPONENTS. BEST PRICES-PROFESSIONAL CONSULTATION. ALL PRODUCTS COVERED BY MANUFACTURER'S USA WARRANTY. AMERISOUND SALES, INC., P.O. BOX 24009; JACKSONVILLE, FLORIDA 32241. EAST: (904) 262-4000; WEST (818) 243-1168.

REVOX, TASCAM, OTARI, MARANTZ recorders; E-V, Shure, Sennheiser, AKG microphones; mixers, Ampex tape, JBL monitors, dbx. Free flyer. Rick Marder, AHCo. (201) 561-8123.

PARTS & ACCESSORIES

BRISSON MI-330 INTERCONNECT, SUPERB PHASE, time coherent design; specialists in difficult terminations, flexible section tonearm sets, camacs; Goldmund, Levinson owners take note! Tiptoes with machine threading, fittings, to firmly couple to any audio product. Michael Percy, Box 526, Inverness, CA 94937. 415-669-7181.

DBP-16 INPUT ATTENUATORS provide 12 dB of attenuation for sources with too high a level. Gold plated pair, $11.95 plus $2.50 handling. DB SYSTEMS, Rindge, New Hampshire 03461. (603) 899-5121.

TUBES & ACCESSORIES WITH ADVICE on tubes, mods., system design, new & used components. Amperex, EE, GE, Gold Lion, Mullard, Sylvania, Tungsram. Exclusive US rep. Siemens/Telefunken. Great prices. Consultant/supplier to manufacturers, dealers, clubs, individuals. Douglas Kent Smith Consulting, 240 W. Pike St., Canonsburg, PA 15317-1163. (412) 746-1210.

BLANK TAPE

TAPE WORLD 1-800-245-6000

TDK		T/120/L750		HG		MAXELL	
MAR-90	5.59	TDK	4.59	5.99	SONY UCXS-90	1.85	MX-90	3.75
MA-90	3.85	TDK-HDPRO	—	8.79	SONY HF-90	.99	XLIIS-90	2.25
MXS-90	3.89	MAXELL	4.69	5.99	FUJI FR11-90	1.69	XLII-90	1.69
SAX-90	2.35	MAXELL GOLD	—	7.99	FUJI METAL 90	3.39	XLII-46	1.65
ADX-90	2.00	FUJI SONY	4.69	5.99	BASF METAL 120	5.49	UDSII-90	1.65
SA-90	1.59						UR-120	1.89
SA-60	1.40						UR-90	.99
AD-90	1.55						UR-60	.89
D-90	.99						XL135-90B	6.40
D-60	.85						UD35-90	4.99
AMPEX 456 CALL							SONY ES90	4.99

VISA, MC NO EXTRA CHARGE

48 HR SHIPPING

WE WILL BEAT ANY PRICE OF THE TOTAL ORDER INCLUDING ALL SHIPPING & HANDLING CHARGES BY 1% 3.95 SHIPPING ANY SIZE ORDER C.O.D. ADD 1.95 ALL TAPES HAVE U.S. WARRANTIES

220 SPRING ST BUTLER, PA 16001

M-F 8:30-5:00 412-283-8621

COMPLETE LINE OF TDK AND MAXELL IN STOCK

AMPEX 406 & 407 blank 1/4" tape on 10'1/2" NAB reels or 7" reels. With or without boxes. For price/quantity, send SASE to: Reels and cassettes, P.O. Box 263, Riverside, IL 60546.

CD PLAYERS

NAKAMICHI, CARVER, REVOX, CROWN, BANG & OLUFSEN, TANDBERG, KYOCERA, N.A.D., THORENS, HARMAN-KARDON, B & W, E-V, A.D.S., DCM, KLIPSCH, AND OTHER QUALITY COMPONENTS. BEST PRICES-PROFESSIONAL CONSULTATION. ALL PRODUCTS COVERED BY MANUFACTURER'S USA WARRANTY. AMERISOUND SALES, INC., P.O. BOX 24009; JACKSONVILLE, FLORIDA 32241. EAST: (904) 262-4000; WEST (818) 243-1168.

CARTRIDGES & TONEARMS

ABSOLUTELY BEST BUY MAYWARE MOVING COIL cartridges High output MC-3L/2 or MC-2V $55 with 'Vital' super-polished nude diamond styli. MKIV tonearms $69. Visa/MC. Reviews $1 Bill. Mayware, POB 58, Edgware, Middlesex, HA8 7UE, England.

SME TYPE V—The finest tonearm in the world. For the most demanding professional and commercial applications—radio stations, libraries, mastering studios, etc. For order information call or write to: **TOPOLOGY**, P.O. Box 1452, Palo Alto CA 94302, (408) 723-7404. Due to limited availability orders will be filled on a first come basis.

WANTED TO BUY

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COAXIAL, TRIAXIAL SPEAKERS OF JENSEN, Tannoy, Trusonic. Altec 604's. JBL 150-40, N500, Hartsfields. EV Patricians. Western Electric Equipments. Mcintosh, Marantz Tube Amps. David Yo, POBx 832, Monterey Park, Ca. 91754. Tel: 818/576-2642.

MCINTOSH, MARANTZ TUBE, MCINTOSH S.S. equipment, Thorens, Western Electric, Tubes, Speakers, etc. Scott Dowling, 9908 Daines Drive, Temple City, CA 91780. (818) 286-9122, evenings/weekends.

WANTED TO BUY

MCINTOSH, MARANTZ TUBE COMPONENTS, Western Electric, Altec, JBL. John Conrad, 1178 Blackbird St., El Cajon, CA 92020. (619) 449-9155.

PIONEER SA9100 AMP, TX9100 TUNER, SD1100 Scope; Sony SB500 tape selector; Sequerra tuner cheap—not working; Japanese "Stereo Sound" magazine. (818) 709-1662.

QUADRAPHONIC OPEN REEL TAPES, RECORDS (whole collections), select equipment. Michael Robin, 120 Atlanta Place, Pittsburgh, Pennsylvania 15228. (412) 341-1686.

WANTED: MCINTOSH, MARANTZ, QUAD, BROOK, A.R.C., Regency and other tube equipment as well as Altec, J.B.L., E.V. speakers and Sequerra FM1, Beveridge and older Levinson gear. Ed: (718) 377-7282.

WHAT! NOT ANOTHER AD FOR that old tube gear and speakers? You got it! Send for my pricing schedule. I buy most anything. Charlie Dripps, 4331 Maxson Rd., El Monte, PA 91732. (818) 444-7079.

BUSINESS OPPORTUNITIES

ELECTRONIC REPRESENTATIVES NEEDED!! UNLIMITED PROFIT POTENTIAL! LOWEST POSSIBLE PRICES!! OVER 100 BRANDS! AUDIO — VIDEO — CAR STEREO — COMPUTERS & PERIPHERALS! — ELECTRONIC EXPERTS, 1000 ORANGE AVE., WEST HAVEN, CT 06516.

J.P.W. LOUDSPEAKERS LTD OF PLYMOUTH Devon England seeks profit minded dealers and aggressive reps. Our loudspeakers offer outstanding value. Call today! Contact: Power Audio Distributors, Inc., 4632 Crossroads Park Drive, Liverpool, New York, 13088. 315-451-5721.

MISCELLANEOUS

INVENTIONS, IDEAS, NEW PRODUCTS WANTED for presentation to industry/exhibition at national innovation exposition. Call free 1-800-528-6050. In Canada, 1-800-528-6060. X831.

MAIL ORDER

ABARGAIN: TECHNICS STYLUS GUAGE $49, 205CMK4 $159, 100CMK4 $285, EPA500 $275, EPA250 $269, PRO LAMBDA $519, SRM1/2 $279, SIGMA $199, LAMBDA $162, SRX/3 $129, SRD7 $68, GRACE 747 $165, F9E $109, F9E RUBY $165, F9E STYLUS $60, RUBY STYLUS $110; ACCUPHASE AC2 $295, AC3 $245; DENON 103D $149, 103C $99, DL303 $199, DL304 $235; DYNAVECTOR 23RS(MR) $165, 17DS(MR) $330, 17DII $149, 20BII $159; KOETSU BLACK $450, ROESWOOD $635; FR64fx $289, FR1MK3F $139, MC45 $235; SIGNET TK50 (AT1100) $199; SERIES 20 X-OVER EXC $395; ORSONIC AV101B $22; HITACHI INTERCON 3' $30, NAMIKI DIRCT FNDR $49; ORIGIONL MFG STYLUS REPLCMET: OLD DYNAVECTOR FOR 23RS $125, 17DS $240; AC2 $210, AC3 $170; 103D $125, DL303 $140; SHIP COD; ALL UNUSED, ALL DAY (212)784-2939; (305)487-1048; (212)619-2888.

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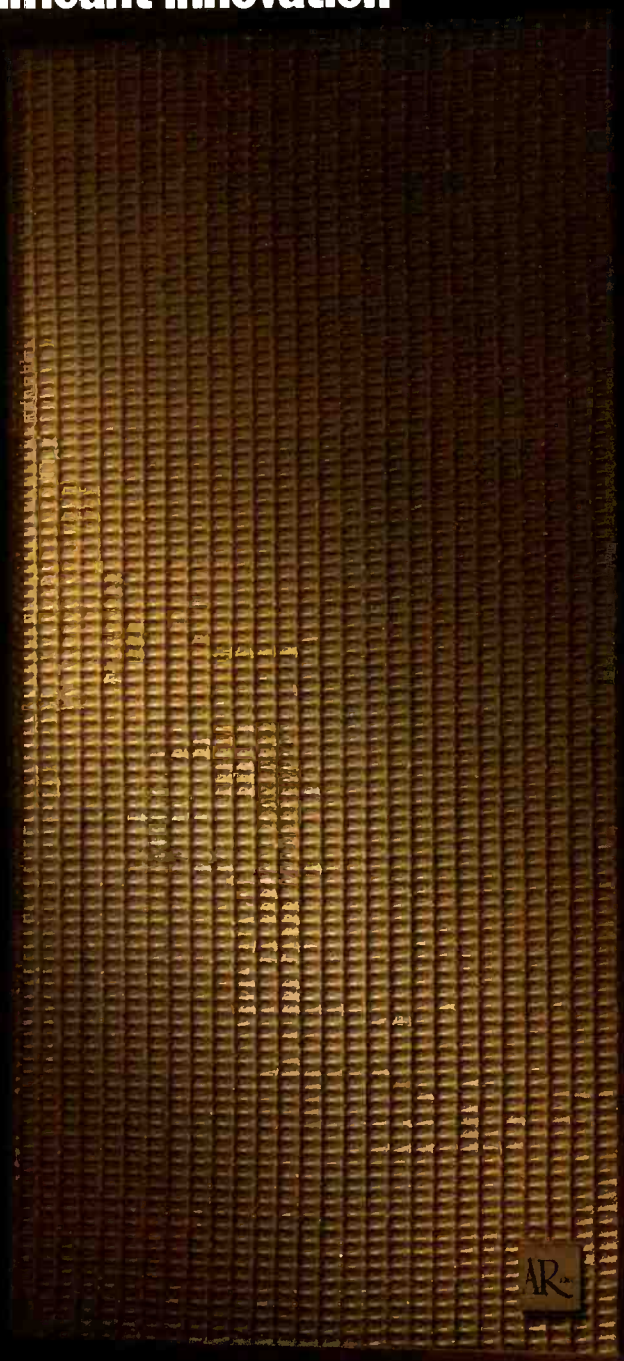
AMERICAN, BRITISH, AND JAPANESE HIGH END: SHAMEFULLY LOW PRICES, Nakamichi, Mission, B&W, KEF, Revox, Sumo, NAD, Denon, Plus Over 100 Other Brands. Information SASE Required. VISA/MC, COD. Serious Buyers Only. East 1-202/723-7404, West 1-206/325-7601. AudioWorkShop, Box 18009, Seattle, WA 98118.

BEAT THE PRICE FIXERS WITH low discount prices and full U.S.A. manufacturers warranties on: Nakamichi, Revox, Carver, Bang & Olufsen, ADS, Kyocera, HK, Crown, Hafler, B&W, NAD, Tandberg, Polk. Island Audio, Inc., 1122 Riverside Drive, Holly Hill, FL 32017. (904) 253-3456.

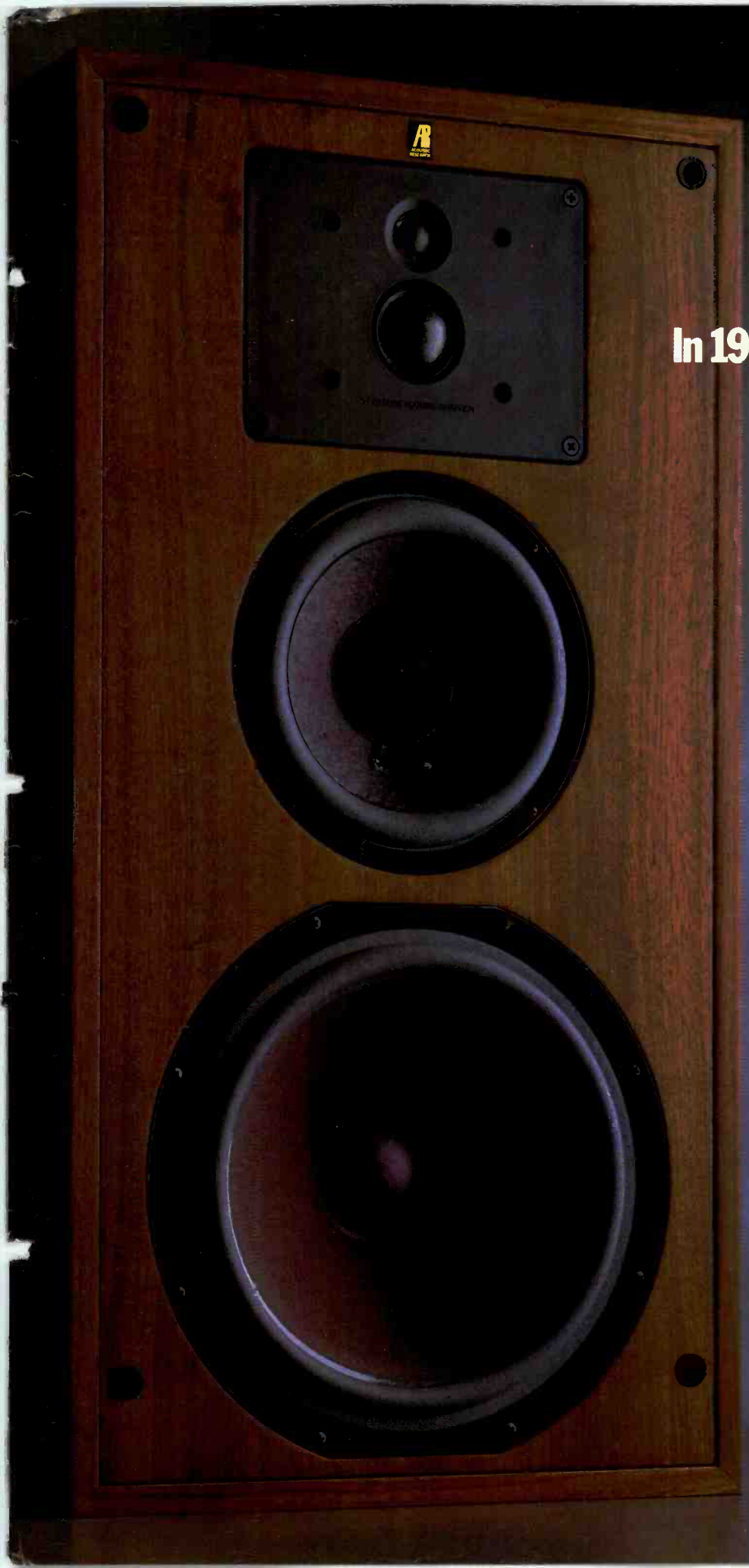
AD INDEX

MAIL ORDER

In 1954, our Acoustic Suspension was the most significant innovation in loudspeakers.



TELEDYNE ACOUSTIC RESEARCH
330 Turnpike Street, Canton, MA 02021



In 1986, it still is.

If you wanted good sound in the early days of hi-fi, you cut a hole in your wall and mounted the woofer inside. Or you built a Flared Horn the size of a refrigerator. Or bigger.

In 1954, a man named Edgar Villchur found a better way. In building the world's lowest-distortion low-frequency speaker, he replaced crude mechanical suspensions and giant cabinets with a cushion of air in a small, tightly sealed box. Called "Acoustic Suspension," the new loudspeaker reduced distortion by a factor of 10. And it was the first high fidelity speaker you could fit on a bookshelf.

To build his Acoustic Suspension speakers, Villchur founded a new company: Acoustic Research. Overnight, AR products became the most revered, most sought-after, most imitated speakers in history. In fact, over 70 different speaker manufacturers are using AR's Acoustic Suspension design today.

Since 1954, AR has substantially improved the original Acoustic Suspension speaker. By inventing the dome tweeter, introducing magnetic fluid cooling, building ¾" high-density enclosures, eliminating cabinet diffraction, and solving the problem of speaker/room interface.

AR's new BXi Series Loudspeakers for 1986 are the most highly refined speakers on today's market. And they should be. It took us 32 years to make them.

AR
ACOUSTIC RESEARCH

We speak from experience.

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The finer your audio system, the more you should enjoy it. So why confine your listening pleasure to just one room?

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