

The
Authoritative
Magazine
About
High Fidelity

Audio

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new
Compact Designs

The
Mechanical
Marvel

Directory
Of Blank
Tape

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WITH ONLY ONE EXCEPTION, THIS IS THE MOST REMARKABLE TAPE DECK IN THE WORLD.



WITH ONLY ONE EXCEPTION, THIS IS THE MOST REMARKABLE TAPE DECK IN THE WORLD.



But without exception it's the most remarkable cassette deck.

Today, a thousand dollars or more is standard fare for a professional quality cassette deck. But when Pioneer designed the new CT-F1250, they not only raised the performance standards of high quality decks, they also lowered the standard price.

Metal tape capability is something most new high quality cassette decks have in common. But while many of them have just been modified for this advancement, the Pioneer CT-F1250 has been specially designed for it.

Instead of the two heads found in most metal capable tape decks, the CT-F1250 has three. And it's these three heads that keep us way ahead of the competition.

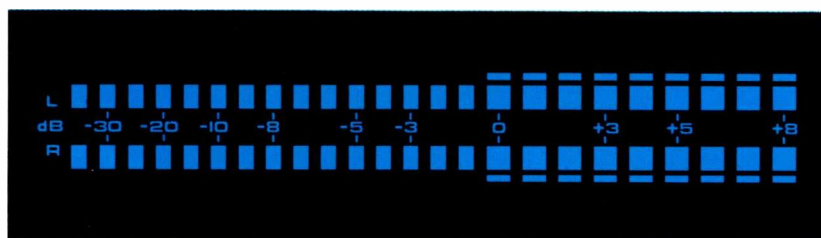
Our new "small window" erase head makes a big difference in making sure all metal tapes are wiped completely clean. And our Uni-Crystal Ferrite recording and playback heads give you greater frequency response and better wear-resistance than the ordinary ferrite and Sendust alloy heads you'll find on most other tape decks.

But you don't get distortion-free recordings just by using your heads.

Instead of the single capstan tape transport system you'll find on some tape decks that are nearly twice the price, the CT-F1250 has a closed-loop dual capstan system, similar to that found in our remarkable RT-909 open-reel deck.

This system keeps the tape in perfect contact with the heads at all times. So you are assured of getting everything that's on

Pioneer's 24-Segment Fluorescan Meter gives you an instantaneous picture of what you're listening to.



the tape. Nothing more; nothing less. What's more, the CT-F1250 has a Quartz-Locked Direct Drive capstan motor that senses the slightest deviation in speed and automatically corrects it to keep wow and flutter down to an unbelievable 0.03%.

It's engineering innovations like these that make the CT-F1250 so remarkable. But equally remarkable are the features that make the CT-F1250 so easy to operate.

Like our specially engineered Tape Calibration System that lets you quickly set bias level, Dolby adjustment, and record equalization for the best possible signal-to-noise ratio, the lowest distortion, and the best high frequency response.

And our 24 segment Fluorescan meter that works on Pioneer's own microprocessor to give you a more accurate reading of what you're listening to. It even has Peak, Peak Hold, and Average Buttons that let you record without fear of overload.

In addition Pioneer's CT-F1250 has a digital brain with a memory that controls four different memory functions. Plus pitch control. Mic/line mixing. Independent left/right input/output controls. And more.

By now, it must be obvious that the CT-F1250 was designed to push up the limits of cassette deck performance. But only Pioneer would do it, without pushing up cassette deck prices.



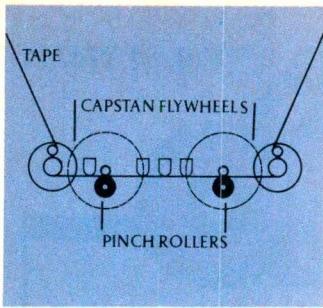
Metal tape capability for far greater dynamic range and far less distortion.

PIONEER®
We bring it back alive.

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Pioneer's easy-to-use Tape Calibration System guarantees optimum performance from every tape.



Pioneer's Closed-Loop Dual Capstan Tape Transport System ensures constant tape to head contact.

But without exception it's the most remarkable reel-to-reel.

Today, many audio manufacturers are putting a lot less into their tape decks and charging a lot more for them. But when Pioneer designed their new RT-909 open-reel tape deck they made certain it had every conceivable feature an audiophile could expect.

And one feature that was totally unexpected. A reasonable price.

Even if you pay \$1500 or more for a so called "professional" quality tape deck, you'll probably still be getting a conventional single capstan tape transport system that is prone to wow and flutter.

Pioneer's RT-909 has a specially designed closed-loop dual capstan system that isolates the tape at the heads from any external interference. So you get constant tape-to-head contact. And constant, clear, accurate sound.

And while many of the expensive new tape decks have old fashioned drive systems that drive up heat and distortion, the RT-909 doesn't. Instead, it has a far more accurate DC motor that generates its own frequency to correct any variations in tape speed. And keeps wow and flutter down to an unheard of 0.04% at 7½ ips.

What's more, the drive system of the RT-909 is unaffected by fluctuations in voltage. So a drop in voltage doesn't mean a drop in performance. The RT-909 also has a logic system that ensures smooth, accurate speed change.

Most professional quality tape decks are designed for use outside the home. So the convenience features

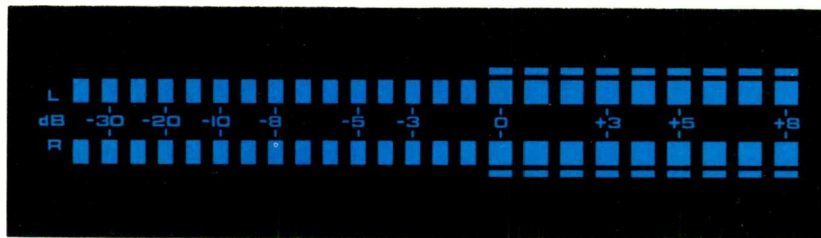
most audiophiles enjoy are nowhere to be found. The RT-909, on the other hand, offers automatic reverse, automatic repeat, and a timer controllable mechanism that lets you record a midnight concert even if you can't stay awake for it.

Examine our heads and you'll see Pioneer engineers at their very best. Our playback heads, for example, have a new "contourless" design that makes them more sensitive. They increase frequency response upwards to 28,000 hertz, and extend it all the way down to 20 hertz. So you not only get greater range than any other tape deck, but also any other musical instrument.

Of course, these features alone would make Pioneer's RT-909 quite a remarkable tape deck.

But the RT-909 also has a Fluroscan metering system that gives you an instantaneous picture of what you're listening to. A pitch control that lets you listen to music in perfect pitch even if it was far from perfectly recorded. Four different bias/equalization selections so you can use many tapes and get maximum performance from them all.

Obviously these advancements are very impressive. But there's still one thing even more remarkable than the technology we feature. It's the price we feature.



Pioneer's 24-Segment Fluroscan Meter gives you an instantaneous picture of what you're listening to.

PIONEER®

We bring it back alive.

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Independent bias and equalization for maximum performance from any tape.

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Audio

"Successor to **RADIO** Est. 1917"

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About the Cover: A nostalgic look at the beginnings of FM and record changers this month is highlighted by our cover photo of a one-of-a-kind Victrola produced during the 1920s by some highly skilled, but unfortunately unknown artisan. The piece is sturdily made from opalescent glass on a wood frame and was used in a hotel in New Hampshire. The present owner believes it is truly unique, and the piece is for sale through Irreplaceable Artifacts, 526 East 80th St., New York, N.Y. 10021. Photo by Susanne Buckler.

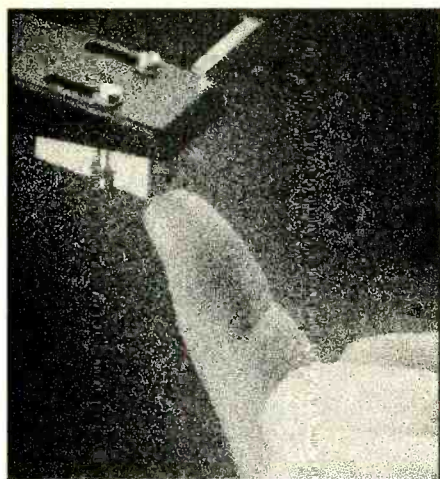


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SC-2 gives your cartridge more than The Finger!

The famous SC-1 stylus brush (standard of the record and hifi industries) now has a synergistic fluid called SC-2.

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unit that produces more than three times the energy of conventional circuits. And a new high-compliance diaphragm accurately reproduces the 20 to 20,000Hz bandwidth and improves low-range response.

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MDR

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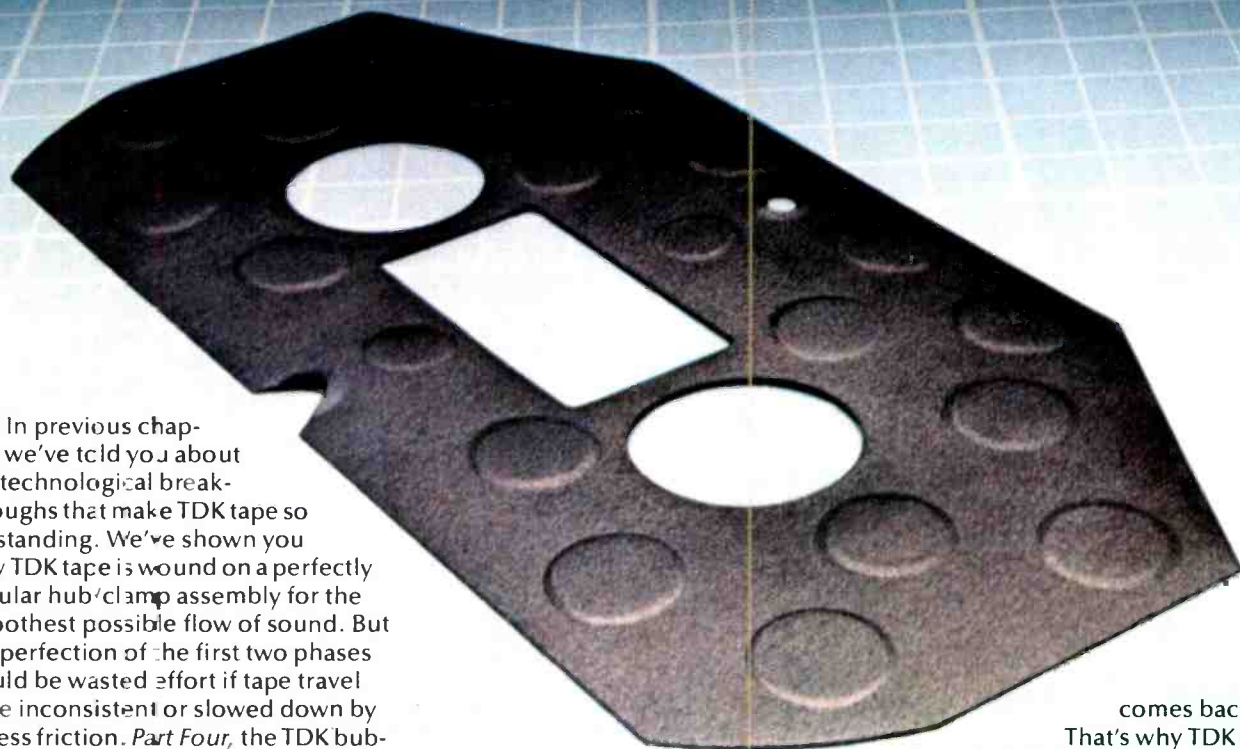
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The continuing story of TDK sound achievement.

Part Four.

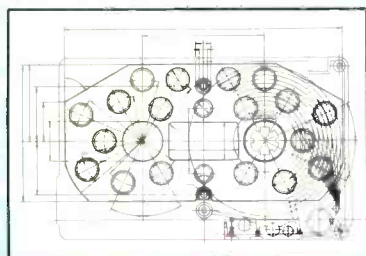


In previous chapters we've told you about the technological breakthroughs that make TDK tape so outstanding. We've shown you how TDK tape is wound on a perfectly circular hub/clamp assembly for the smoothest possible flow of sound. But the perfection of the first two phases would be wasted effort if tape travel were inconsistent or slowed down by excess friction. *Part Four*, the TDK bubble slip sheet, is one of our unique answers to reducing friction. On it rests TDK's reputation for smooth-running sound.

TDK engineers painstakingly studied tape travel. They found the edge of the tape comes into direct contact with the cassette at several points. At any of those critical spots, the tape can be slowed down, tilted away from the parallel, side-tracked or damaged. The need to reduce friction was evident. And it had to begin where the tape edge makes contact with the shell.

The TDK slip sheet first came into existence as a flat piece of paper. Our engineers knew it had to do more than reduce friction. It also had to maintain constant tape speed and perfect tape winding. Two formulations met the exacting TDK standards. Ultra-thin paper coated with silicone. And teflon

coated with a fine layer of graphite. To further diminish the area of contact between tape and slip sheet, our engineers created the bubble concept.



Running analysis of TDK bubble slip sheet.

Each TDK bubble slip sheet is computer-designed with twenty bubbles of varying diameters. Each bubble slip sheet is manufactured to micron tolerances to guarantee uniformity in height. In operation, the TDK bubble slip sheet maintains a constant running angle for the tape, minimizing friction. Tape winding is even and consistent. Your music is recorded and played back in a safe, reliable environment.

Music is what it all

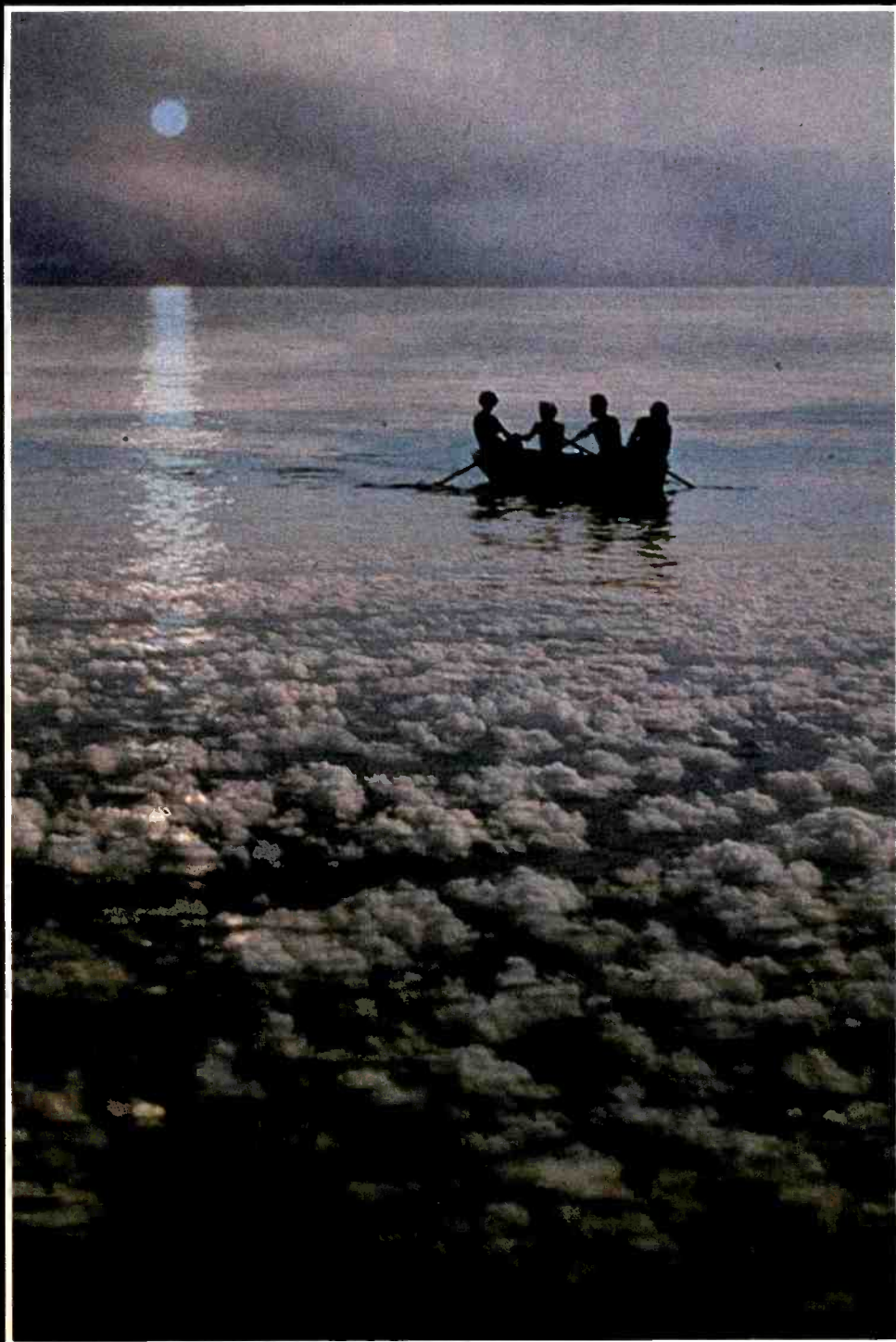
comes back to. That's why TDK considers all parts in a cassette equally important. And why every effort is made to achieve a perfect interplay between them. It's an achievement you'll hear every time you play your favorite music on TDK. Music is the sum of its parts.



TDK
The Amazing Music Machine.

The secret of Onkyo.

You'll find it in all four of our new stereo tape decks.



Let Onkyo transport you to a world beyond electronics . . . to a world of more perfect sound. Where you'll hear music of such stunning purity and richness, that you'll forget you're listening to an audio system.

That's the secret of Onkyo . . . and Onkyo's dramatic success. The unique ability to take you several steps beyond pure technology . . . to experience more exciting sound. And you'll find it in all four of our new stereo tape decks.

■ The Onkyo TA-630DM is an outstanding example. It achieves performance heights only hinted at in the acclaimed Onkyo TA-630D.

In 1979, independent testing



The Onkyo TA-630DM

confirmed that the TA-630D outperformed all 19 cassette tape decks in its price range . . . placing first in both sound quality and value. Now even more innovations have been added in the TA-630DM, to widen Onkyo's lead still further.

Not only have we designed-in metal tape capability . . . using a newly developed high-performance hyperbolic S&S sendust record/playback head . . . but we've also fully redesigned the record system electronics to take fullest advantage of metal tape's much improved dynamic range.

The feature-laden TA-630DM also employs Onkyo's exclusive "Accu-Bias" control system . . . which assures that every recording you make is superior . . . regardless of tape-type or brand.

Built-in tone generators in the TA-630DM let you sense each tape's unique bias requirements . . . guiding you to the precise setting for optimum sound. Brighter high notes are the reward.

The TA-630DM's Dolby* noise reduction system, with switchable MPX filter, even lets you decode Dolby* FM broadcast signals for more brilliant off-air recordings.

Other important features include

. . . memory rewind, full auto stop, a timer start/pause function, and two large peak level VU meters.

Throughout, the system has been engineered for extreme reliability and long service life . . . from its precise and rugged phase-locked loop (PLL) servo DC motor drive system, to its richly designed electronic control systems.

■ Equally impressive is the elegant new Onkyo TA-2050 . . . an advanced two-motor stereo cassette tape deck featuring "Accu-Bias", a Dolby* noise reduction system with switchable MPX filter, full metal tape capability, and soft touch controls. It too delivers more perfect sound.

The TA-2050 utilizes a full logic direct drive motor transport for extremely high reliability with minimum wow and flutter. A separate motor handles fast forward and rewind functions. A special Hard-Permalloy record/playback head . . . and a ferrite erase head . . . provide optimum performance with all types of tape, including metal.

Two valuable features of the TA-2050 are its instant muting and automatic fade in/fade out control systems . . . which permit far more professional recording effects. Musical passages can be "cut-n" or "cut-out" instantly. Sound passages can be "faded-out" or "faded-in" smoothly. And cassettes can be recorded right to the end . . . then reword a short bit to overlay a professional "fade-out" effect.

The Onkyo TA-2050 also features a memory-stop/memory-play system, a timer mode selector, special "peak-hold" meters for added precision and convenience, and full remote control capability with the optional RC-5 remote control unit.

■ Many of the same innovations are found in the Onkyo TA-2020 . . . a surprisingly affordable stereo cassette tape deck with "Accu-Bias" and metal tape capability.



The Onkyo TA-2050

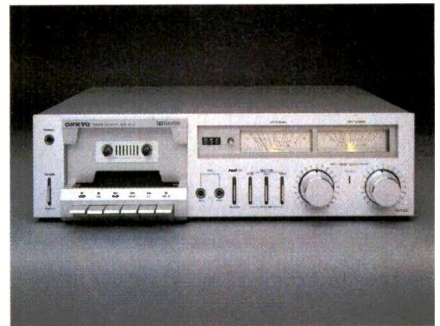


The Onkyo TA-2020

The TA-2020 features a servo-controlled DC motor, large VU meters, a Dolby* noise reduction system with built-in MPX filter, and a convenient timer/pause button for unattended operation.

Richly engineered to Onkyo's uncompromising standards, no other stereo cassette deck in its price range provides such sound quality.

■ The Onkyo TA-1900 represents an incredible achievement . . . in both performance and economy. It



The Onkyo TA-1900

puts full high fidelity metal tape stereo within easy reach of even the entry level audiophile.

The TA-1900 features simplified soft-touch controls, three position Bias/EQ switches to maximize tape performance, Dolby* noise reduction circuitry, a Hard-Permalloy record/playback head, a ferrite erase head, and a DC servo motor.

Without exception, the Onkyo TA-1900 is the most affordable quality tape deck in audio today!

■ Styling of all four new stereo cassette tape decks is superb. Brushed silver metal with elegant appointments. The TA-630DM resembles Onkyo's top-of-the-line TA-2080 . . . while the other three models debut Onkyo's dramatic new slim-line design.

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*TM of Dolby Laboratories

Audio etc.

Edward Tatnall Canby

"What is the future of classical recording?" With that somewhat grandiose question I recently began a late-summer trilogy on a subject particularly dear to my musico-audio heart, which loves the ancient LP record as a very old friend, a friendly medium that, as we all know, can never, ever, be purely digital, any more than, say, you can motorize the horse. Digital is a horse of another color altogether and, in spite of all the talk, is not yet with us. We still have the LP and will continue to make use of it during what I have called the Great Interim, until a true all-digital disc system appears at last to replace the LP forever.

A bit of recapitulation. In August I promoted what is surely my most important thought in this series to date: Why classical music is so important in the audio field and in the consumer hi-fi industry, considering that it makes up such an insignificant proportion of total recorded music sales. I've said my all on that subject and will say no more. See the August issue.

In September I took an oddball look at the immediate future of our present hi-fi sensation, the audiophile LP record, a worthy collective endeavor so full of happy contradictions that I can't see how it can avoid phasing itself out before very long, by virtue of its own success. How can you have a specialized, special-care, limited-production disc that becomes so popular that it proliferates into near-mass production? How can you perpetuate a special kind of disc for hi-fi listeners when in truth *all* first-line records should provide first-line quality?

And so the audiophile LP simply will become the expensive first-line standard LP disc as everybody and their brother applies undoubted competi-

tive skill towards successful production of better quality LP records at much higher prices. Inevitable, what with such as Columbia and RCA now joining the club, not to mention literally dozens of smaller outfits. Fun and games, as we always say, and I am all for it, whatever the chosen designation. We have needed a genuine, competitive improvement of quality in the finished LP disc for a long, long time

which right now is producing first-quality LP records at a price you won't believe if you haven't paid it — mail order.

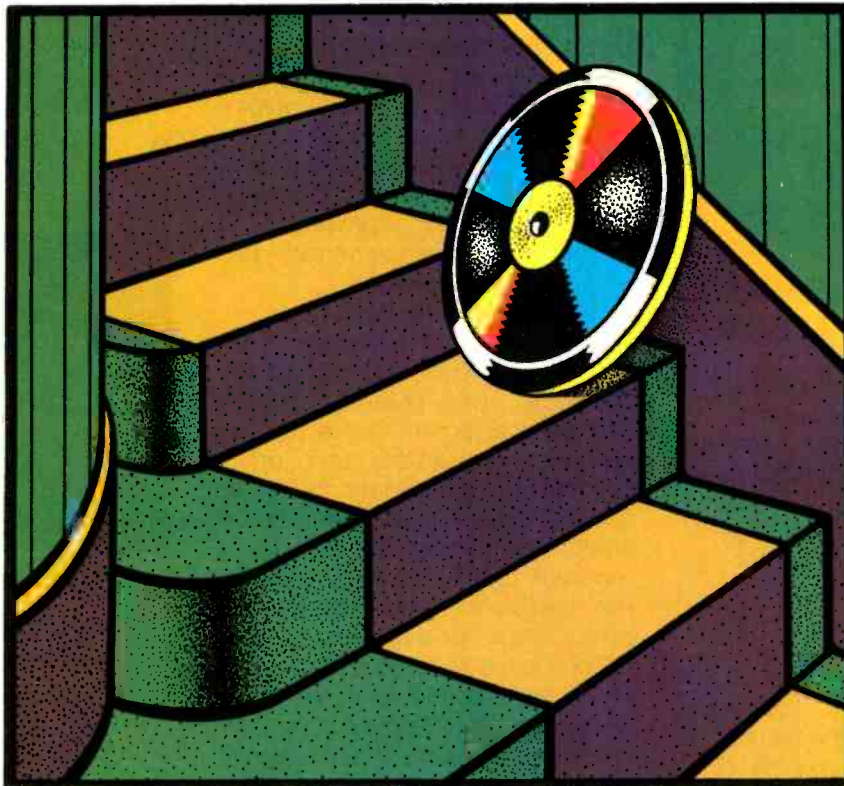
There is absolutely *nothing* we can't do in the area of better quality if we really want to apply our skills, engineering and merchandizing, with the proper acumen, and it does not really matter whether the price is extra high or extra low. It can work both ways.

I am, of course, speaking still within the present standard operation according to the LP system. The entire audiophile movement moves within that system and its very strict analog limitations. The LP is a real bottleneck but, I think, a benign one, like the bottlenecks we find in every flask of good wine. Surprising what good things can get past those narrow necks, when the product is right.

Frisco Discs?

While I'm at it, I must purvey another analogy concerning the audiophile disc. I am just back from vacationing in chilly San Francisco, the city of dizzy heights

and extreme pitches. It occurs to me that the audiophile disc is much like a San Francisco phenomenon, I noted with amusement, since I have only seen the same in European towns of enormously greater age. Paved streets so steeply inclined that there are steps alongside to keep pedestrians from sliding downhill on their behinds. In San Francisco the cars don't use the steps; they climb straight up, then veer crazily sidewise and park at an angle you don't dare believe. To get in or out of either door, up side or down side, takes an athlete's strength and a lot of courage. I really gasped as I watched two elderly tourists trying to turn their Cadillac around at the top of one such hill. The wheels were splayed out and



and if it had to come via the term *audiophile*, I am perfectly happy.

N.B. There just might come a day (disturbing thought) when a blockbuster of a still newer idea takes hold: Audiophile records at low prices. That ploy appears periodically in almost every commercial field, and if it is timed right and the product is right, there is success. Top-flight engineering can be applied in this way, too, as we ought to know. Remember Concert Hall's MMS (Musical Masterpiece) records? Remember Nonesuch at a dollar an LP, around 1963 or so? Remember Columbia's 78 price cut in the early 1930s to a dollar per shellac? And do not forget that large and quiet organization called MHS (Musical Heritage)

The best for both worlds

The culmination of 30 years of Audio Engineering leadership – the new Stereohedron®

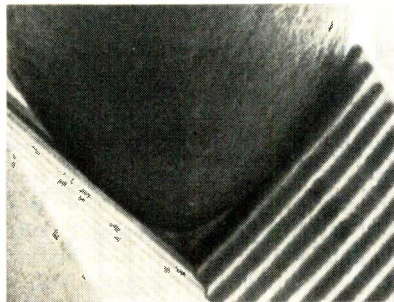
XSV/5000

One of the most dramatic developments of cartridge performance was the introduction of the Pickering XSV/3000. It offered the con-



sumer a first generation of cartridges, combining both high tracking ability and superb frequency response. It utilized a new concept in stylus design – Stereohedron, coupled with an exotic samarium cobalt moving magnet.

Now Pickering offers a top-of-the-line Stereohedron cartridge, the XSV/5000, combining features of both the XSV/3000 and the XSV/4000. It allows a frequency response out to 50,000 Hz.



The Exclusive Stereohedron Tip

The new XSV samarium cobalt magnet accounts for an extremely high output with the smallest effective tip mass. The Stereohedron tip design is the result of long research in extended frequency response for tracing of high frequency modulations. The patented Dustamatic® brush and stylus work hand in hand with the rest of the cartridge assembly to reproduce with superb fidelity all frequencies contained in today's recordings.

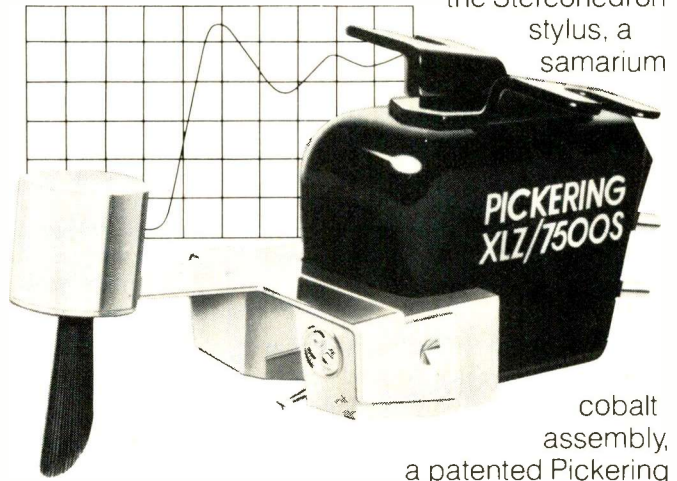
Pickering is proud to offer the XSV/5000 as the best effort yet in over 30 years of cartridge development.

A fresh new breakthrough in cartridge development designed specifically as an answer for the low impedance moving coil cartridge –

XLZ/7500S

The advantages of the XLZ/7500S are that it offers characteristics exceeding even the best of moving coil cartridges. Features such as an openness of sound and extremely fast risetime, less than 10 μ , to provide a new crispness in sound reproduction. At the same time, the XLZ/7500S provides these features without any of the disadvantages of ringing, undesirable spurious harmonics which are often characterizations of moving coil pickups.

The above advantages provide a new sound experience while utilizing the proven advantages of the Stereohedron stylus, a samarium



cobalt assembly, a patented Pickering Dustamatic brush, with replaceable stylus, along with low dynamic tip mass with very high compliance for superb tracking.

So, for those who prefer the sound characteristics attributed to moving coil cartridges, but insist on the reliability, stability and convenience of moving magnet design, Pickering presents its XLZ/7500S.



"for those who can hear, the difference"

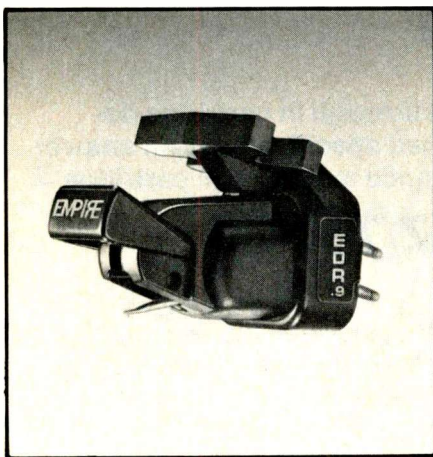
Two new sources of perfection!

For further information on the XSV/5000 and the XLZ/7500S write to Pickering Inc., Sunnyside Blvd., Plainview, N.Y. 11803.

from Pickering

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Empire's EDR.9 The Phono Cartridge Designed for Today's Audiophile Recordings



Direct-to-Disc and digital recording have added a fantastic new dimension to the listening experience. Greater dynamic range, detail, stereo imaging, lower distortion and increased signal-to-noise ratio are just a few of the phrases used to describe the advantages of these new technologies.

In order to capture all the benefits of these recordings, you should have a phono cartridge specifically designed to reproduce every bit of information with utmost precision and clarity and the least amount of record wear.

The Empire EDR.9 is that cartridge. Although just recently introduced, it is already being hailed as a breakthrough by audiophiles, not only in the U.S., but in such foreign markets as Japan, Germany, England, France, Switzerland and Sweden.

At \$200, the EDR.9 is expensive, but then again, so are your records.

For more detailed information and test reports, write to:

Empire Scientific Corporation
1055 Stewart Avenue
Garden City, New York 11530

EMPIRE



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curled under, on the shaky verge of an upset. Phew!

Those San Francisco streets and the busy cars that climb up and park precariously at the top represent the fast progress of audio and recording. (See how my mind runs on business even when I'm on vacation?) High powered and high risk, recession or no (see Whyte for August). I tried to walk straight up one such street like a car, but my feet were so bent and tortured I had to take to the steps. Ha! The audiophile disc is like one of those steps, I said to myself, gasping for breath. A sudden, all-out burst of technological progress straight up, then forward on a dynamically flat and workable plane. That's where we are in audiophile discs right now. But note that the overall rate of audio progress keeps right on climbing at the same steep angle, and pretty soon the step finds itself back at grade, and so we need another sudden step forward. Get me? I rather like the analogy.

For The Present

Of course, for that next big step we'll have to find a new name. By then, almost every LP disc will be called audiophile, just as all beers are superior products (according to the label) including the low-priced super-market specials. Just had a drink of the latter and it was lousy beer.

Now, folks, let us set our friends and relatives straight on this digital business. It used to be that my non-hi-fi acquaintances were incessantly after me, the "expert," as to what kind of a stereo they should buy at, say, \$150 for the whole. Now it's different. What they want to know now is whether these new digital discs will play on their present system. Yes, Virginia, they will play on your present stereo because they aren't digital at all. They are merely audiophile.

So please tell your intelligent, if unknowing, friends that while our present audiophile discs are indeed often superb, there is no such thing as a purely digital LP and never will be. I will not say that current publicity is mendacious, it merely misleads. All in a good cause. Everybody is hopping out there to buy expensive digital records and wondering why, strangely enough, they sound like very good LPs. What else? That's what they are, and often worth the money; you can tell 'em so.

Imagine having to write this out in an audio magazine! You think you know all about it, but go ask your aunt, whose IQ is 147, and you'll find out what I mean. A sea of digital confusion.

I do not need to speak at length — write at length — concerning the one

alternative to the audiophile disc that now exists via the LP system, to keep us all going during the Great Interim — pending true digital. I wrote at length about it in our December, 1979 issue and so did the chief purveyor of the system in a more technical article. This is, of course, the dbx-encoded LP disc, somewhat analogous to the Dolby cassette.

The reason the coded disc is important is it manages to break through the LP bottleneck as no audiophile LP can ever do, and this is in fundamental respects that take us a long way towards the ultimate parameters of the all-digital consumer disc that we do not yet have. The price is a decode circuit, at the moment only available as a separate small component, although it is handy and simple to use, but just may be an extremely minute cost in sound quality, immeasurably small (nonexistent for my ears).

For this micro-cost in sonic quality — if there really is any audibly perceptible loss — the advantages of the coded LP disc are enormous and go beyond anything that any audiophile LP can offer in a number of fundamental respects. Since my December, 1979 discussion I have heard most of the currently available coded LPs in my home via my system and the little decoder, and I continue to be enormously impressed by the potentialities of this state-of-the-audio-art system of compression-expansion, mirror image.

What advantages? Simple enough. The greatest, without the slightest doubt, is the elimination of noise. Uncanny. All audible traces of continuous LP hiss are completely removed, along with print-through and groove echoes of the sort that many of us find musically painful, however faint. Moreover, those hideous loud pops and ticks and wide smears of irregular surface noise, if not totally eliminated, are reduced to the most polite little sounds you ever heard, wholly unobjectionable. When you push the "Decode" button, you think you are turning your entire system off. Yet when the recorded music begins, it can be startlingly loud.

With an encoded LP disc there is absolutely no "turning" rhythm at all, no sense of a record being played. Just music. On my reviewer's rating scale this rates an accurate A++, as I have observed before. The coded "surface" is simply off scale. There is no surface, as far as the ear is concerned. Is that a boon!

Second (and some put this first), is the suddenly widened dynamic range. From a maximum in the 60s for even the best standard LP, the coded disc jumps out to 85 dB. That is only slightly short of the dynamic range found

We fit the same. But we perform so much better.

When it comes to fitting any audio or video recorder, there's no apparent difference between Fuji and any other brand of cassettes: we all fit the same.

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Interface: C Series II is the fulfillment of our six-year association with optimally vented speakers based on the theories of A.N. Thiele — speaker designs first introduced by Electro-Voice in 1973: The Interface: C offers you a unique combination of high efficiency and high power capacity — the only way to accurately reproduce the 120+ dB peak sound pressure levels found in some types of live music

The SuperDome™ tweeter, an E-V exclusive, and the VMR™ vented midrange driver, the first to apply optimally vented design to mid frequencies, ensure your music is reproduced without the coloration normally found in other high-efficiency drivers. An honest 30 Hz low end totally eliminates the need for expensive subwoofer assemblies.

When you spend \$1,000 for a speaker system, get your money's worth. Audition the Interface: C Series II at your nearest Interface dealer. If you want a speaker that sounds like music, the Interface: C Series II is the one you'll buy.

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on digital tapes and prototype digital discs. Sometimes, musically speaking, this is hair raising. At other times, different music, it is only marginally important. We don't always need that vast, almost-digital dynamic range for a lot of our listening — hence my reason for placing it second. Total silence is more important, not only for its freedom from aural irritation but because it brings out such marvelous tiny details in the recording, both in loud passages (greater inner clarity) and soft.

I need say no more, except to note a third enormous advantage for the encoded LP in the coming period before we get to true digital home discs. That is the fact that the encoded release can bring to the LP medium a great deal more of the original dynamic range, not to mention silence, than any standard or audiophile LP. That is what is now being done in the first updating of the encoded disc, via reissues encoded from many different record labels out of past and present top-level master recordings.


Parallel Yet Merging

Perhaps even more important is that the new digital recordings can also be and are being issued in the coded form, thereby bringing to the LP a great deal more of the digital essence than is possible through the standard audiophile LP. In fact, there is no reason why the audiophile movement and the encoded LP cannot merge, and indeed they are doing just that in a widening area of top-flight recording. You'll find alternative parallel issues, coded and uncoded, as in other

times of dynamic change in the record business.

I can easily see how this may develop. Can't you? Decode circuitry built into more and more components, eventually becoming automatic in preamp departments, as Dolby in most cassette players. A slow phase-out of standard releases in favor of encoded discs, to suit the state of current home equipment. We've been here before.

At the moment, the coded disc is not in the audio spotlight. You have scarcely heard of it. Good reason. We are still in the throes and the joys of the audiophile disc, the "digital" LP. And please, one sensation at a time. But as I say, time will pass and we will need a new and drastic step upwards in the LP if we are to keep things dynamic in the continued absence of true digital playback for consumers. As I figure it, this can *only* come via a process as sonically radical as the encoded LP disc, whether from analog or digital masters, or even direct-encoded-to-disc — how about that? I think it's entirely feasible.

So do not let the fact that present encoding is the exclusive property of one company affect you at all. Fortunately, there are many record labels being encoded with more to follow, and there is no reason why the process itself might not be licensed out, even if this company does turn out to have a technological *de facto* semi-monopoly, in the manner of the Dolby-encoded cassette. These things get around, one way or another, when the need for them is real. We are desperately going to need a next (and perhaps final) LP step. This could be it. 

OBITUARY

John E. Volkmann

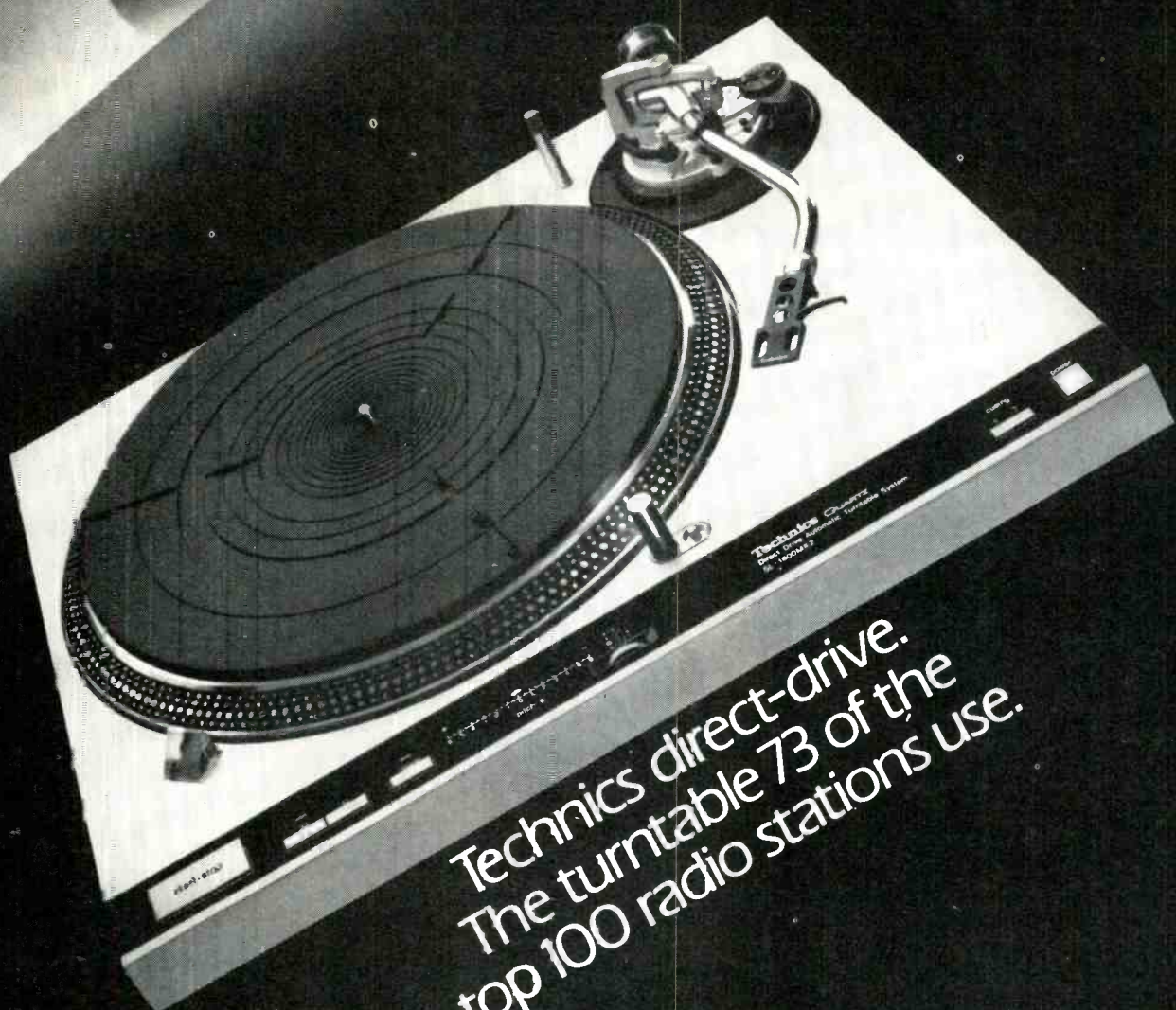


John E. Volkmann died on July 9, 1980, following a short illness. For over 30 years, Mr. Volkmann was in charge of advanced acoustic development and theater engineering activities at RCA, Camden, N.J. He specialized in the development and application of large auditorium loudspeakers and stereo sound systems and he consulted on architectural, electronic and acoustic problems.

Design and development projects on which he contributed his expertise include: Stereo sound systems for the John F. Kennedy Center, Washington, D.C.; Radio City Music Hall, N.Y.; the Hollywood Bowl; Jones Beach Marine Stadium, N.Y.; custom loudspeakers for the New York World's Fairs of 1938 and 1964, and recording acoustics for Walt Disney's "Fantasia."

Mr. Volkmann pioneered the concept of variable acoustics which he applied to the design of RCA Recording

Studios, N.Y., and he provided the acoustic design for RCA Italiana's 364,000-cubic-foot Studio A (the first and largest room ever built for recording full-scale operas and symphonic orchestras).



Technics direct-drive.
The turntable 73 of the
top 100 radio stations use.

Performance and reliability. That's why 73 of the top 100 radio stations that use turntables use Technics direct-drive turntables. In fact, of those stations surveyed by Opinion Research Corporation, Technics was chosen 6 to 1 over our nearest competitor.

Why did station engineers choose Technics direct drive? "Low rumble"—as low as -78 dB. "Fast start"—as fast as 0.7 sec. "Wow and flutter"—as low as 0.025%. "Direct drive and constant speed"—as constant as 99.998%. Perhaps one engineer said it best when he described Technics direct drive as the "latest state of the art."

But Technics state of the art goes beyond performance.

Station engineers also depend on Technics direct-drive turntables because of "reliability and past experience" as well as "quality and durability." In fact, the most listened to classical music station, WQXR in New York, has depended on Technics direct-drive turntables since 1972.

You'll choose Technics direct-drive turntables for the same performance and reliability that's made Technics the turntable top radio stations use. And there are eleven Technics direct-drive turntables from manuals, to semi-automatics, to fully automatics, to changers. Starting at \$125 to \$600 (Technics suggested retail prices). So listen to Technics and hear the Science of Sound.

Technics
The science of sound

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Recording engineers rely on Crown amps to make better music.



THE BARN Recording Studio, Alexandria, Indiana

So can you.

CROWN IN THE STUDIO

The recording engineer, who employs both art and science to create the final tape, does not listen to the music "live" while he is recording.

He wants to hear the music in the same way *you* will hear it. So while he's creating the final recording, he listens to the output of his mixer board through a carefully selected speaker/amplifier system in the control room. The system is identical to those available to you at quality audio dealers.

BILLBOARD Magazine, each year, surveys U.S. recording studios to determine brands of equipment used. Year after year, the #1 power amplifier has been Crown, selected by more recording studios to drive monitor speakers than the next three brands combined.

MIX Magazine publishes equipment lists for U.S. recording studios. Again, the favorite brand of power amplifiers is Crown. Most interesting is the fact that as you consider studios with

more sophisticated capabilities (16 or 24 track and up), the proportion of studios selecting Crown as their *only* monitor amplifier increases. The more experienced the professional, the greater is his reliance on Crown.

The music which is so important a part of your life was probably first heard by a recording engineer through a system powered by Crown amps. We think it makes good sense to use that same Crown quality when you're listening to that music at home.

CROWN AT HOME

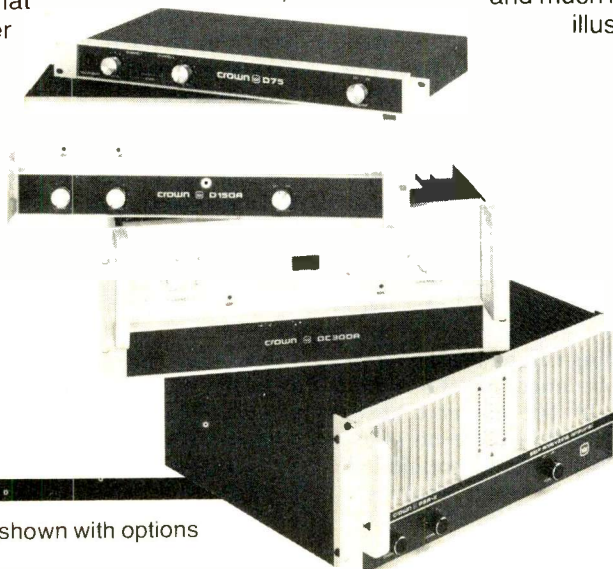
The Crown Information Package tells all about Crown and its products, and is possibly the finest collection of audio information easily available to you from a manufacturer. In over 50 pages, we have included Crown technical papers on audio concepts, discussions of product design and operation, product reviews from publications, specifications, prices, dealer locations—and much more. Many illustrations are in full color.

To order the package, send three dollars with the coupon. If it's not worth it, send it right back. We'll refund your money.

Or you can, if you wish, simply check our number on the reader service card in this magazine, and we will send you—free—a listing of nearby Crown dealers. They have much of this same information for free. They are also very knowledgeable about Crown amps, and would be pleased to spend some time discussing your needs for a better system, and demonstrating our products. It's worth your time to visit them, just to keep up with what's new from Crown.

CROWN AND GOOD SOUND

Whatever your taste in music—symphonic, acid rock, chamber music, pop, baroque, disco, opera or c & w—it will sound more like it should with Crown amps in your system. Since the good sound of your kind of music is important to your lifestyle, you owe it to yourself to check out the equipment that makes it sound good in the first place—Crown.



Product shown with options



crown

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Innovation. High technology. American. That's Crown.

TO: Crown International

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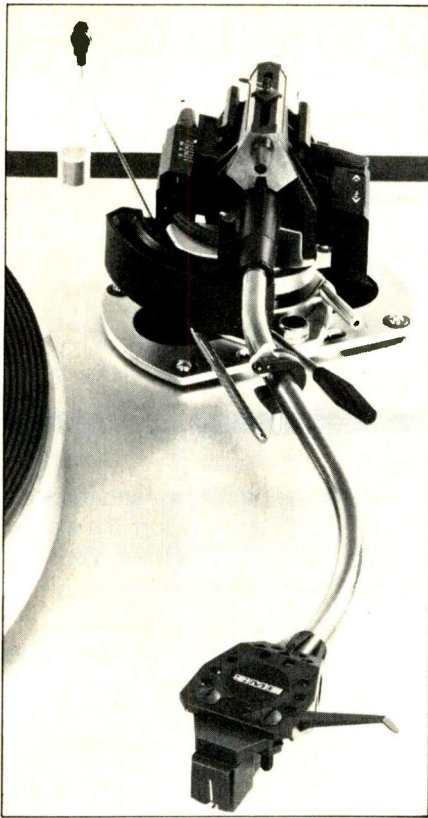
Here's my three dol!ars. Please rush my Crown amp information package.

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SERIES III + COMPATIBILITY

Series III and III S precision pick-up arms are suitable for all cartridges having $\frac{1}{2}$ " fixing centres, weighing not more than 12 grams and requiring a tracking force not higher than 2.5 grams. They are adaptable to suit the mass and compliance of the cartridge, which may employ a moving coil, moving iron, moving magnet or any other generating principle.

Series III arms are true low mass designs with headroom to increase effective mass as desired whereas with high mass arms reduction is generally impracticable.

We shall be pleased to send you information sheet No. 24 which tells you how to adjust effective mass to suit your cartridge. It could make all the difference to your listening.

SME

*The best pick-up arm
in the world*

Write to Dept 1461, SME Limited,
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Exclusive distributors for the U.S.:
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and in Canada:
A. C. Simmonds and Sons Ltd,
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Ontario, L1W 3B2

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Dear editor

Auto Suggestion

Dear Editor:

I agree with everything Bob Curtis said in the July, 1980 article "Keep Your Car Stereo Safe" and I would like to add the following suggestions: 1) Mount speakers as inconspicuously as possible — although my car has four speakers, not one of them is visible. 2) Never ever park your car while music is pouring out because it will alert the entire neighborhood that you have a high-powered stereo. 3) Get a hide-away (even motorized) antenna, or lower your antenna as far as possible.

The point I'm making is — keep a low profile and keep your car stereo!

Alan Crawford III
Devon, Pa.

More on Record Wear

Dear Editor:

In light of our recent research comprising literally thousands of staff hours with Discwasher's scanning electron microscope, we feel that the September article "Close Up View of Record Wear" contains largely incorrect interpretations of the SEM photos. Our experience indicates that Mr. Davies has not photographed "holes" or "conchoidal fractures" but rather dirty records and vinyl pressing defects. We are in communication with another laboratory whose work with electron microscopy on phonograph records confirms our interpretation.

A detailed analysis of each photo would be too lengthy for this letter but a few critical points can be made here. The stylus contact zone is shown in many of the photos, and conchoidal fractures are absolutely impossible at positions significantly higher or lower on the groove wall than the stylus contact area. Yet Mr. Davies names all of the similar-looking debris in the picture as holes or conchoidal fractures. We can replicate his SEM photos with dirt on unplayed records.

Groove shading can be readily interpreted with experience, and the "lighting direction" of the electron beam clearly shows the "holes" to be shaded identically to groove modulation ridges. Analysis by seven engineers from two different laboratories, all very experienced in SEM work with re-

cords, interprets the "holes" and "fractures" as actual mountains of debris!

Two of the photos are presented upside down, and three photos clearly show stamper-vinyl separation and flow problems. Nevertheless, we believe the presence of dust and debris unquestionably is destructive to record surfaces. Mr. Davies only reinforces the fact that cleaning with isopropyl alcohol does not pick up these destructive contaminants, but may actually "glue" debris to the vinyl.

Bruce R. Maier, Ph. D
Discwasher Laboratories
Columbia, Mo.

Hats Off to Prof. Lirpa

Dear Editor:

It seems what many audiophiles want is some sort of audio "nirvana." Since most manufacturers are only able to offer real products, it is not merely *refreshing* to review the product offerings of Lirpa Labs, but damn near *enlightening*. (See April, 1980 issue.)

Could there possibly be a more different drummer than the one lashing about in Prof. Lirpa's cranium? Professor, my hat is off to you.

Jay Mitchell
Columbus, Ohio

Tracking Down Capacitance Alarm Systems

Dear Editor:

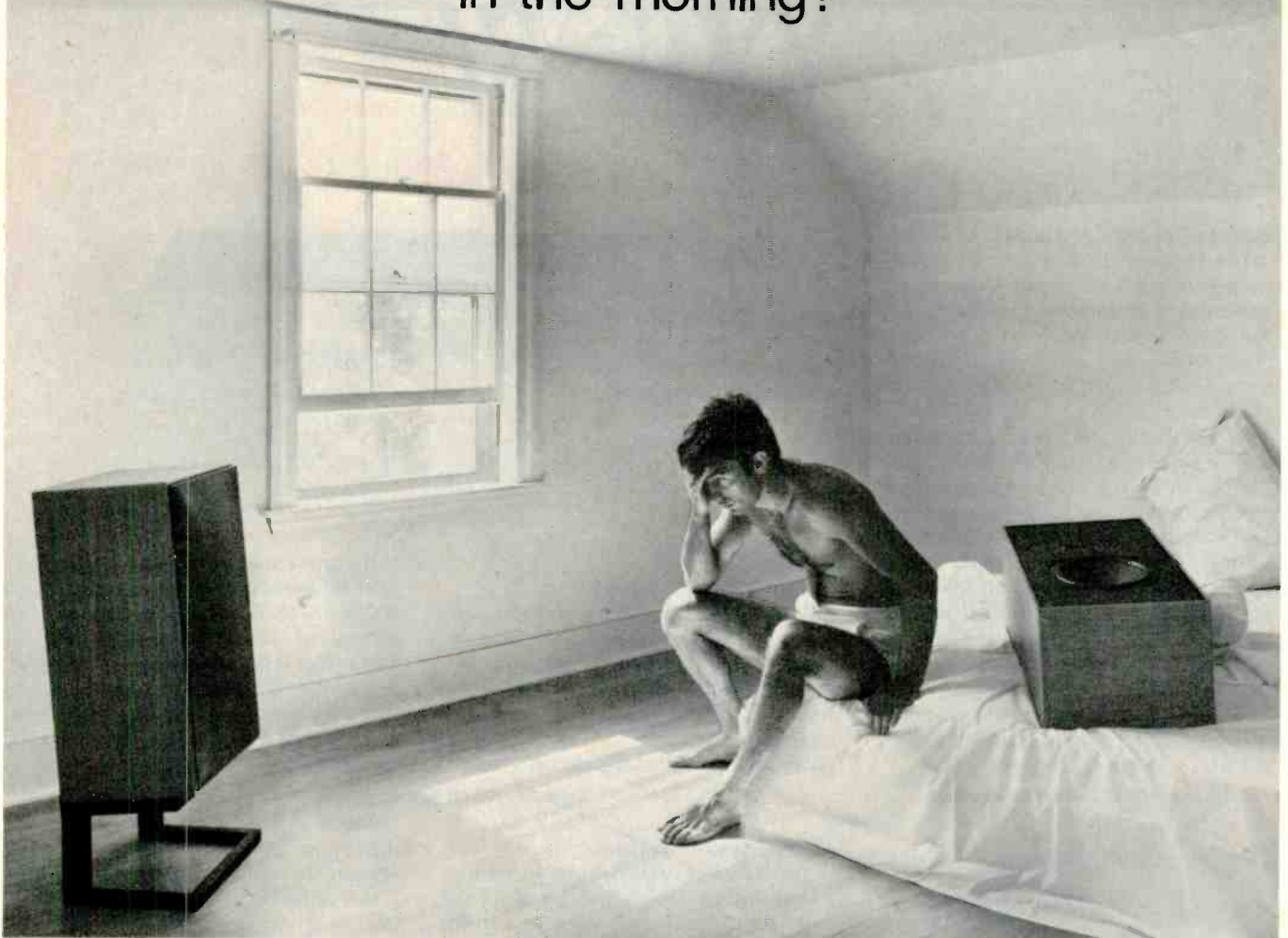
In the July, 1980 issue, there is an article entitled, "Keep Your Car Stereo Safe." In the article, the author, Bob Curtis, mentions a type of alarm system I have not heard of — a capacitor system which reacts to human touch.

I have not found anything like this for sale in all the years I have been buying alarm systems for car and home. If you have any knowledge of where I can purchase such a system, please let me know.

Eugene S. Sandow
Inglewood, Ca.

The Editor Replies: Mr. Curtis tells us that the Mosler Safe Company sells the capacitance type of alarm system. Alternatively, you might try writing to *SDM Magazine* (Security Distributing & Marketing), 5 South Wabash Ave., Chicago, Ill. 60603 about other firms which offer such a system.

Will you still respect your speakers in the morning?



Sure, they sounded great last night.

But the real test of a speaker system is the morning after.

Will your speakers sweeten your morning coffee with Vivaldi, or will they make you wish you'd never turned your stereo on?

Do your speakers make you glad you're alive, or do they serve only to remind you of last night's excesses?

Some speakers are impressive when played loudly. But a truly great speaker is equally, if not more, impressive at low listening levels. "Loud" is desirable at times, but a speaker to be lived with must do much more.

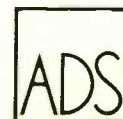
For years, and without fanfare, ADS has been building monitor speaker systems for some of the most demanding sound engineers in the music industry. ADS technology is uniquely able to accommodate their diverse and challenging re-

quirements. This same technology, not surprisingly, produces some of the finest speaker systems available for home use.

The new ADS L730, for example, is a direct outgrowth of ADS' continuing involvement in digital recording technology. An unusual combination of extended fre-

quency range, uncanny sonic accuracy, razor-sharp stereo imaging and true-to-life dynamic range, the L730 delivers untiring musical performance. Although the system is capable of shaking walls with clean, undistorted sound, you'll appreciate it most on those mornings when quality counts more than quantity.

The L730 is only one of many ADS speakers, all meticulously engineered and superbly crafted. Your ADS dealer will be happy to help you select the model which best suits your purposes. For more information and the name of the ADS dealer nearest you, please write ADS, Dept. AU-20, or call 1-800-824-7888 (California 1-800-852-7777) toll free and ask for Operator 483.



Audio for the
critically demanding

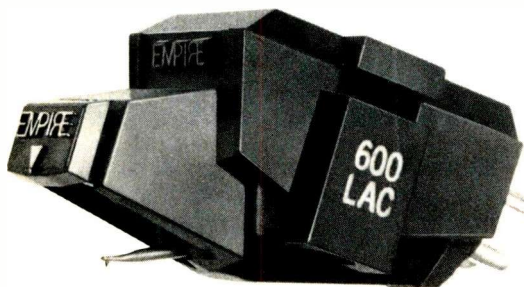
Analog & Digital Systems, Inc., One Progress Way, Wilmington, MA 01887 (617) 658-5100

What's new

Empire Phono Cartridges

The Dynamic Interface series of cartridges includes six models embodying engineering techniques which allow the cartridges to be used with optimum results in a wide variety of systems. Specific design achievements include a reduction of mass by 20 percent for better tracking, particularly with warped discs, inclusion of samarium cobalt magnets for higher output, electrical matching to the low-capacitance cables and phono inputs for smoother frequency response, and a two-point stylus-lock system for proper orientation. The top-of-the-line Model 600LAC has a specified response of 6 Hz to 50 kHz and separation of 30 dB at 1 kHz and of 17 dB at 12.5 kHz. Recommended tracking force is 1½ grams, and tracking ability at 1 kHz is 38 cm/S. Price: \$175.00.

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Adcom Power Amplifier

Model GFA-1 stereo basic amp is rated at 200 W average per channel into 8 ohms over a 20 Hz to 20 kHz bandwidth at 0.05 percent THD. A Balanced Bridge (TM) configuration is used for accurate and symmetrical output of both the positive- and negative-going waveforms, while the toroidal transformer minimizes stray magnetic field effects for lower hum and noise. Other specs, per IHF-202A, are a damping factor of 200 at 100 Hz, slew rate of 80 V/μs, and S/N of -90 dB at 1 W, "A" weighted. Features include built-in whisper fan, overload protection, and thermal sensing relay. Price: \$400.00.

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Beveridge Preamp/Power Supply

Model RM-1/RM-2 incorporates circuitry featuring wideband, accurate RIAA equalization (1 Hz to 100 kHz, ±0.05 dB) and over 120 dB of dynamic range. The RM-1 preamplifier uses only vacuum tubes in the signal paths, with solid-state circuitry to in-

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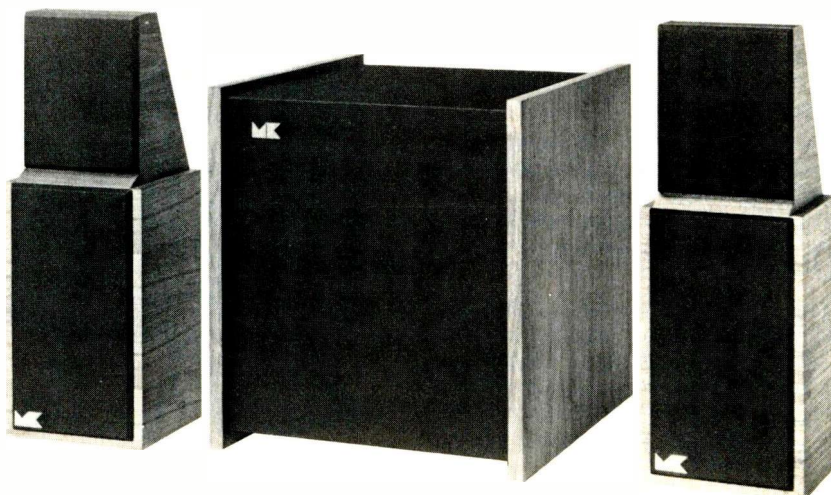
sure operating point stability. Specified frequency response is 0.15 Hz to 600 kHz, ±0.05 dB, with a maximum output of 10 volts and 0.02 percent THD. The separate power supply, RM-2, provides 80,000 μF of capacitance to three regulated stages. Each unit measures 9 x 3½ x 9 inches. Price: \$2,500.00 for both units.

M&K Speaker System

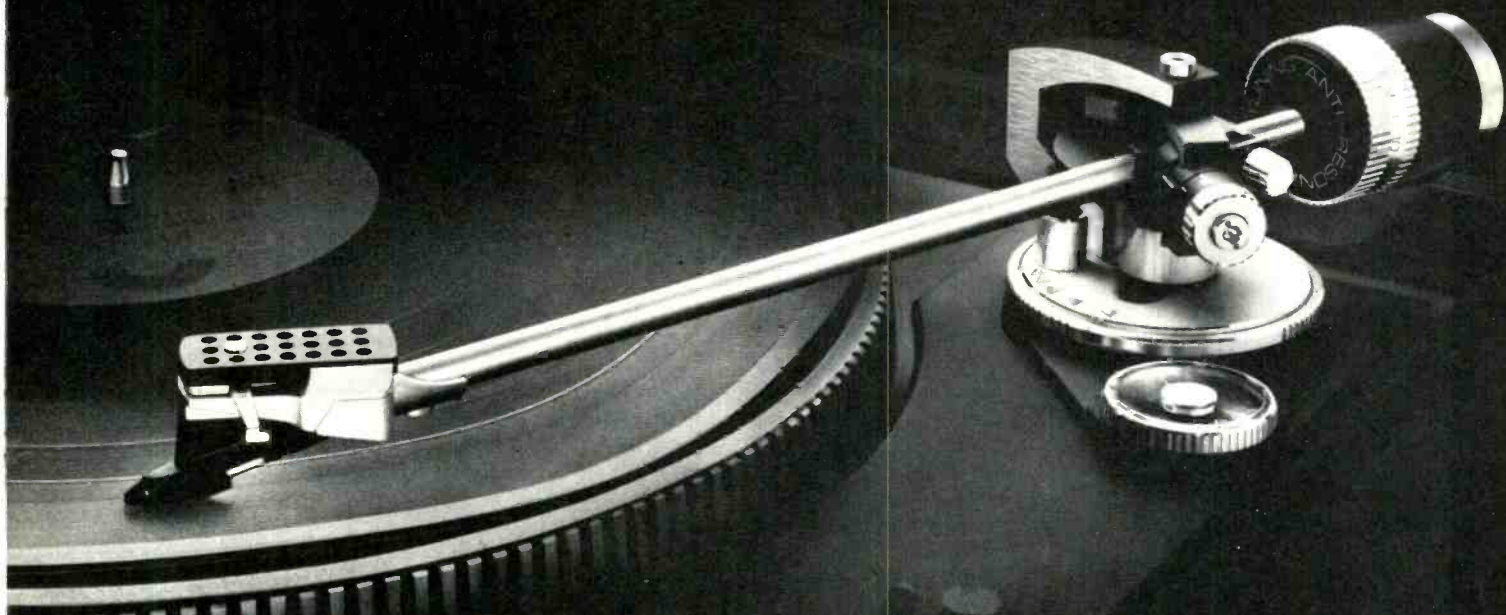
The Satellite-Volkwoofer system is a three-piece design incorporating the Satellite-1 units which are designed for minimum diffraction for good imaging and transparency, and feature group delay alignment via physical displacement and crossover circuitry to 0.02 mS for smoother transients and accurate imaging. The Volkwoofer is an

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internally amplified, servo-feedback system intended for bi-amplification and features a 50-W amp, switch selection of any of three response settings, and a separate volume control. Crossover to the S-1 is at 100 Hz, and response above that point can be selected from four separate input networks and adjusted by means of two high-frequency contours. Price: \$895.00.



Test labs now use
an extraordinary new instrument to
evaluate record playback performance.
A warped record.



Magazine test reports are usually based on measurements made with professional equipment and under ideal laboratory conditions. None of which matches the real-life situation you face at home.

Virtually all records manufactured today are warped. And even records that are slightly warped can make conventional tonearm and cartridge combinations typically 18 grams effective mass distort badly and even leave the record groove.

The test labs know this, of course, which is why they tried something different with Dual's 8-gram Ultra Low Mass tonearm and cartridge system. They added an innovative test instrument to their scopes and meters.

A badly warped record.

The results of this new test are not reported as percentages, decibels or other technical argon, but in clear and understandable language:

"Navigating the worst warps we could find the Dual/Ortofon combination proved very agile indeed, with nary a mistrack."
High Fidelity

"... tracked the most severely warped records in our collection, usually so well that we heard nothing wrong."
Stereoc Review

"Even a severe warp that would normally throw the pickup into the

air will usually give no more than a slight 'thump'... and most warps are undetectable by ear."

Popular Electronics

"The Dual takes dead aim at the fiend of disc reproduction—the warped record—and response to record warps practically is eliminated at the source."
Stereo

One test lab, after making the usual measurements, chose to just listen to music as reproduced by ULM.

"There is no way measurements, or mere words, can describe the acoustic presence of this record player... highs are crystalline, with a purity we haven't heard before. The bass is so clean that one can hear new sounds from records, such as the harmonic vibration of unplayed strings on the double bass... overall definition and transient response were outstanding."
HiFi Stereo Buyers' Guide

You too can hear the difference ULM makes. Visit your local Dual dealer and be sure to bring your own "test instrument." Especially one that seems unplayably warped.

U.L.M.

A major breakthrough in record playback technology.

Write for our brochure describing all the Dual ULM turntables. Prices start at less than \$190. United Audio, 120 So. Columbus Ave., Mt. Vernon, NY 10553.

Dual

Tape guide

Herman Burstein

Warbling Saxophone

Q. I play the alto saxophone and want to make cassette recordings of it. With each one of several top-flight cassette decks, an odd fluttering or warbling tone develops. The notes come out as though burbling through water. In addition to trying different tape decks, I've tried various types of microphones and tapes, and I have even tried recording at levels so low that the tape hiss is louder than the music. Nothing helps. Any advice would be greatly appreciated. — David Altic, Newport, Vt.

A. Your problem is a baffling one, and I don't have a sure cause or cure. Possibly your playing of the sax is somehow accompanied by a subaudible frequency that drives the record amplifier into "blocking," as sometimes also happens when trying to record a phono disc with substantial warp.

There are subsonic filters on the market which cut off sharply below 20 to 30 Hz. Placing one of these between the cassette deck and a preceding component such as a mixer might help. Another strategy might be to first record an open-reel tape and assuming this is successful then dub from the open-reel tape onto cassette. I have found this a worthwhile tactic when trying to make cassette recordings of severely warped records; direct recording from disc onto cassette resulted in a burbling sound similar to the one you describe.

Leveling an Organ

Q. Recently I purchased a battery/a.c. portable cassette recorder, which I use to monitor my electronic organ. However, I find that the recorded music is quite distorted. This distortion occurs at any organ output level. The recorder has auto-level control. No distortion occurs when recording music at any output level from a radio or TV speaker. In each case the microphone is placed near the speaker. Can you tell me what is causing this and if the condition can be corrected? — M. W. Van Lenter, Clifton, N.J.

A. My guess is that when you are recording from the organ you are dealing with a much bigger and better speaker than when you are recording

from radio or TV. If the organ speaker delivers powerful bass notes, perhaps even sub-audible ones, they may well be overloading your cassette machine. If the auto-level control cannot be deactivated, I am afraid that the only suggestion I have is that you try another cassette machine, preferably one without auto-level control.

What's Digital?

Q. What specifically is digital recording? Does it mean that the recording was done on equipment equipped with digital accuracy, or does it mean something entirely different? — Scott Barber, Douglas, Wo.

A. In conventional tape recording, the audio signal is recorded on the tape in the form of a series of bar magnets which are an analog of the audio signal: The higher the frequency, the more bar magnets per inch of tape; the greater the amplitude, the greater the strength of these magnets.

In digital recording, the audio signal is sampled about 45,000 to 50,000 times per second, and each sample is translated into a number that shows the value of the signal voltage at a given instant. These numbers are recorded on the tape. In playback, the numbers are reconstituted into a signal voltage.

Compared with conventional (analog) tape recording, digital recording permits lower distortion and much higher S/N ratio — something like 90 dB compared with about 65 dB (at best) for conventional recording. However, digital tape machines are still very expensive, some of them costing upwards of \$100,000, so it will be a while before home digital machines are commonplace.

An important advantage of digital recording for commercial use is that it enables successive copies to be made of a master tape without loss in terms of S/N ratio. In contrast, when using conventional recording, noise increases about 3 dB with each successive copy, unless distortion is allowed to rise. Since commercial prerecorded tapes represent about a third or fourth copy of the master, the copy one buys may have 12 dB more noise than the master. However, if digital recording is employed at all stages up to and in-

cluding the final one, where the digital recording is translated into a conventional prerecorded tape, this tape can have a much better S/N ratio along with low distortion.

Mating Plugs

Q. A few months ago I ordered a remote control unit for my tape recorder. When the unit arrived the male plug on the remote cable didn't match the socket in the deck, even though the plug was marked with the proper part number. The plug has only four prongs, while the socket has holes for eight prongs. What should I do? — Les Gueydan Jr., Metairie, La.

A. The fact that the remote control plug has only four prongs, while the mating socket has eight holes, does not necessarily signify anything wrong. Four prongs are probably sufficient to perform the remote control function. If the plug and jack fit each other, the control device should work.

Magnetometers

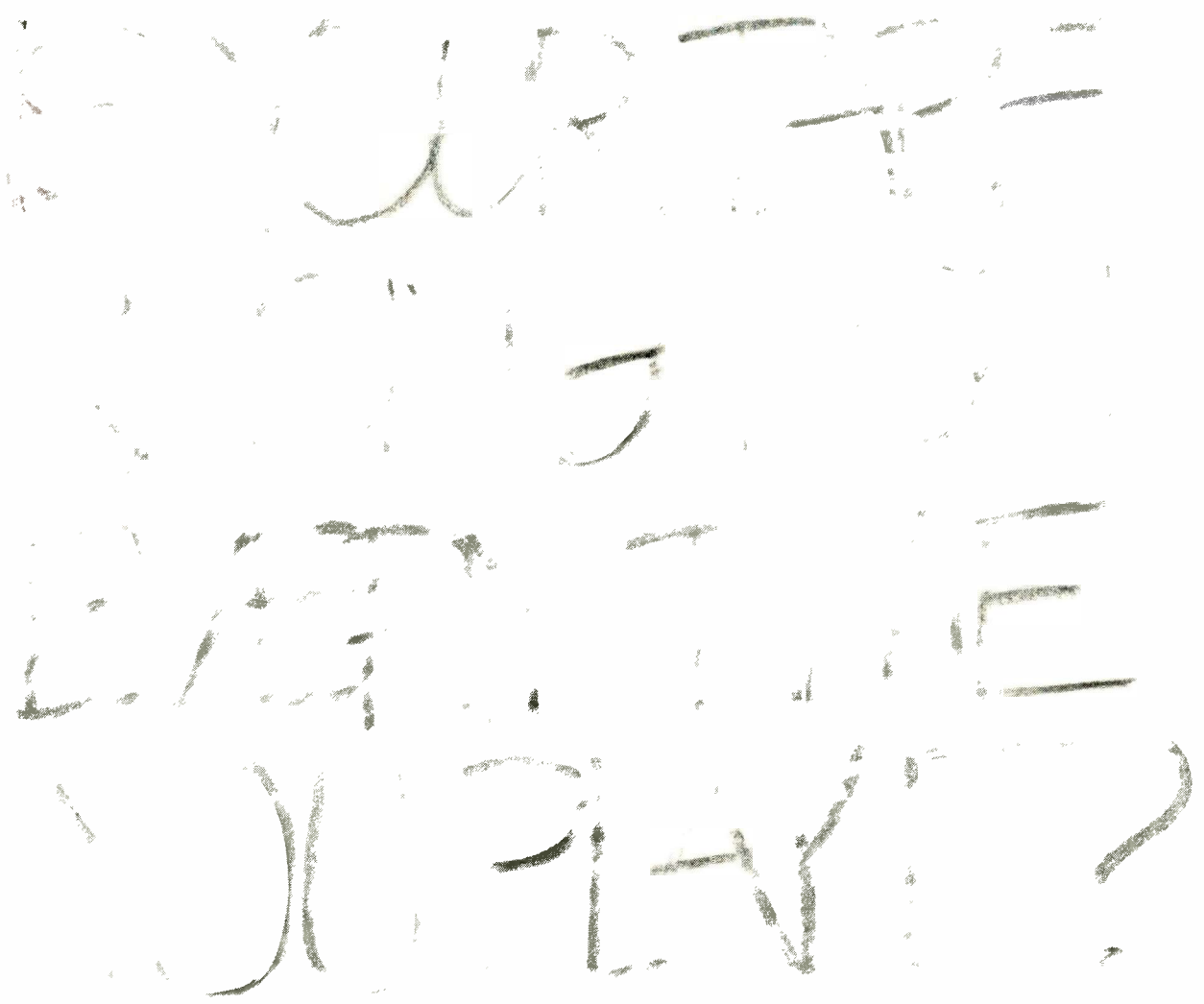
Q. Quite some time ago I read about a company that makes a pair of magnetic devices useful to the home recorder, consisting of a magnetic field strength meter with a zero center scale. Unfortunately I cannot remember the name of the manufacturer and his address. Can you supply these? — James Baumgartner, San Francisco, Calif.

A. Pocket-sized magnetometers, of two different degrees of sensitivity, are available from the R. B. Annis Co., 1101 No. Delaware Ave., Indianapolis, Indiana 46202.

Tape Tension and Dropouts

Q. With a Revox A-77 I am experiencing dropouts. I find the effect most disconcerting, and it ruins my listening, knowing that these dropouts will occur and waiting for them. After a while, I can't help listening less to the music and more to the dropouts — most upsetting! I have used tapes of

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different thicknesses, and the problem persists. An associated problem is both channels periodically fade out, as though the balance were shifting. Is this the fault of the tape or the machine? Can anything be done to remedy the fault? —C.F. Gaetjens, Glenelg, South Australia


A. Your dropouts may well be due to the lack of good contact between the tape and the heads. Adjustment of tape tension is where to start. You mention that either channel appears to fade out slightly. This may relate to your dropout problem, that is, the tape may be making poorer contact with one gap than with the other — usually poorer contact with the upper (left channel) gap. The reason for this may lie in improper tape tension, incorrectly mounted tape guides, tape guides of improper width, or in other things that affect the path traveled by the tape and its contact with the heads. I'd look at these areas closely.

Bias vs. EQ Adjustments

Q. I have noticed that some of the cassette decks have only a bias adjustment switch, while others have an equalization adjustment as well. I know what each one does. What I want to know is, which one of these controls has the biggest advantage as a fine adjustment. — John Stokes, APO 96358.

A. It might be best to begin with a review of the purpose of these switches. Some cassette decks have a single switch that adjusts both bias and equalization according to the type of tape used. Other decks have separate switches for bias and equalization. The latter design is somewhat more desirable because it offers more flexibility to those seeking flattest possible response with a particular tape.

The purpose of bias current is to reduce distortion and to increase the amount of signal recorded on the tape. Bias is applied only in recording. The purpose of equalization, which is applied both in recording and playback, is to compensate for treble and bass losses that occur in the record-playback process. The amount of bias and the amount of equalization required vary with the brand and type of tape employed.

Bias adjustment usually has the greatest effect. Relatively small changes in bias can substantially alter treble response, as well as affecting distortion. It is difficult to say that one or the other has the "biggest advantage" because both are important, and they should probably be changed together to get the most accurate fine tuning. 



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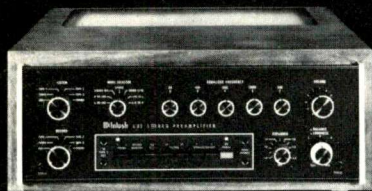
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Joseph Giovanelli

Current vs. Voltage

Q. I have never understood the statement and applied practice that, in the output stage of an amplifier, we are more interested in power than in voltage and therefore want a great flow of current rather than big changes of voltage. The way I see it is as follows: If power is the product of voltage and current, it does not make any difference which is increased. If we want a lot of current to flow through the loudspeaker, that is another story. Most present-day hi-fi systems have multiple speakers with crossover networks, and these networks incorporate capacitors in series with the voice-coil of the speaker. So what does the loudspeaker see? It would appear to see only the modulation voltage superimposed on the d.c. of the output stage. No current can flow through the capacitors.

The actual power is really that of the permanent magnet. The bigger the magnet, the higher the power. The greater the modulating voltage affecting the magnetic field, the greater the interaction.

Obviously, there must be something wrong with my analysis.—N. Brenes, Brooklyn, N.Y.

A. While an electrostatic speaker requires considerable voltage at low current in order to move its diaphragm, the conventional loudspeaker, employing a voice-coil, requires relatively low voltage at a comparatively high current. Both of these speaker types require power. The magnet in the speaker using a voice-coil does not supply power; that is the job of the amplifier to which the speaker is connected. The magnet supplies a steady field which is alternately aided and opposed by the variations in the magnetic field produced by the voice-coil. The voice-coil is an electromagnet whose polarity reverses as the a.c. polarity reverses. This changing field is alternately attracted and repulsed by the fixed field of the permanent magnet in the speaker. Any electromagnet is created by what are known as "ampere turns." The number of these ampere turns is found by multiplying the number of turns in the voice-coil by the number of amperes flowing through the coil. The strength of the electromagnet is directly proportional to the number of ampere turns.

You stated that voltage is the important consideration because a capacitor cannot conduct and capacitors are used in multiple speaker systems. As a matter of fact, capacitors can and do conduct current. (One might say that current flows "around" the capacitor, rather than through it as is true of a piece of wire.) Usually we do not think about the amount of current taken through a capacitor because the circuits with which we are most familiar are those in which the capacitor feeds a high resistance which will not draw much current. The resistor does draw some current, however, even when it is as high as you would care to make it.

To illustrate the point, assume that we have an 8-ohm resistor fed by a capacitor which, in turn, is fed by a suitable amplifier. Let us assume further that a signal is applied to the amplifier. In this example, we will assume that as a result of this signal, four volts appear across the resistor. If there is a voltage across this resistor, current must flow through it. Ohm's Law shows us that the current under these conditions is 0.5 ampere. By definition, one volt is that amount of electrical pressure which will force a current of one ampere through a resistance of one ohm. Accordingly, we can see that if we have a resistor and can measure a voltage across it, that voltage could not be present without forcing current through the resistor.

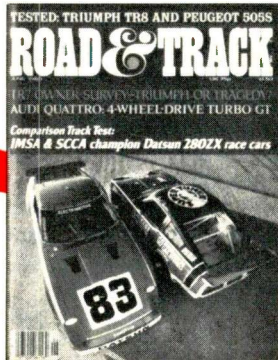
Again by definition, power is the amount of work being done. The work, in the case of a loudspeaker, is the movement of the cone against the resistance of the air, of the suspension system for the cone, and of the voice-coil, plus the heat produced in the voice-coil itself. Work, or power, is expressed electrically by multiplying the resistance by the square of the current. It can also be expressed by multiplying the current by the voltage. Power can also be found by dividing the square of the voltage by the resistance. All of these methods will give the same answer, provided that all of the numbers are the same for all examples. No matter what method you use, you will see

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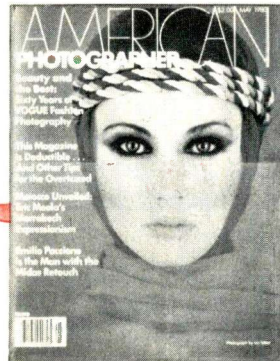
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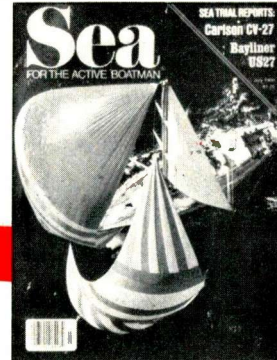
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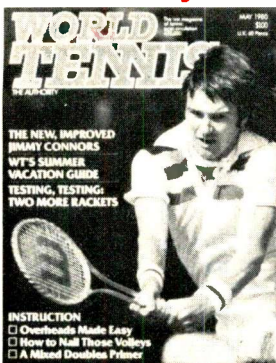
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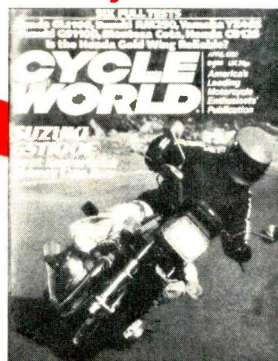
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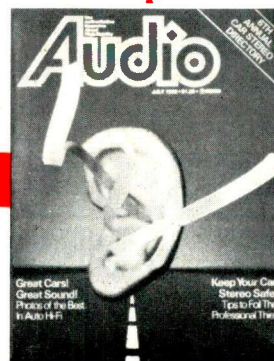
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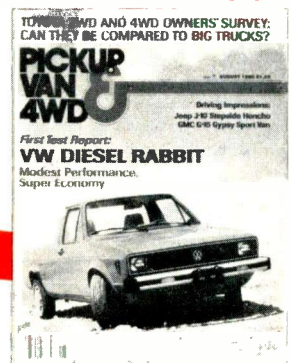
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that, in our example, two watts of power are being consumed when we have four volts across an 8-ohm resistor.

Channel Imbalance

Q. I have a question regarding balance control settings. At present I must keep this control at approximately its two o'clock position for proper channel balance. I never had to set the balance control that far from its center position when I was using a pair of relatively inexpensive speakers. The problem has come about since up-

grading to more expensive speakers. Is this the result of some defects in the receiver so that it is not putting out equal power to the two speakers? Is it the fault of some malfunction within the speakers? — Terry Greenberg, Brooklyn, N.Y.

A. Perhaps the balance control itself is not accurate. To obtain equal output from both channels it might have to be adjusted, apparently favoring the right channel.

It is possible that something has gone wrong in your receiver since replacing the speakers — this would

sometimes lead to one channel producing more power output than the other when the balance control is in its center position.

To determine whether the receiver is indeed producing equal power with the balance control centered, connect an audio oscillator into the auxiliary inputs of both channels simultaneously. Connect a dummy load to each output — with the speakers disconnected. Feed a small amount of signal from the oscillator, with the frequency set to approximately 1 kHz. Next, connect an a.c. voltmeter alternately across the left and right channel outputs. (There is no need to have more than approximately one volt appearing across each of the channel outputs.) Note the position of the balance control required for the receiver to produce equal output. Repeat this measurement using different amplifier volume control settings.

Of course the voltage output from the oscillator should be adjusted to compensate for these changes in the setting of the amplifier's volume control. The purpose of this latter set of tests is to determine whether or not the volume control tracks at different settings.

There is the possibility that you have more cable connecting one speaker to the amplifier than for the other. If the cable you have used is too light a wire gauge for the length of the run, you would lose more power in the longer cable than would be lost in the shorter cable. This would have to be overcome by offsetting the position of the balance control.

Never use the very thin wire that is often sold as speaker wire. It is inadequate even for short runs. For a short run between amplifier and speaker, use at least No. 18 gauge wire. If the run is 25 feet or more, use No. 16 gauge wire. If the run is more than 35 or 40 feet, use No. 14 gauge wire. All of these wire gauges can be had in the form of "zip" cord.

It is possible that your two speakers do not produce equal output when the same amount of signal is fed to each. Correcting it would require that you set the balance control to favor the one having the least output. To do so, disconnect the speakers from their cables — leaving the cables still connected to the amplifier. Physically interchange the positions of the two speakers, exchanging the present right speaker for the left channel, and vice versa. If the speakers are at fault, you will have to swing the balance control to its ten o'clock position, favoring the left speaker rather than the right speaker.

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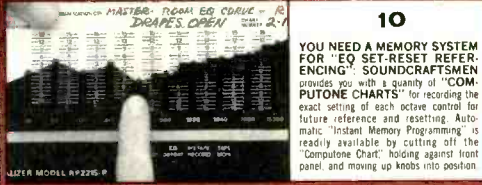
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What If It's Wide?

Q. I have noticed that several tuners feature switchable i.f. bandwidths. Is the ability to choose between receiving either strong, local signals with high sound quality (i.e. "normal" tuner) or distant, weak signals with low sound quality (i.e. "narrow" tuner) achieved at the expense of middle signals which fall into neither category? It seems that with a normal (non-switchable) tuner, some of these middle signals might be strong enough to achieve high-quality quieting, low distortion, etc., while in a switchable tuner the same signals would have to be received in the narrow (distant) mode, with its corresponding low fidelity, because the signal strength would not be high enough for the less sensitive, less selective wide (local) mode. Is my interpretation of the situation correct?— Greg Jones, Ann Arbor, Mich.

A. The wide bandwidth i.f. system is applicable in any instance where interference is not a problem, whether listening to a weak signal or a comparatively strong one. Often the audible difference between the wide and narrow bandwidth is a subtle one, involving changes in separation and a slight rise in distortion (in the case of the

narrow i.f. bandwidth). It is not a question of a tuner improperly receiving middle-distance signals.

Linecord FM Antennas

Q. I am interested in wiring a linecord antenna into my FM tuner, which has the usual 300-ohm antenna terminals. Would this be more satisfactory than the simple wire hank that I am now using? (Reception is local only.)— Name withheld.

A. Chances are that a simple folded dipole antenna will outperform either the wire hank or linecord antenna which you propose using. The linecord antenna does offer the advantage of compactness; there are no wires to string up on walls, etc.

You can try one of these linecord antennas quite readily. Wrap a turn or two of thin aluminum around the linecord — this piece of metal should be extended in such a way that it can be put under one of the screws that connects the conventional antenna to the tuner. I suggest that you cut a slot into this aluminum so that it will fit under the screw more securely.

Because there is a small amount of capacitance between the aluminum and the linecord, the cord can feed

signals into the FM set. The linecord must be oriented for best reception of any given station.

The linecord itself is the receiving antenna; the power line itself does not come into play here because it is essentially shielded within BX armor.

In The Long Run

Q. Which is more likely to cause a degradation of performance: A long run of cable between amplifier and speakers or an equally long one between preamplifier and amplifier? — Bill Nabor, Mission Viejo, Cal.

A. I prefer to have a long cable run between the preamplifier and power amplifier rather than a long run between power amplifier and loudspeaker. In the latter case, much power would be lost, and from my experience low frequency and quality of lows would both suffer dramatically. In the former case, however, the worst that can happen would be a loss of some extreme highs. The output impedance of many preamplifiers is very low, often 100 ohms. Such a low output impedance means that relatively long cable runs are possible between preamplifier and power amplifier with no noticeable high frequency loss. Δ

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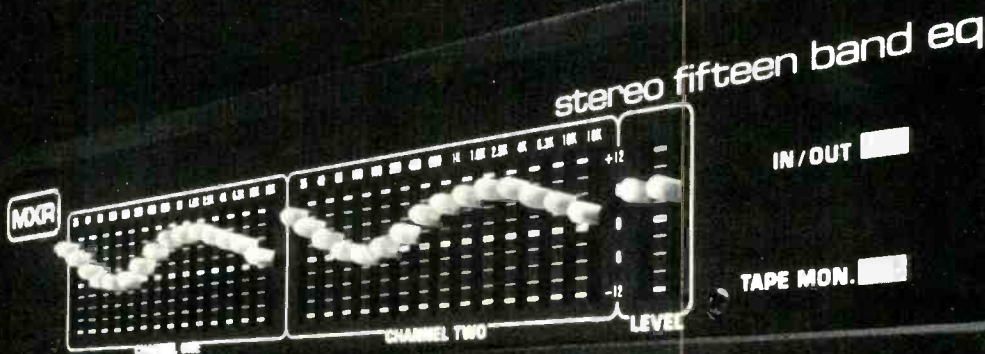
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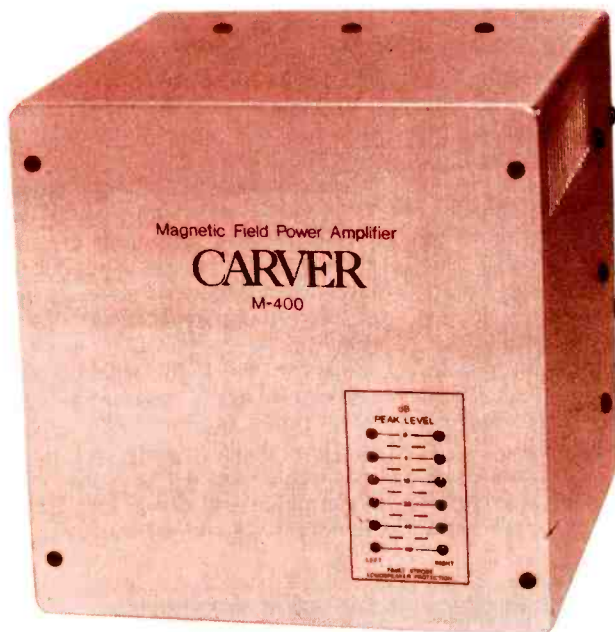
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Carver Model M-400 Magnetic Field Power Amplifier



Manufacturer's Specifications

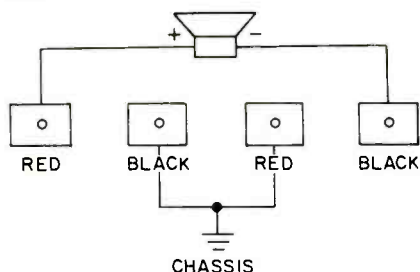
- Power Output:** 201 watts per channel into 8 ohms from 20 Hz to 20 kHz with no more than 0.05 percent THD.
- Power At Clipping:** 250 watts per channel into 8 ohms at 1 kHz, 500 watts for 1 channel into 8 ohms at 1 kHz.
- Noise:** Greater than 100 dB down, IHF A weighted. Harmonically related "commutation noise" is equal to or less than nonlinear distortion components, IHF A weighted.
- SMPTE IM Distortion:** 0.05 percent.
- Transient Intermodulation Distortion:** Unmeasurable.
- Frequency Bandwidth:** +0, -3 dB, 1 Hz to 250 kHz at 1 watt.
- Slewing Rate:** 40 volts per microsecond.
- Input Filter:** +0, -3 dB below 5 Hz.
- Output Filter:** +0, -3 dB, 0 Hz to 40 kHz.
- Display Tracking:** ±1 LED digit.
- Display Ballistics:** Peak responding, 1 millisecond attack, 0.5 second decay.
- Dimensions:** 7 in. (17.78 cm) W x 7 in. (17.78 cm) D x 7 in. (17.78 cm) H.
- Net Weight:** 9.5 lbs. (4.32 kg).
- Price:** \$349.00.

It's been a long wait! About two years ago I first heard rumblings about Bob Carver's new amplifier design which he called (and continues to call) a Magnetic Field Amplifier. About six months later, I heard a prototype of this amp at a trade show and, like everyone else who heard it with me, had a temptation to peek behind Carver's display to see if there wasn't a large conventional amplifier hidden away somewhere that was actually delivering the big sound we were hearing. There wasn't (at least none that we could find without being too obvious about it).

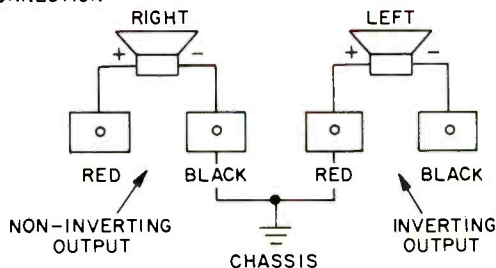
Some six months after that, Bob Carver showed up at my lab with a preproduction model of the Magnetic Field Amplifier, just to give me an opportunity to do some preliminary measurements on the test bench and to do some fast listening. We ran into no problems in the listening tests. In fact, the amp sounded about as open and clean as any power amp I'd measured in recent months. But when we got it up on the bench, I discovered that with my load resistors (which at that time were slightly reactive), we couldn't quite make the 0.05 percent harmonic distortion claim at 200 watts per channel. I

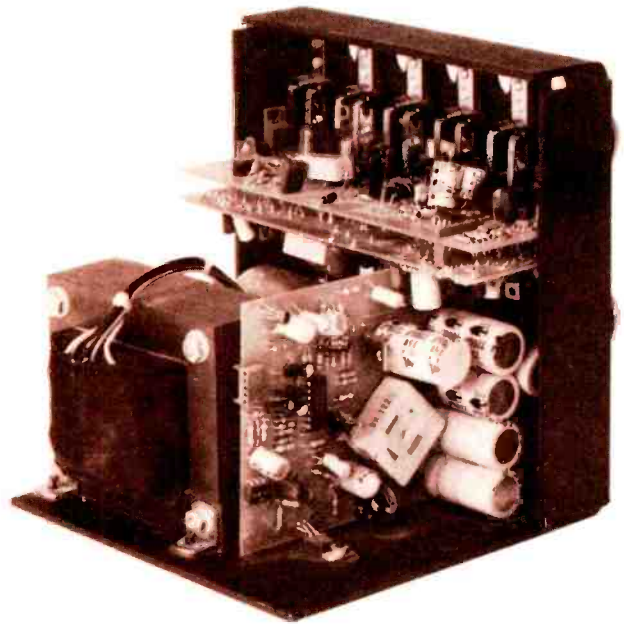
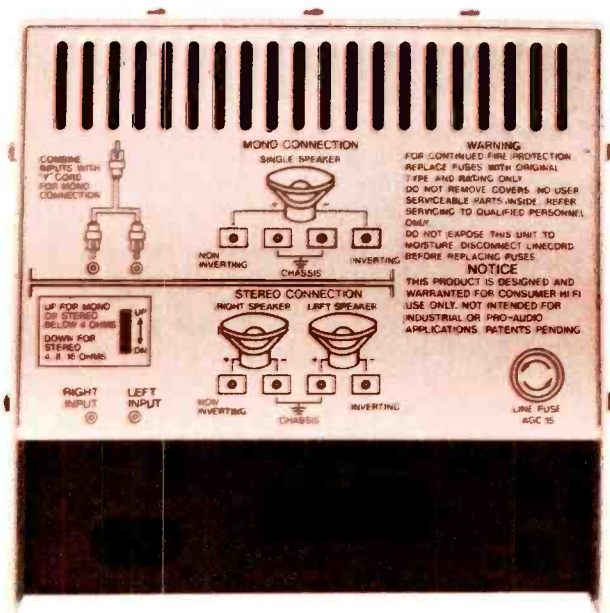
Fig. 1 — Unusual speaker terminal arrangement of Carver M-400 amp.

MONO CONNECTION



STEREO CONNECTION





think we topped out at about 195 watts. Carver and I would have been perfectly content with that, but when I told him that the FTC might take a dim view of his rating the amp at 200 watts per channel, Carver, the perfectionist, packed up his amp and went back to the state of Washington to do a little more tweaking.

I suspect that his new power rating of 201 watts per channel is his way of telling me (and the FTC) that he not only licked the problem, but managed to squeak out an extra watt or two. I admire a dedicated designer with a sense of humor! And, happily, I admire the result of Bob's two-year effort. It is, to put it mildly, quite an achievement and one that is likely to change the way many of us think of power amp designs in the future.

The M-400 amplifier comes in a gold-anodized metal housing that's cube shaped. Nothing remarkable about that until you measure a side of the cube and find that it's only something around seven inches in each dimension. You can't appreciate that from the photo, but take my word for it, you will do a double take when you see this 200-watt (excuse me, 201 watt) per channel amplifier in person! Pick it up and you are in for an even bigger surprise. It weighs less than 10 pounds! There are no controls on the front panel, not even a power on/off switch. At the lower right of the panel, however, are two vertical banks of LEDs, each calibrated in dB for a single channel. Specific dB steps are at 0 dB (at the top), -5 dB, -10 dB, -20 dB, -40 dB and "infinity." The last named set of LEDs illuminates when power is applied, even if no signal

Fig. 2 — Power output into 8-ohm loads vs. distortion.

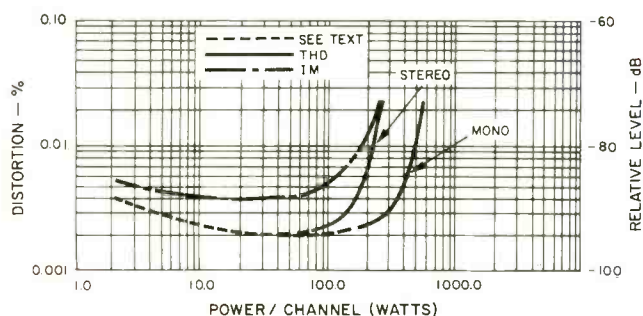
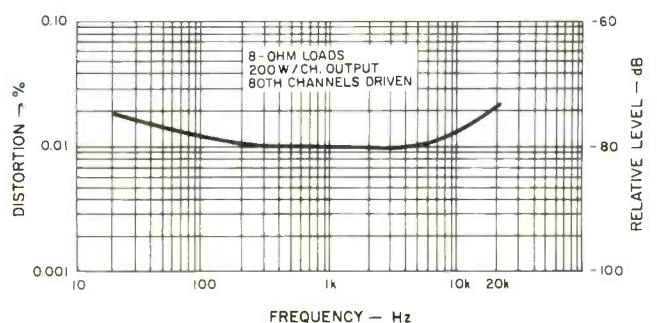


Fig. 3 — Total harmonic distortion vs. frequency.



is being amplified, and also serves another important function. The pair will blink or "strobe" approximately twice per second with diminished brightness to indicate a possible short circuit in a speaker connection or severe overloading. The blinking will continue for periods of from a few seconds to several minutes, depending upon the fault. When proper operation is restored, the display reverts back to its power indication status.

The rear panel of the M-400 contains a recessed pair of phono-tip jacks for inputs, four color-coded speaker terminals, an impedance switch, and a fuseholder with a 15-ampere fuse. The impedance switch is a two-position slide type which is normally placed in its downward position for 4-, 8-, or 16-ohm loads. For mono operation, or for impedances below 4 ohms, the switch is moved to its alternate position.

We were warned in advance to be careful of the color coding of the speaker terminals. The black terminal of the right channel pair is chassis ground, while for the left channel, the chassis terminal is red. In other words, the two channels of amplification deliver out-of-phase signals. To put it

another way, you would connect the positive terminal of the right speaker to the red-right output terminal, while the positive terminal of the left speaker would also be connected to the red-left terminal, even though that terminal is chassis ground. For mono operation, you simply connect the single speaker to the two outermost terminals, as illustrated in the diagrams of Fig. 1.

For the home user, none of this unusual arrangement poses any problem whatsoever, since speakers would be connected in accordance with the usual color coding and everything comes out in phase. For testers such as myself, however, care must be taken not to reference the black-left speaker output terminal to ground. The only unusual result of this bench hookup is that we obtain out-of-phase outputs during bench measurement of the two channels simply because of our need to establish a ground reference.

How It Works

Normally, at this point in any test report, I try to explain, in brief, any special circuitry or theory of operation that relates to the product under test. In the case of the Carver Magnetic

OPERATION OF THE MAGNETIC FIELD AMPLIFIER

According to Bob Carver, President and founder of Carver Corp., there are two concepts associated with the Magnetic Field Amplifier that combine to give it its small size and weight. The first of these is the power supply which he calls a "magnetic field" power supply because energy storage is shared, to some extent, between the electric field that exists between the plates of the filter capacitors and the magnetic field that exists in the core of the magnetic field coil.

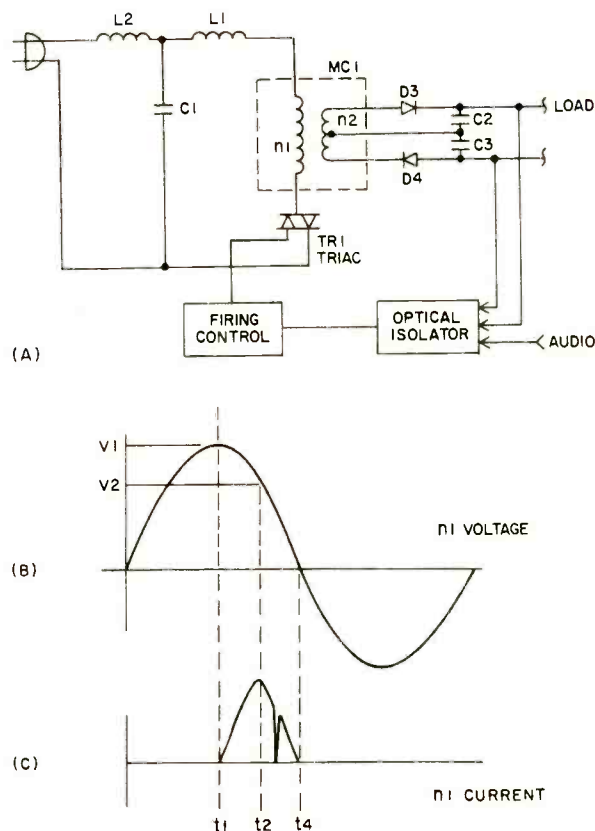
The magnetic field coil looks like a small transformer but its mode of operation differs from that of the conventional transformer. It has the ability to deliver extremely high power for power requirements that have a large crest factor, or high peak-to-average ratio, making it particularly suitable for musical signal applications.

The second concept is that the output of the amplifier is, in reality, the output of the power supply being switched on and off at a rate directly related to the incoming audio frequency. The switching is done by a so-called "commutator" which supplies an amplitude-modulated, step-like approximation of the audio signal to the output. This approximate waveform is then converted to a replica of the audio input by a small feedback linear amplifier. In effect, the small linear amplifier uses as its power supply rail the changing output of the commutator. Since the instantaneous voltage output of the commutator is very close to the instantaneous output of the power amplifier, the voltage drop across the output devices is small and the overall efficiency is high. This obviates the need for large heat sinks. Though more efficient than conventional amplifiers, the amplifier still requires cooling, and this is provided by the small chassis itself.

Theory of Operation of the Magnetic Field Coil

Referring to Figs. B1A, B1B and B1C, TR₁ is fired and turns on at time t₁. Current flows into MC₁ from time t₁ to time t₂.

Fig. B1 — Theory of operation of Magnetic Field Coil.



Field Amplifier, everything is so new and unusual that such an explanation cannot be brief. Accordingly, in this report, I will simply disclose the results of my bench and listening tests which were conducted in much the same way as I would for any conventional amplifier. Readers who want to know how the amplifier works can read my accompanying description, most of which is derived from conversations with, and written material supplied by, the inventor himself.

Laboratory Measurements

To begin with, we were advised to measure the amplifier with its power cord not connected to our usual Variac, but directly to an outlet. The reason for this will become apparent if you read the accompanying article and, in simple terms, is because the phase angle between current (I) and voltage (E) can be rather extreme as power is delivered from the utility company to the amplifier. Thus, current may be very high while actual power consumed is much lower. This might tend to pop fuses which are rated at only 10 amperes in my bench Variac. All of this preface is simply to explain that at the time of measurement, my own local utility compa-

ny was delivering only 117 volts instead of the required 120, so some of our measurements may be a bit on the low side, insofar as clipping levels are concerned.

At mid-frequencies we measured 231 watts per channel, both channels driven into 8 ohm loads, before reaching the rated THD of 0.05 percent. SMPTE 1M turned out to be just about the same, as shown in the graphs of Fig. 2. The high-end power output is still the limiting factor for this amplifier, but now we were able to read 210 watts per channel output at 20 kHz for rated THD. We must point out that anyone attempting to duplicate our measurement had better make the test quickly. Carver's amp begins to behave more like a conventional amp at high frequencies and therefore cannot deliver continuous rated power at 20,000 Hz for any sustained period. Clearly, this will never constitute a problem during actual use as a music-reproducing amplifier. Distribution of musical frequencies is such that when mid-frequencies are driving an amplifier to full power output, high frequency content is much lower (often 20 dB lower, on average, for an ordinary selection).

Even on the test bench, subjecting the amp to 20-kHz in-

During this interval, current also flows in the secondary winding and charges C_2 and C_3 to voltage equal to V_2 times the winding ratio of MC_1 . Since the output is clamped at ± 80 volts by D_3 and D_4 , C_2 and C_3 , the difference between the reflected clamp voltage (V_2) is: $V_2 = 80 (n_1/n_2)$. V_1 must appear, because of conservation of energy, somewhere. Ordinarily, the voltage drop ($V_1 - V_2$) would appear as IR losses in the primary. However, by winding a magnetic shunt into the magnetic field coil (similar to a ferro-resonant transformer), a deliberate and controlled leakage inductance L_1 is formed. This causes $V_1 - V_2$ to appear across L_1 in the form:

$$(V_1 - V_2) = -L \frac{di}{dt}$$

The energy associated with that quantity is stored in the field of L_1 . The amount of energy thus stored is $\frac{1}{2}L_1 i^2$, where i is the current flowing at time t_2 . The amount of power that would otherwise be wasted is:

$$\text{Power} = \text{energy/time} = \frac{\frac{1}{2}L_1 i^2}{t} = \frac{1}{2}L_1 \frac{i_1^2}{(t_2 - t_1)}$$

At time t_2 the incoming 60-Hz line has fallen below the clamping voltage, hence D_3 and D_4 switch off. Once D_3 and D_4 are turned off, the tank circuit formed by L_1 (the leakage inductance) and C_1 (the commutating capacitor) begins to oscillate. However, since TR_1 commutates off as soon as its current passes through zero, only one half cycle of oscillation can take place. Once TR_1 has commutated off, the field surrounding L_1 begins to collapse. Since the flux linkages of L_1 are common with n_2 , a flyback voltage appears on the secondary and causes D_3 and D_4 to switch on again, clamping the output to 80 volts. At time t_4 current is no longer maintained by L_1 since the stored energy has been transferred to the secondary of MC_1 and to the load. The same sequence of events takes place during the negative half of the input voltage cycle.

Commutator Details

A more detailed circuit diagram of the power supply, as shown in Fig. B2, reveals that the secondary of the magnetic field coil has multiple taps which drive three full-wave bridge rectifiers to form six different levels of supply voltage: ± 25 , ± 50 , and ± 80 volts. A duty-cycle control circuit maintains

these three voltage levels relatively constant, with some "softness" of regulation programmed into the system for good dynamic headroom of the amplifier. The output of

Fig B2—Detailed view of secondary taps of Magnetic Field Coil.

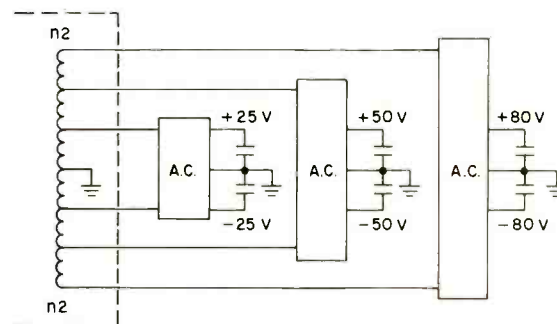
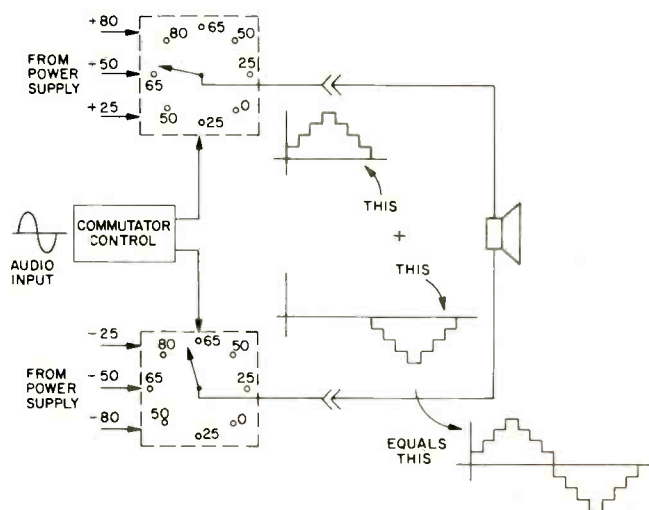


Fig. B3—Conceptual explanation of commutator action.

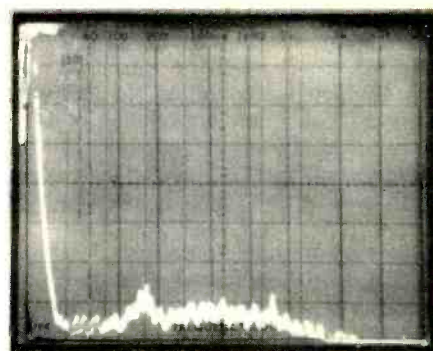


puts for more than a few seconds will not do any harm. It simply shuts down the amplifier. Remove the signal and, after a few seconds, things pop right back to normal with the amp none the worse for the experience.

Harmonic distortion versus frequency for rated power output into 8-ohm loads is plotted in Fig. 3. Referring back to Fig. 2, we should point out that it was somewhat difficult to quantify distortion at low power levels simply because the Magnetic Field Amplifier's unique method of operation generates minute output components which Carver calls "commutation noise." Some of these components are harmonically related to the test signal, but in general are well outside the audio band. Thus, while our distortion analyzer may read distortion levels of 0.03 percent, if we interject a low-pass filter between the output of the amplifier and the input of our Sound Technology 1700 Analyzer we find that the distortion level drops to the residual value of the generator (about 0.002 percent) even if the cut-off frequency of the filter is set to around 20 kHz.

To further verify this point, we reduced the output way

Fig. 4 — Wide, linear spectrum analyzer sweep from 0 Hz to 110 kHz discloses that "commutation noise" occurs above the audio frequency range. (Scale is 10 kHz per horizontal division.)



down to 1 watt — to reduce the dynamic difference between the signal peak and these residual "noise" components — and swept our spectrum analyzer over its widest range, linearly, from 0 Hz to 110 kHz. In the photo of Fig. 4, disre-

these six voltage levels goes to the input of the commutator. In concept, the commutator may be thought of as a rotary switch which is controlled by the input signal (or the output signal, since input and output are identical except for 30 dB of gain). The commutator delivers an output voltage that is a step-like approximation of the audio envelope, as illustrated in the diagram of Fig. B3.

The loudspeaker loads could be connected directly to the

Fig. B4 — "Filter" amplifier translates step waveform into replica of audio input.

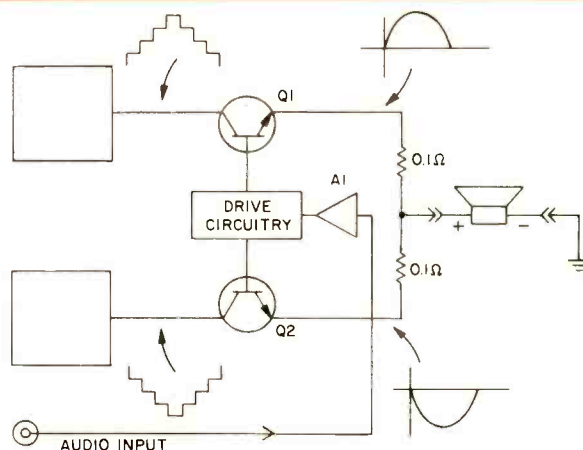
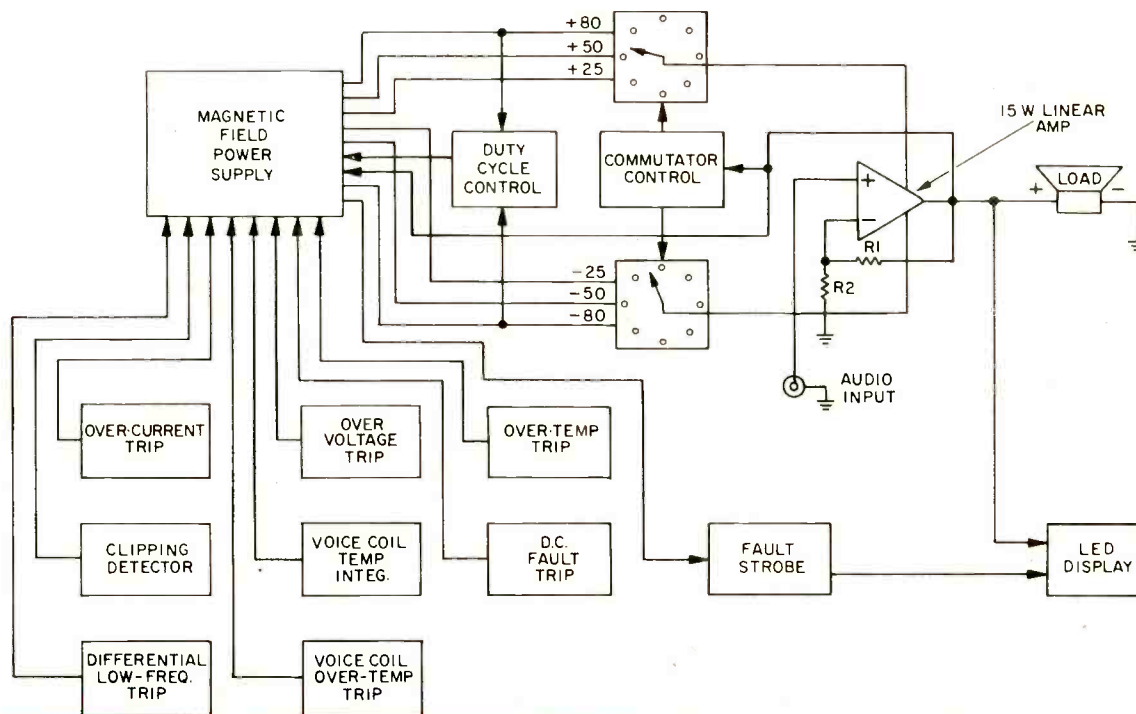


Fig. B5 — Block diagram of Carver Magnetic Field Amplifier.





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gard the logarithmic frequency notation, and read frequency linearly as 10 kHz per horizontal division. On that basis, the commutation noise peaks at around 28 kHz, well outside the audio band. Even at that, the peak measures about 75 dB below the 1-watt level (reference spike at the left of the display). That works out to a percentage of only 0.0178 percent, whether you call it a distortion component or commutation noise.

Applying an A weighting filter, we measured a signal-to-noise ratio (re: 1 watt output) of 81 dB or 104 dB below rated (201 watt) output. Overall frequency response was down 3 dB at 45 kHz, rolled off deliberately by Carver's built-in output filter. The amplifier had a very high damping factor. We measured it using a 50-Hz test signal and results were a DF of 170. Dynamic headroom was a higher than average 1.6 dB. That means that under short-term musical peaks, the amp could deliver around 290 watts per channel without evidence of clipping! IHF IM and CCIF IM were both too low to be reliably measured. Slewing factor measured slightly higher than the 40 volts per microsecond claimed by Carver. Allowing for the wide spread between LEDs in the display, we

found these indicators to be reasonably accurate. As evidently happened to Bob Carver, we weren't able to read significant amounts of TIM when we tried to measure that parameter either.

One of Carver's claims concerning his amplifier has to do with efficiency. Indeed, for an amplifier to pump out that kind of power without heating up to well beyond the melting point of solder, it would have to be pumping most of its power into the load and not into the chassis (what there is of it) in the form of wasted heat. Here are some power consumption numbers to compare with those of any amplifier you may be familiar with: Under quiescent conditions (no signal applied), the amp's total power consumption is a mere 26 watts! When delivering 100 watts per channel to 8-ohm loads, total power consumption is only 550 watts. At full power output (200 watts per channel), total power consumed by the amp was only a bit under 800 watts. During actual use, when reproducing music signals, average power consumption would, of course, be much closer to the 26-watt figure, since average power output will be only a couple of watts per channel.

outputs of the commutators as shown in Fig. B3, but such an approach would obviously result in highly distorted sound reproduction. Furthermore, for signal levels between 0 and 25 volts, there would either be zero output or 25 volts of d.c. at the speaker!

Consequently, the time-varying, conjugate-output voltages of the commutator go to a pair of complementary transistors, which may be thought of as a filter, to remove the steps, or as a small 15-watt amplifier whose B+ and B- supplies vary in level with the audio signal, as shown in Fig. 4. Note that this amplifier, composed of A₁, Q₁, Q₂ and associated drive circuitry is a linear amplifier, biased so that both Q₁ and Q₂ conduct simultaneously for small signals. A conceptually complete block diagram of the entire Magnetic Field Amplifier is shown in Fig. B5.

As indicated in Fig. B5, there is an assortment of protective circuits all designed to make the amplifier as fail-safe as possible. Carver also supplied us with details and descriptions of how some of these protection circuits work.

The Clipping Detector

This circuit senses the presence of high-frequency components that occur during clipping. It will allow some clipping to occur, but if too much occurs for too long (and at too high a frequency content), the circuit will shut down the amplifier for a while. The circuit, detailed in Fig. B6, has two inputs: The input audio signal and the output audio signal from the amplifier. So long as the output follows the input, the output of the differential amplifier, A₂, will be zero. If the output fails to follow the input because of clipping or overload, A₂ will have an output that is then differentiated by C₁R₁ and peak rectified by D₁C₂. This positive d.c. voltage is then time integrated by D₂C₃. The voltage appearing at C₃ represents the "stress history" imparted to the high-frequency driver during prolonged clipping. Too much clipping will cause the trip threshold to be exceeded, shutting off the supply.

Voice-Coil Temperature Integrator

Referring next to Fig. B7, this circuit represents a first-approximation analog of a high-fidelity loudspeaker's thermal

properties. The audio output of the amplifier is rectified and filtered by D₁ and C₁. Average voltage on C₁ is related to the spectral energy distribution and to signal amplitude. C₂ charges through R₁. The voltage on C₂ represents, to a first approximation, the thermal stress history of the loudspeaker system, taken as a whole. The integral $\int v_i dt$, the volt-amp-time product, increases faster for high frequencies than for low frequencies. (Tweeters break down more easily than woofers, generally speaking.) The logarithmic junction of Q₁ is used to get the product of $v \times i$ (power) delivered to the speaker.

Over-Current Trip Circuit

If too much current flows in the 0.1-ohm resistors in the output circuit, transistor Q₁ in Fig. B8 turns on Q₂ which trips

Fig. B6 — Clipping detector circuit.

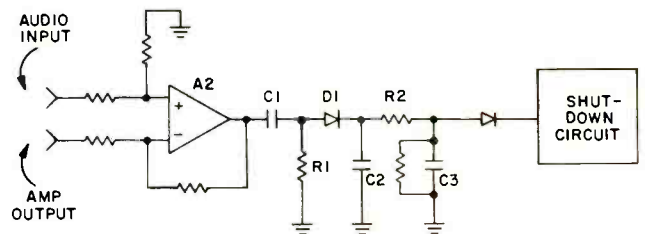
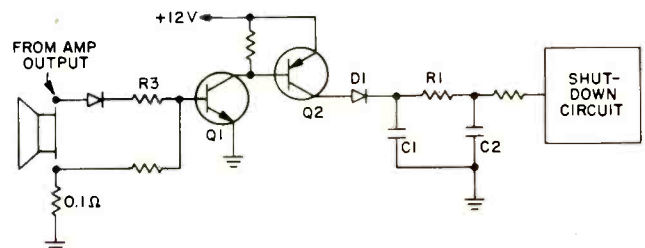


Fig. B7 — Voice-coil temperature integrating circuit.



LINN ITTOK LV II (\$650.00)

This arm is the best of two worlds, being designed by Linn and manufactured impeccably in Japan, and it sounds correct. The design pays little attention to faddish trends in sleekness and has the aura of "high-tech" functionalism regardless of bulk. The wide aluminum tube and large counterweight give it a somewhat clumsy silhouette. Examined closely, however, the arm seems well thought out with silky smooth "direct coupled" bearings and a resonance free tube. The effective mass is quite low allowing use of high compliance cartridges in spite of the lack of fluid damping. The vertical force is applied by a spring at the pivots after the arm is in perfect horizontal balance. For some reason, wobbly floor vibration will cause more havoc with this design than typical unbalanced arms. The quick dial-in anit-skate is integrated into the base so that pressure is not applied unevenly to the tube causing a tilt of azimuth. The bad news is that cartridge changes requisite dismantling to protect bearing damage, but may be this is inevitable.

The Ittok works MIGHTY sonic wonders. The frequency balance of its sound consists of more full bodied bass and less high end hash. What the arm neither does is to vibrate in all manner of modes cancelling some musical information, nor, at the same time, add harmonic distortions which glaze over the treble region with hardness. The second listening impression is that of a "surgically clean" and silent sound stage. The discs play quieter and with reduced frequency and amplitude of ticks and pops; even surface noise is reduced to a new low minimum. There is more precise attack and subsequent decay of instruments leading one to rave about its quickness and dynamic range. Furthermore, the arm is able to delineate various levels of harmonics without splaying sound into one conglomerated mass. Similarly, this control of vibration does not allow certain

instruments to change projection of depth in the sound field with varying instrument loudness as do all other high class arms.

The third impression is of an increase in front to back depth, improved spatial, and pin point imaging. One can quickly, DECISIVELY, localize individual instruments and voices even en masse — this is fully analagous, by the way, with changes produced by the FMI wire. Instruments are more stable and in better focus like going from a 10 power on a microscope to a more revealing and informative 40 power objective. Even so, there is a DELICATENESS to the quiet passages which are rendered as faithfully as loud ones. Listening to quiet woodwind backgrounds, such as Mozart Symphony #41, second movement, Phil. 6500 429, Rachmaninov Sym. #2, EMI ASD 2889, etc., reveals information not previously heard, plus the impression that the rear sound stage is just as accessible and transparent as the front.

The final judgement is that the arm approximates the sound of a master tape recording, by-passing the rattles of antiquated needle and groove technology. Once again, homage must be paid to Linn — can all this be happen-stance? The arm is worth the money, cost effective, and a sonic joy. Unquestionably, the Linn Ittok reigns aristocratically as the best arm in Audiodom.

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Stereo One, East Rochester

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Stereo Sound, Chapel Hill
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Taylor House, Denver

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Oxford Audio Consultants, Oxford

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Maguire High Fidelity, Ltd., Oklahoma City

Oregon

Audio Alternative, Portland

Pennsylvania

Mel Shilling Audio, Ardmore

South Carolina

British American Sound, Charleston

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Audio Concepts, Austin
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Virginia

High C Stereo, Leesburg

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Definitive Audio, Seattle

Wisconsin

Audiophile's Sound Studio, Madison

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Audiophile Systems, Ltd., 6842 Hawthorn Park Dr., Indianapolis, IN 46220

Listening Tests

We hooked up the amplifier to our latest pair of reference speakers (KEF Model 105-II), which are of medium to high efficiency. We must admit that, having "seen" that commutation noise outside the audio band, we suspected that it might contribute some audible effect during our listening tests. It did not. Music reproduction was superb and completely free of any false bass coloration or muddiness. The amplifier handled the toughest transients we were able to feed to it with ease. To insure against introducing any sonic aberrations from our reference preamp, we switched back and forth using a tuner program source (created via closed-circuit in our lab) first fed to the amp via a preamp and then fed directly to the amp.

At no time did the amplifier shut down during our listening tests, despite the fact that we did occasionally push it to clipping or overload for brief periods. Needless to say, at such listening levels we couldn't stay in the room with our speakers for very long and we seriously doubt whether anyone would want to listen to such levels on an ongoing basis. Reproduction remained accurate right up to the point of

clipping, and there was none of that brittle quality that one often detects from amplifiers that are beginning to strain.

Carver prints a warning on his little amplifier to the effect that it is designed and warranted for consumer hi-fi use only and is not intended for industrial or pro-audio applications. I'm not sure why he did that, but I will predict with a reasonable amount of certainty that the incredible portability and small size of this amp is going to tempt many a professional to disregard that warning and use it "on the road" and in live performances. I suspect, too, that it will hold up under such "illegal usage." Even if it does shut down when subjected to unreasonable overload, my own tests suggest that it has so many levels of protection circuitry (none of which, by the way, affected sound quality as far as I could tell) that recovery will be swift and no permanent damage will result.

I must admit that for the better part of last year I was beginning to wonder whether Carver would ever get beyond the prototype stage on this revolutionary new amplifier. Now, having tested and listened to this mighty midget of an amp, I feel that the wait was more than worthwhile.

Leonard Feldman

Enter No. 90 on Reader Service Card

the power supply. R_1C_1 serve as an integrating circuit (with an approximate time constant of 200 milliseconds) to prevent shut-down during very brief overloads.

Differential Low-Frequency Trip

Since the output of the left-channel amplifier is 180 degrees out of phase with the right channel (see Equipment Profile), in-phase signals at the input to the left and right channels will result in a small signal at Tp_1 . Out-of-phase signals, on the other hand, will produce a large signal at Tp_1 . Accordingly, the low-frequency response at Tp_1 is small for (L+R) signal components, and large for (L-R) signal components. Response for high-frequency signals is virtually zero for both (L+R) and (L-R) signals because of the bypassing effect of C_1 .

A dropped tonearm, for example, will generate large (L-R) signals, whereas musical bass tones generate primarily (L+R) in-phase signals. Therefore, a low-frequency shutdown is arranged so that it will allow high-power, low-frequency musical signals to pass through, but will shut down for high-power, low-frequency faults.

Additional blocks shown in Fig. B5 but not fully described here are a d.c. fault trip, an over-temperature trip (a simple thermal switch on the chassis) and a circuit which is a voice-coil over-temperature trip, the details of which Mr. Carver asked me not to divulge.

Basic Shutdown Circuitry

While several fault types will cause circuit shutdown, the shutdown circuitry itself is illustrated in Fig. B9. When a "trip command" reaches amplifier A_1 (for whatever reason and from whatever fault detection circuit), its output goes high in voltage, turning on Q_1 and charging C_1 . Q_2 turns on and discharges the power supply capacitors through R_1 and the LED that shines in the vicinity of the LDR. The R_2C_1 time constant determines the minimum amount of time that the power supply can remain in the shutdown state. Once the power supply capacitors discharge, the power supply will come on again. If one of the trip lines to A_1 is still high, the power supply will try to come on again but will turn off

almost immediately (in about 20 milliseconds) after rising in voltage only slightly.

It should be clear from all of the above that the Carver Magnetic Field Amplifier is an extremely sophisticated piece of audio equipment that, despite its long gestation period, has left little to chance insofar as long-term reliability is concerned.

L.F.

Fig. B8 — Overcurrent trip circuit.

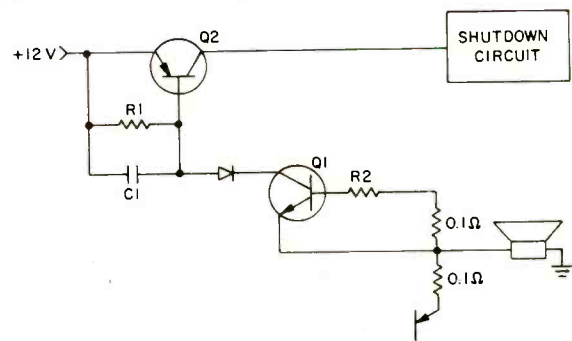
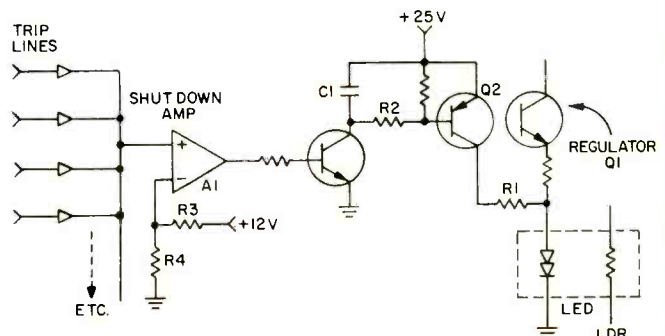
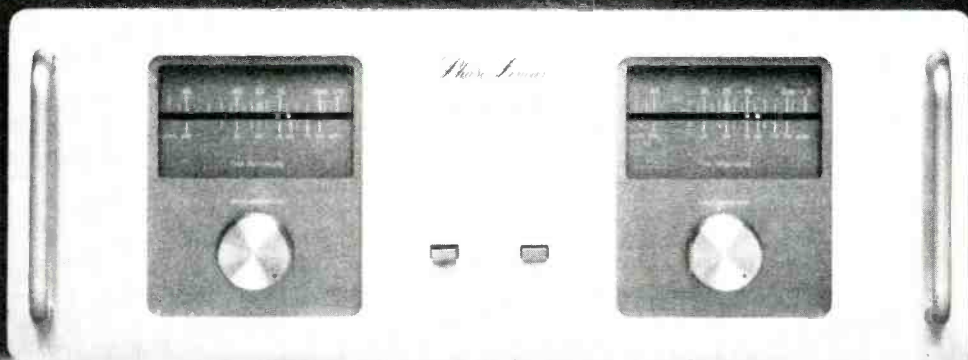


Fig. B9 — Shutdown circuit.



ONE OF THE WORLD'S GREAT POWERS.



THE PHASE LINEAR 700 SERIES TWO.

Over seven years ago, Phase Linear took the audio world by storm when it introduced the first truly high-power, high-fidelity amplifier: the Phase 700. Everyone was stunned at the incredible 350 watts per channel, with ultra low distortion. (In those days, popular mythology held that amps would never need more than 50 watts to a side. In fact, who had even heard of clipping?)

Naturally, the skeptics scoffed. But audio critics and music-lovers worldwide listened. And for the first time, they heard recorded music reproduced in the home accurately. No muddy rumble at the low end. No harsh, distorted clipping of the highs. The era of great power amps had begun!

Today, it's generally accepted that you need an amplifier with a massive reserve power to drive inefficient high-technology speakers and reproduce all the musical transient peaks without clipping. The amplifier with unquestioned ability to meet this criteria is the Phase Linear 700 Series Two.

GREATER POWER RESERVES MEAN GREATER HEADROOM

The Phase 700 Series Two is rated at 360 watts per channel,

with distortion virtually inaudible at 0.09%. With this tremendous power, the Phase 700 can reproduce musical transients with ease, giving you almost unlimited headroom. As a result, your music sounds lively, with incredible realism. Even the deepest notes are clearly distinguishable.

INCREASED ACCURACY AND PROVEN RELIABILITY

The original Phase 700 was designed for home use, but it rapidly won the approval of the pros. Its proven dependability on the road made the 700 a favorite touring amp for super groups and sound reinforcement companies.

The Phase 700 Series Two retains this legendary reliability, and improves sonic accuracy by utilizing an advanced BI-FET input stage. This integrated circuit keeps the output virtually identical to the input. Beautiful music in, beautiful music out.

The 700's instantaneous LED output meters move at lightning speed, accurately monitoring the output voltage, with calibrations for 8 and 4-ohm applications. If you're listening at quiet levels, you can activate a Meter Range Switch to upscale the meter by 20dB. You have a visual indication of output activity, in addition to the Electronic Energy Limiters that prevent damage from accidental overloads.

If you demand great performance, don't settle for less than a great amplifier.

SPECIFICATIONS:

Output Power: 360 WATTS, MIN. RMS PER CHANNEL 20Hz-20kHz INTO 8 OHMS, WITH NO MORE THAN 0.09% TOTAL HARMONIC DISTORTION.

Continuous Power Per Channel At 1000Hz With No More Than 0.09% Total Harmonic Distortion: 8 OHMS-450 WATTS, 4 OHMS-550 WATTS.

Intermodulation Distortion: 0.09% Max (60Hz: 7kHz-4:1).

Damping Factor: 1000:1 Min.

Residual Noise: 120uV (IHF "A").

Signal To Noise Ratio: 110dB (IHF "A").

Weight: 45 lbs. (20 kgs).

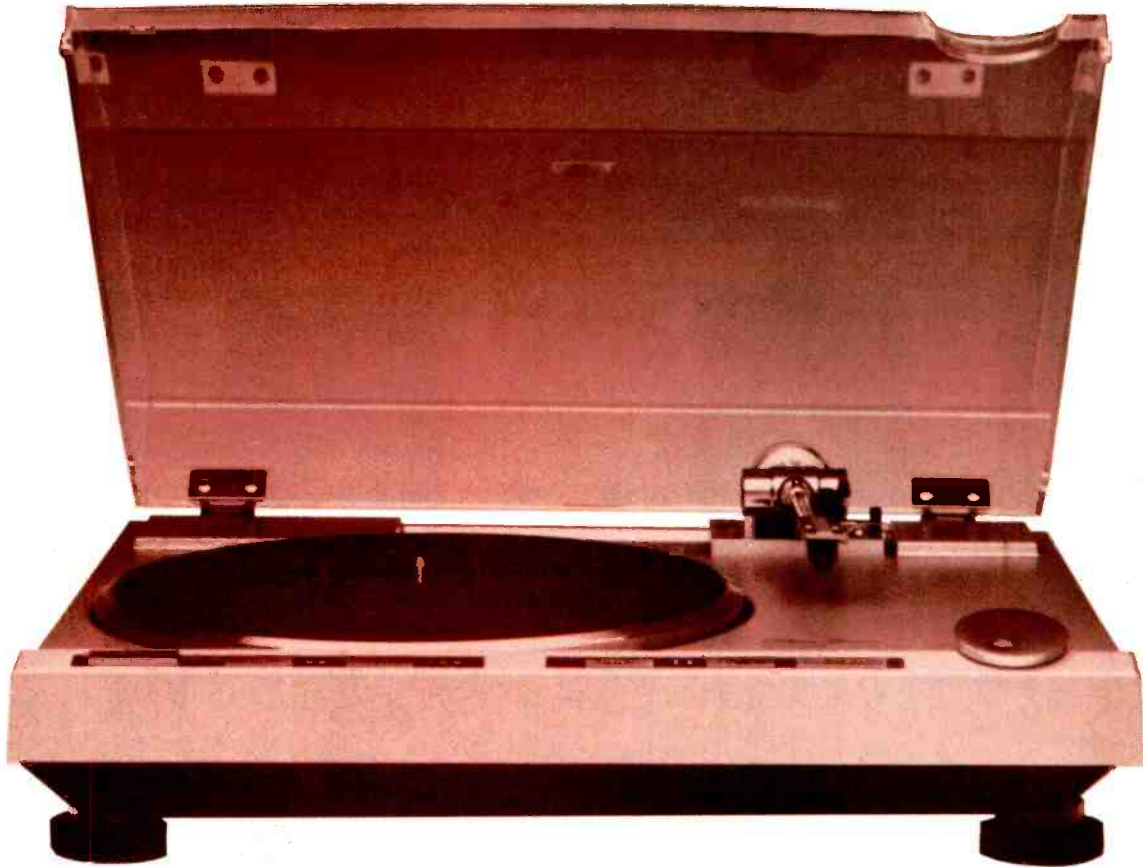
Dimensions: 19"x7"x10"

(48.3cm x 17.8cm x 25.4cm).

Optional Accessories: Solid Oak or Walnut Side panels. E.I.A. standard rack mount configuration.

Phase Linear®

Phase Linear Model 8000 Series Two Turntable



Manufacturer's Specifications

Type: Two speed.

Motor Type: Direct-drive, quartz-locked, PLL Hall-effect.

Platter: 12.2 in. (31 cm) dia. aluminum alloy die-cast.

Wow and Flutter: Less than 0.013 percent W rms.

S/N: Greater than 78 dB (DIN B).

Speed Deviation: Less than 0.002 percent.

Speed Drift: Less than 0.00008 percent/hour at 33 $\frac{1}{3}$ rpm; less than 0.00003 percent/degree at 33 $\frac{1}{3}$ rpm.

Time to Reach Full Speed: 0.6 S, less than 120 degrees rotation.

Tonearm

Type: Linear motor direct-drive, tangential tracking, static balance.

Length: 7.5 in. (19 cm).

Overhang: 0 in. (0 cm).

Height Adjustment Range: ± 0.12 in. (± 3 mm).

Headshell Weight: 10.5 g.

Usable Cartridge Weight: 4 to 14.5 g.

General Specifications

Power Requirements: 120 V a.c., 50/60 Hz, 35 watts.

Dimensions: 19.4 in. (49.3 cm) W x 6 in. (15.2 cm) H x 17 $\frac{1}{2}$ in. (44.5 cm) D.

Weight: 26 $\frac{1}{2}$ lb. (12 kg).

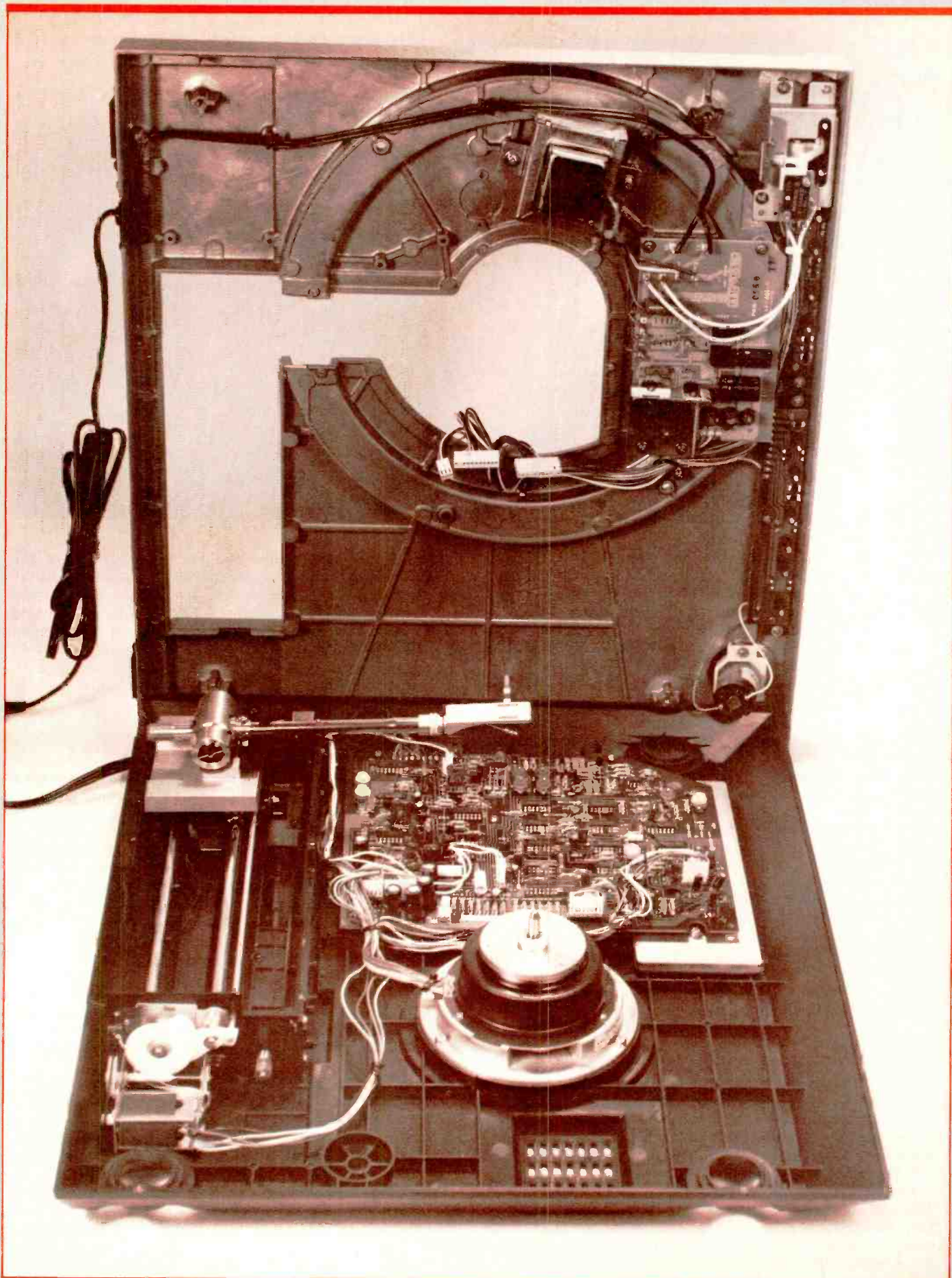
Price: \$750.00.

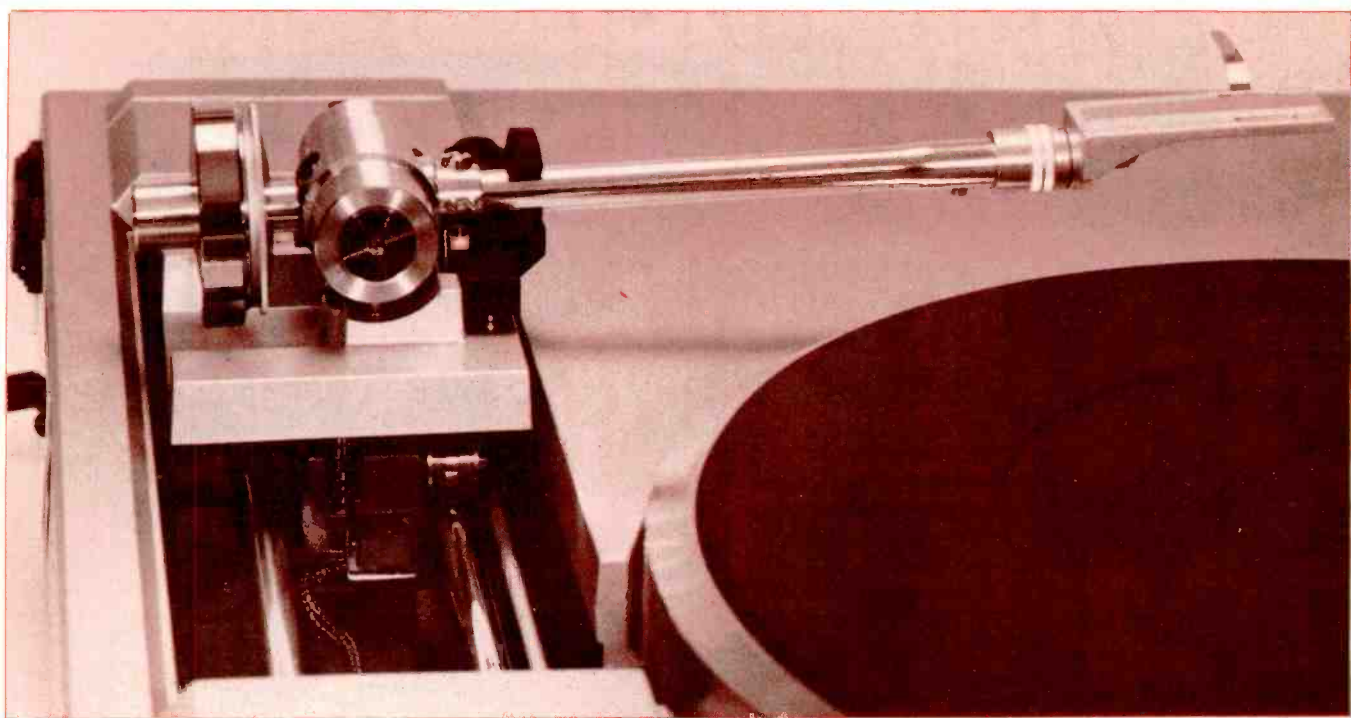
Linear, or straight-line, phono tracking has long been the engineer's dream, and many attempts have been made to translate the idea into practice. Early models were not too successful as they merely replaced one source of distortion with another, but the use of modern technology with optical sensing has enabled designers to come up with at least two well-engineered models during the past few years. Phase Linear's 8000 Series Two turntable also employs optical sensing to keep the cartridge in the groove, but there's a difference. Instead of an ordinary drive motor, the arm is driven by a linear induction motor. The coils are positioned horizontally in a straight line, while magnets are mounted on the arm base. When a current flows in the coils, the arm is impelled along a rail — so there are no gears or linkages of any kind. As the stylus tracks the record groove, lateral deflections move the arm slightly towards the record center. If the move-

ment at the stylus tip is not matched to the arm base, the unequal stress would result in mistracking and consequent distortion. However, the optical sensor prevents this by sending correction signals to a differential amplifier controlling the motor. The manufacturer points out that this system is sensitive to deflections from either side, and therefore warped records present no problems.

A separate d.c. motor is employed to control the cue-lift function, and no less than 11 ICs are used in the command link to the front-panel controls. The turntable drive motor itself is a "hanging rotor" type similar to the Pabst "inside-out" design where the coil assembly rotates instead of the motor shaft. It makes use of the Hall-effect principle and is quartz-controlled with a PLL circuit.

The unit is somewhat larger than most, measuring 19.4 inches wide, 17 $\frac{1}{2}$ inches deep and 6 inches high. The arm,





which is made from highly polished aluminum, slides along two parallel rails at the rear. A counterweight and calibrated ring enable it to be balanced in the normal manner, and there is a locking clamp over on the right-hand side. Distance from pivot to stylus is only 7.4 inches, thus increasing the strength-to-mass ratio. A large control knob on the front panel allows the arm to be moved to the left or right, while to its left is the *Start/Stop* switch and the cue lift button. Then comes another push button for *Repeat*, and way over on the extreme left is a group of three buttons for speed (33 or 45 rpm), disc size, and on-off. An indicator light next to the speed switch shows when the quartz PLL circuit takes over. All controls are accessible when the dust cover is closed, and the cover is specially shaped to accommodate the large arm control knob.

The unit stands on four adjustable isolating feet. Because of the unique design, accurate balance is essential, otherwise the arm tends to slide one way or another. To facilitate leveling, a large flat spirit level is supplied; this is not intended to go on the motor board but on the actual arm rails — which, of course, makes more sense!

All Phase Linear products are styled in a distinctive nonsense way, and the Model 8000 is no exception. The aluminum top panel is finished in a satin silver, while the push buttons have neat brown surround trim, giving the unit a modern, streamlined appearance.

Measurements

For test purposes, an Adcom XC-E moving-coil cartridge was mounted on the detachable headshell, using the gauge supplied. Next, the isolating feet at the base were adjusted so the unit was perfectly level, and the tracking force was then set to one gram. Arm height is adjustable but I did not find it necessary to change the setting, and, of course, there is no anti-skating control to bother with.

The first test was for wow and flutter, and the figures were near the limits of the test records at 0.03 percent. (DIN 45-507). Rumble was as low as I have yet measured at -63.5 dB, using the ARRL weighting method. Tracking error was zero (no surprise there), and arm resonance with the Adcom car-

tridge was at 8 Hz with a rise of 2 dB. Speed was right on the nose, and I should mention that there is no variable control. Arm friction was very low indeed — especially in the lateral mode where, as already noted, a slight imbalance would cause the arm to move. Tracking force was set to one gram which was sufficient to track all sections on Shure's ERA — III test record and all bands on ERA IV. The lowest force possible with this cartridge on the best "ordinary" arm was 1.25 grams.

In-Use Tests

At the end of a record, the arm would lift and return to its rest, taking about six seconds (sensing is optical). To begin a disc, it can be moved manually, or the start button could be depressed and the arm would take the cartridge to the record and gently lower the cartridge to the run-in groove. Another method — which I preferred — is to use the front-panel remote control to place the arm where required and then press the cue button. If this happens to be in the down position, the arm cannot be moved this way, so there is no possibility of the stylus hitting the edge of the platter. The cue lift arrangement is obviously quite expensive to manufacture but it does work extremely well, and (predictably) there is no backlash whatsoever.

The only criticism I have concerns acoustic feedback, as I found it necessary to use separate isolating feet to cure this completely. However, in all fairness, the loudspeakers are not very far away, and this has occurred with many other turntables.

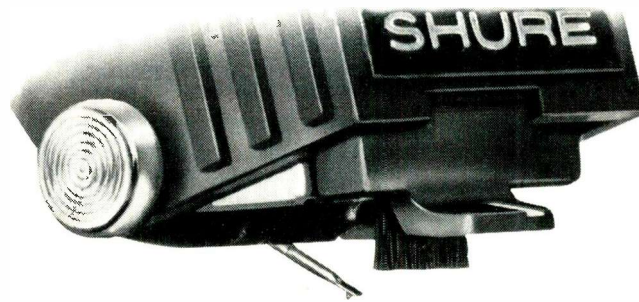
To sum up: The Model 8000 Series Two is very well-engineered, beautifully made, and a joy to use. While not inexpensive at \$750.00, this turntable achieves very high levels of performance, including a best-ever measurement for rumble. It should also be pointed out that tracking all bands of the Shure ERA — IV test record is first-rate performance for any arm-cartridge combination. All in all, then, the Phase Linear 8000 Series Two can be recommended as one of the best designed and manufactured turntables available presently.

George W. Tillett

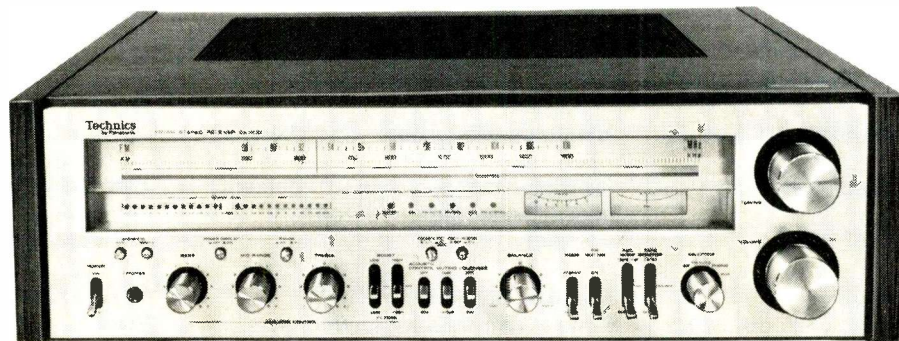
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**fact:
calling this a “brush”**



is like calling this a “radio”



**we call it a Dynamic Stabilizer
...critics call it a major innovation**

True, the device on the front of a V15 Type IV cartridge bears a superficial resemblance to a cleaning brush.

In reality, it is a complex, exquisitely engineered subassembly which performs several complex functions that measurably enhance the quality of record reproduction!

Each one of its 10,000 conductive carbon fibers is positively grounded to discharge ever-present static electricity from the surface of your records. This eliminates static clicks and pops, as well as the tracking distortion produced by the varying electrostatic attraction between the record surface and the tone arm.

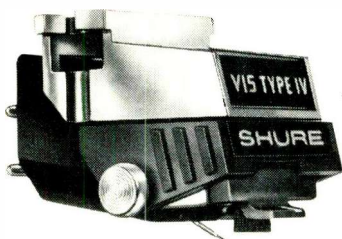
What's more, the Dynamic Stabilizer incorporates Shure-developed viscous damping that results in a uniquely efficient suspension system which maintains precise cartridge-to-record distance and uniform tracking

force—even on severely warped records. The stabilizer also acts as a shock absorber to cushion the stylus in case you accidentally drop the tone arm onto the record.

Finally, the tiny carbon fibers are so fine that 10 of them can fit *inside* a single groove to sweep free minute dust particles.

This integrated approach to pure sound reproduction extends throughout the design of the V15 Type IV. It sets a new standard of high trackability at ultra-low tracking forces—even on records that are warped, dusty, and charged with static.

If faithful reproduction of *all* your recordings is of paramount importance to you, we invite you to audition the V15 Type IV with the Dynamic Stabilizer. Or, write for the complete story (ask for AL569).



V15 Type IV...the stabilized cartridge



Shure Brothers Inc., 222 Hartrey Ave., Evanston, IL 60204, In Canada: A. C. Simmonds & Sons Limited
Manufacturers of high fidelity components, microphones, sound systems and related circuitry.

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**Soundcraftsmen SP 4001
Preamplifier-Equalizer**



Manufacturer's Specifications

Phono Section

RIAA Frequency Response: ± 0.5 dB, 20 Hz to 20 kHz.

Harmonic Distortion: Less than 0.01 percent.

Signal/Noise Ratio: 97 dBA.

to 20 kHz.

Harmonic Distortion: Less than 0.01 percent.

IM Distortion: Less than 0.01 percent.

Signal/Noise Ratio: 105 dBA re: 10 V output.

Octave Control Range: ± 16 dB with all controls at maximum, ± 12 dB with all other controls at zero.

Zero Gain Control: $+6/-12$ dB range.

Dimensions: 19 in. (490 mm) W x 5 1/4 in. (135 mm) H x 11 in. (280 mm) D.

Line Amplifier Section

Frequency Response: ± 0.25 dB, 20 Hz

Equalizer Section

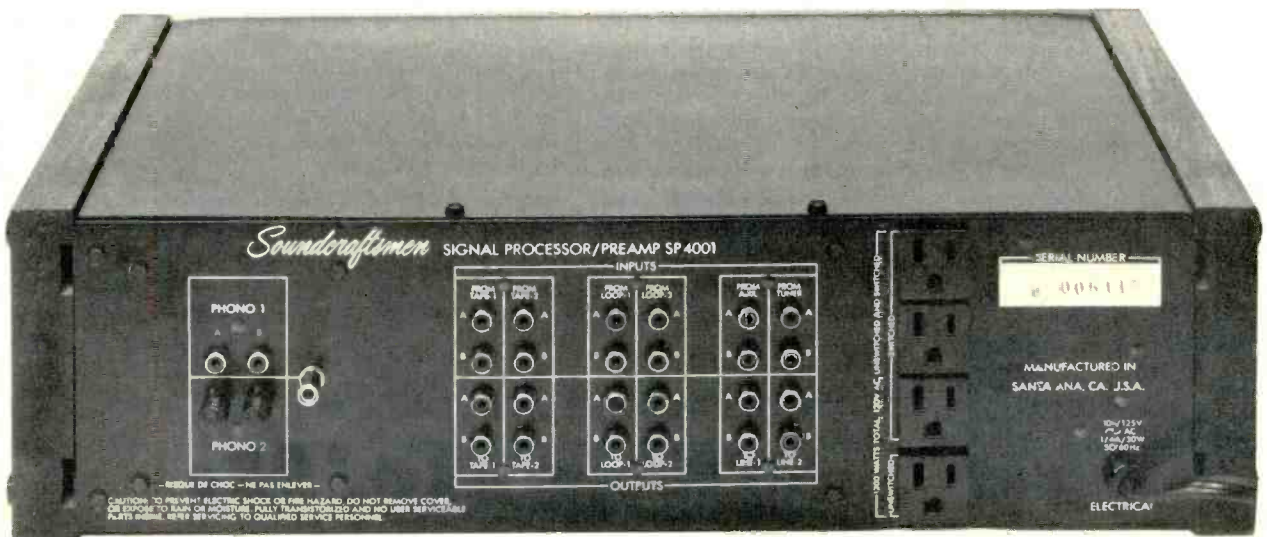
Same as line amplifier section, plus

Weight: 23 lbs. (10.5 kg).

Price: \$549.00.

The Soundcraftsmen SP 4001 is called a "signal-processor preamplifier-equalizer" by the manufacturer, and the combination does have some synergistic properties. It is a single unit with internal interconnections, there is no need for regular tone controls, and there is a price advantage over buying separate units. All designations and scales on the front panel are easily read with white lettering against a black background. The 10 equalizer-filter bands are numbered at the

tops of the vertical controls. The center frequencies are listed at the bottom, starting at 30 Hz and doubling for each band, up to 15,360 Hz at the end. Between the two sets of boost/cut sliders with ± 12 dB ranges are the two channel "equalized signal-zero-gain" controls for matching the gain with EQ to the gain without EQ. Top and bottom LEDs with each control indicate the need for gain increase or decrease, and equal intensity of the LEDs verifies that the level of the total



"Listening tests confirmed what the excellent measurements implied: the Eumig FL-1000 is a superb performer."

JULIAN HIRSCH—STEREO REVIEW, APRIL 1980

What you are about to read is Julian Hirsch's unedited conclusion in his review of the Eumig FL-1000.

"Listening tests confirmed what the excellent measurements implied: the Eumig FL-1000 is a superb performer. Dubbing from FM or phono discs revealed no audible differences between the original and the copy, and even FM interstation noise—our most severe test—could be recorded and played flawlessly up to levels of approximately -5 dB. The Computest adjustment for different brands of tape was not only accurate but contains a built-in rewind mechanism that returns the tape to the precise point where you began your adjustment. The counter was the most accurate we have ever used. And for people who are "into" computers, the one-of-a-kind (so far) Eumig FL-1000 cassette deck opens up endless possibilities."

We couldn't have said it better. We wouldn't even try. For the complete text of the review, write to us. Or, better yet, visit your nearest Eumig dealer and find out for yourself what it takes to make a reviewer rave.

eumig[®]

Eumig (USA) Inc., Lake Success Business Park,
225 Community Drive, Great Neck,
New York 11020, (516) 466-6533



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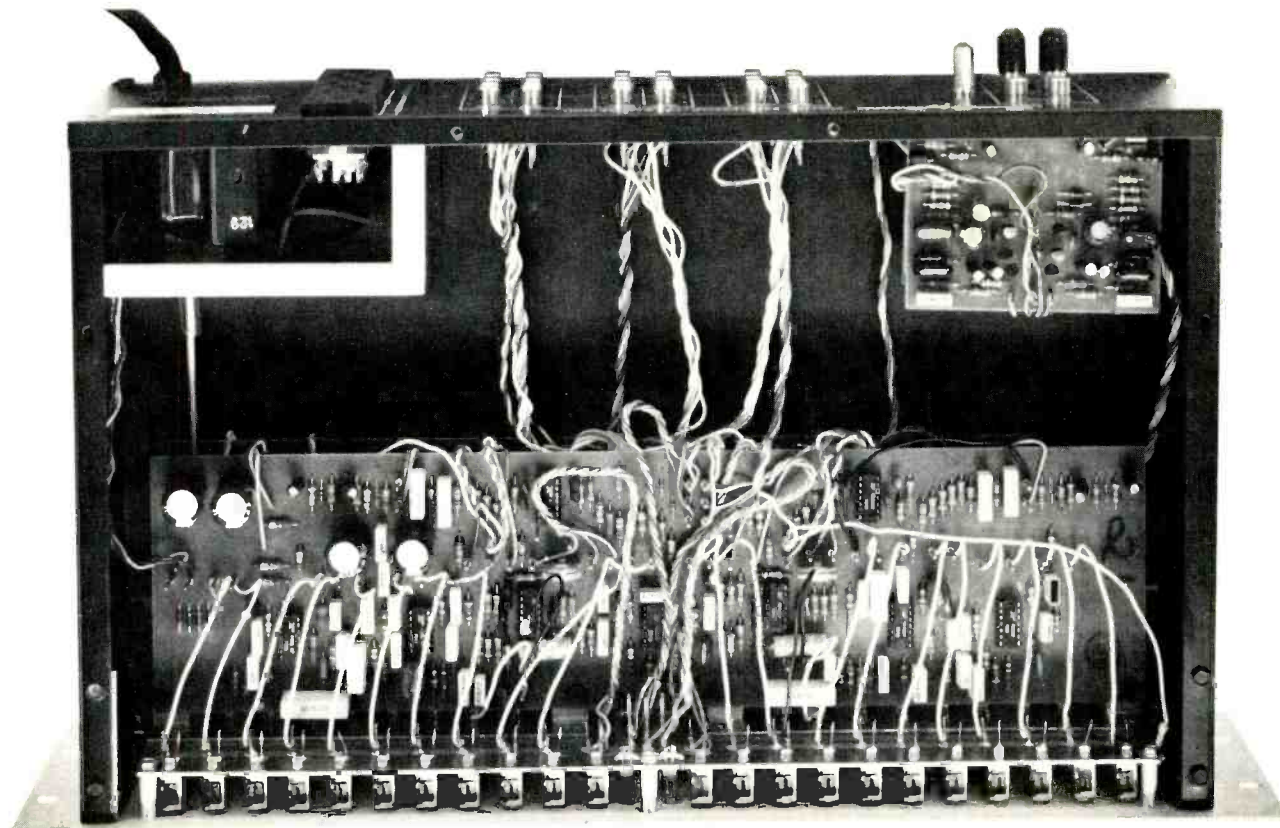
spectrum with EQ matches that without. This is a very worthwhile feature which ensures there will be no large jumps in level with EQ in/out switching. As a result there will be less shock to the nerves, and the effects of the EQ are easier to judge, to say nothing about preventing damage to amplifiers and speakers.

There are four interlocked push-button switches for source selection: *Phono 1*, *Phono 2*, *Tuner* and *AUX*. The SP 4001 is unusual in that there are separate preamp sections for the two phono inputs, and selection is actually made at line level. My own experience has included many examples of system problems because of "minor" contact resistance in connectors and switches, aggravated when at low-level points. For those who want to be able to select between two turntables, this must be considered a good feature. There are six non-interlocked "Signal Processing" push-button switches: *Sub-sonic Filter*, *Ext. Loop 1*, *Ext. Loop 2*, *EQ*, *Mono A + B*, and *Route to Tape Record*. The external-loop functions permit inserting any external device in the signal path, perhaps a dbx II processor or a bandpass filter — whatever you want. *Route to Tape Record* shifts the processing section out of the main line signal path and inserts it into the feed to the unit's two sets of tape-out jacks. Four non-interlocked push-button switches for *Tape Selection* offer *Monitor 1* and *2*, and *Dubbing 1-to-2* and *2-to-1*. In this fashion, it is possible to control dubbing from one recorder to the other at the same time that

the main part of the unit is used for something else.

The power on/off switch is also a push-button design, and there is an adjacent red indicator. The multi-step volume and the center-detented balance controls have good-sized knobs with excellent fine knurling, an aid to easy adjustment. The Soundcraftsmen unit is supplied with wood end pieces and stick-on feet, so it can be placed on a shelf or table. With the removal of the end pieces, the SP 4001 can be immediately rack mounted, requiring a 5¼-inch space. On the back panel are all of the input/output phono jack sets for *Phono 1* and the other sources, two tape recorders in/out, two external loops in/out, and two sets of line out jacks, which actually have low enough impedance to drive headphones. There are three switched and one unswitched a.c. outlets with a total capacity of 1200 W, much better than so many units which commonly have a limit of 300 W or so. The outlets and the power cord are all three-prong, not usually found in such equipment.

With the removal of the steel top cover, it was possible to examine the internal construction. There was excellent soldering on the p.c. boards, two large ones for the majority of the electronics and two small ones for the phono preamps. There were a number of ICs (in sockets) used on the main boards, while the phono preamps used discrete components. There was no parts identification noted on the cards. Wirewrap was used for intercard connections. With the top

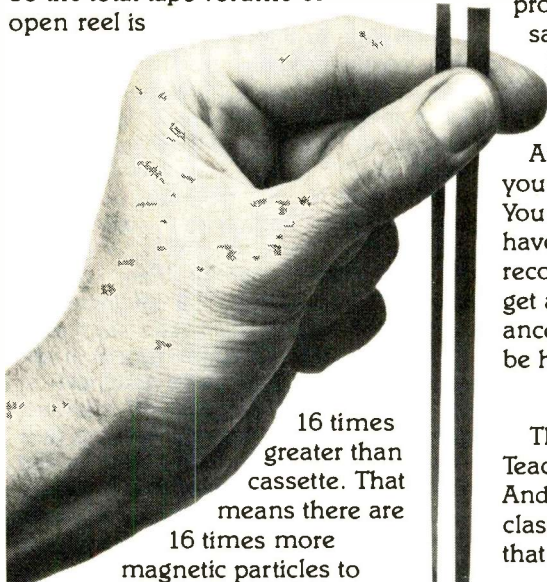


THE SOUND YOU'LL NEVER GET FROM A CASSETTE DECK IS NOW HERE AT A CASSETTE DECK PRICE.

Teac's new X-3 open reel deck costs no more than a good cassette deck. But its fidelity is far superior to that of even the most expensive cassette deck. For a very simple reason.

More is better.

Open reel tape running at 7½ ips is four times faster than standard cassette tape. And twice as wide. So the total tape volume of open reel is



16 times greater than cassette. That means there are 16 times more magnetic particles to imprint the signal. And that means you get as much signal as possible—especially high frequencies—without distortion. Plus a much greater capacity to pre-

serve dynamic range.

Cassette decks can't give you this kind of performance simply because there are inherent limitations in the cassette format. No matter how good the hardware. Even with improved software, the basic problems remain: saturation, overload, distortion. And disappointment.

And fidelity isn't the only thing you get more of with the X-3. You get more time. You don't have to stop in the middle of a recording to flip the tape. So you get an uninterrupted performance. The way it was meant to be heard.

A classic idea.

The X-3 is built the way all Teac machines are built—to last. And to perform. You get the classic, 3-motor, 3-head design that established Teac's reputation 25 years ago.



And you get it for the price of a good cassette deck.

Which means you can finally have the sound you thought you couldn't afford. From Teac.

Performance specifications

Signal-to-noise ratio (overall)	58 dB (3% THD level, weighted)
Wow & flutter (NAB Weighted)	0.04% at 7½ ips; 0.06% at 3¾ ips.
Frequency Response (overall)	30-28,000 Hz at 7½ ips 30-20,000 Hz at 3¾ ips
Playing time (both sides)	3 hours at 3¾ ips with 1800 feet of one mil tape

TEAC

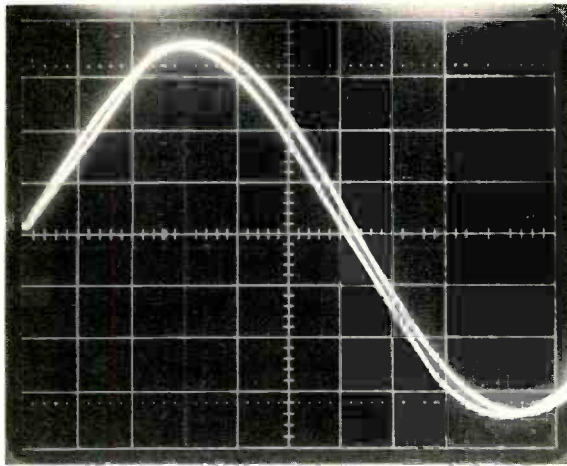


Fig. 1 — Slew limiting with 2.5-V, 40-kHz input signal and 5-V output. (Scales: Horizontal, 2 μ S/div.; vertical input, 1 V/div. with output adjusted to match input display.)

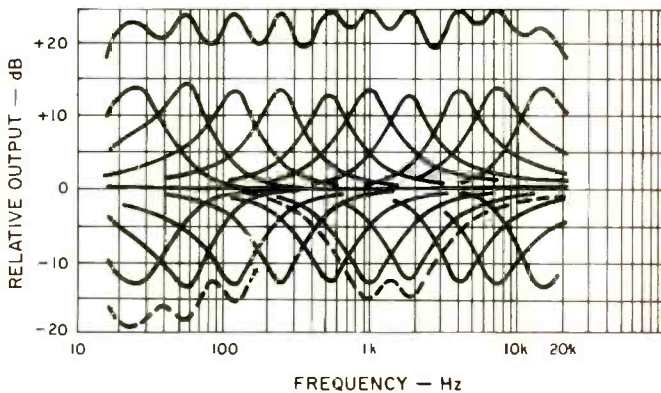


Fig. 2 — Frequency responses of individual filter sections at maximum boost and cut, of unit with no boost or cut, and with all sections at maximum boost. Dashed lines show results with 30-, 60-, and 120-Hz filters at maximum cut and also with 960- and 1920-Hz filters at “-10.”

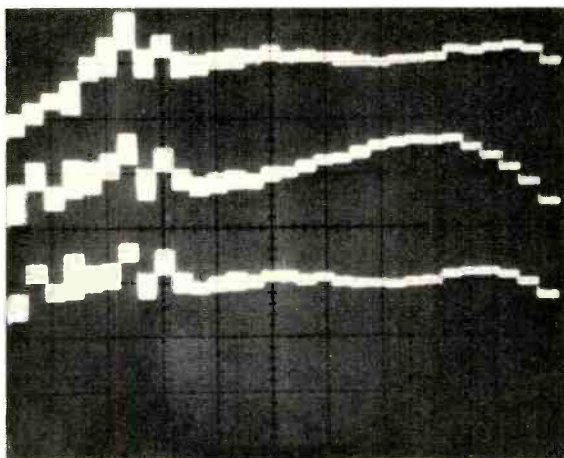


Fig. 3 — Use of EQ to improve recorder response. Top: Pink noise on RTA in “Source.” Middle: Playback without EQ. Bottom: Record/playback response with EQ.

cover replaced, the components were effectively enclosed in a steel box chassis which was quite rigid.

Performance

As some of the information from Soundcraftsmen was preliminary, there was a little confusion on reference levels for some of the specifications, and also whether some things were actually specified or just indicated as typical. The first checks were made on the two phono preamps, really four mono preamps in configuration. All sections reached overload at 120 mV with a 1-kHz test signal. Sensitivity was 17 mV for 1 V out at the tape-out jacks and 1.48 mV for 0.5 V at line out with maximum volume. All sections had frequency responses within ± 0.6 dB with the inverse-RIAA test network used. Most values were within 0.3 dB or better, and there was very close correspondence among all four. With 20-mV drive, there was 1.1 V at tape out. THD was less than 0.006 percent at 1 kHz, about 0.02 percent at 20 Hz and 0.01 percent at 20 kHz. Signal/noise ratios were 81.4 dBA with 5 mV in and 0.5 V at line out, 92.8 dBA with 17 mV in and 1 V at tape out and 98.8 dBA with the Soundcraftsmen 2-V reference. All of the figures are equivalent actually, but the lowest figure goes with the IHF test standard.

With *AUX* input, the line sensitivity was 82 mV for 0.5 V out with max gain. Clipping was very symmetrical at 14 V rms output from 20 Hz up, with a gradual reduction at the highest frequencies. At 20 kHz the output limit was 8.5 V rms, above which slew limiting appeared. The frequency response was down 0.25 dB at 5 Hz and 40 kHz, down 3 dB at 1.5 Hz and 140 kHz. Slew limiting was made obvious with a 40-kHz signal (Fig. 1), with 2.5 V in and 5 V out, quite outside of normal conditions. Please note that the amplitude of the output was adjusted on the scope to match the input to make the linear slope of the slewing most obvious. The measured slew rate was 1.7 V/ μ S, quite sufficient for preamp operating conditions. With 0.5 V in and 2 V out, THD was 0.002 percent or so for most of the band, rising slowly to 0.0077 percent at 20 kHz, and to 1 percent at 81 kHz for a slew factor of 4.05. For the same levels, the SMPTE IM distortion was 0.002 percent. The signal/noise ratio was 91.5 dBA with the 0.5 V reference, 103.5 dBA referred to 2V.

With EQ selected (all controls at zero), there was no change in the distortion figures, except that IM increased slightly to 0.004 percent. The signal/noise ratio showed a slight change — to 91.2 dBA re: 0.5 V. With no special attention paid to zeroing the filter controls, just a fast push to detent, the frequency response was within 0.8 dB from less than 5 Hz to over 20 kHz, very good indeed. EQ out is best for the flattest response, of course. With EQ in, clipping did not occur until a very-high 10.4 V with gain-match adjustment for equal in/out level. The subsonic filter was measured to be down 1 dB at 20 Hz, 3 dB at 15 Hz and 10 dB at 8.5 Hz, a worthwhile feature to include.

The input overload on *AUX* was 17.2 V, unlikely to be reached with normal inputs. The distortion increased very little across the band with increasing drive and volume levels right up to the point of clipping, although slew effects caused distortion at 20 kHz to reach 0.1 percent at 7.18 V output. Actually, that's pretty darn good, unmatched by many units. The output impedances were about 600 ohms for tape outputs and less than 8 ohms for line outputs. Input impedances averaged about 20 kilohms with some dropping off at the highest frequencies.

Closer attention was given to the filters themselves in the equalizer section. Fig. 2 shows the frequency responses of all of the individual filters at maximum boost and at maximum cut, all controls in detent, with all filters at maximum boost, with just the 30-, 60- and 120-Hz filters at maximum cut, and

finally with just the 960- and 1920-Hz filters at "-10." Filter shapes were fairly consistent with a $Q = 2.0$ at maximum boost. A one-octave bandwidth ($Q = 1.4$) was obtained with the 960-Hz filter boosted 11.5 dB. A Q of 1.0 existed with 9.6 dB boost. Center frequencies of the filters were not dead accurate, with some unequal spacing evident in Fig. 2. A recheck on the accuracy of setting the controls in detent showed that with a little care, the repeatability was ± 0.1 dB. With the match-gain controls in detent, selecting EQ increased gain 0.4 dB for both channels, acceptably close. The range of the controls was from +6.7 dB to -13.6 dB re: detent position. With a pink noise source, and a variety of equalizations set in, gain matching with the LEDs for guidance was always within 0.5 dB — excellent performance of a very worthwhile scheme. For good indication of the LEDs and easy adjustment of the match-gain controls, 150 mV was required at AUX. It was possible to match gain with an 80-mV input, but the process was a little fussy.

The stepped volume control seemed almost to be continuous, and it could be set between detents, but there were actually many steps of from 0.75 to 1.5 dB, with larger steps at the bottom of rotation. The two sections of the control tracked within a dB from maximum down more than 60 dB, superb performance.

In-Use and Listening Tests

All controls and switches were completely reliable, and no contact noise was detected in making any of the adjustments. The owner's manual for the SP 4001 is a stiff-paper, four-page summary of functions and a detailing of basic operating instructions, with a listing of typical test data and a simple block diagram. Also supplied are a test record and

what Soundcraftsmen calls "Computone" charts. The album includes equalizer instructions, which are particularly good on setting the equalized-signal zero-gain controls. There are instructions on using the test disc for room equalization, and there are additional helpful comments on the record itself. The Computone charts have scales imprinted for each of the boost/cut controls and the equal-gain sets. This full-size form can be cut to match any particular EQ, such as that for smoothing system response. There are a dozen forms, so many EQ combinations can be stored "in memory" for easy resetting.

To demonstrate the flexibility of the equalizer section, it was used to remove an excessive presence hump in the playback of a recorder. As Fig. 3 shows, this was done very well, without pulling down the highest frequencies as a tone control would have done. On the other hand, during the listening tests a bit of boost in the same region added some desired presence to the voices in Mahler's *Eighth Symphony*. There was a lot of most-satisfying listening with the SP 4001, in all its forms, preamp, equalizer and preamp equalizer. It was also used to insert dbx II processing at one point, using one of the external loops.

The Soundcraftsmen SP 4001 offers excellent performance across the entire audio band with very low noise and superbly low distortion, even with most any combination of boost/cut adjustments. Worthwhile features include separate phono preamps with high-level switching, a subsonic filter, input/output control for two tape recorders, push-button selection of external loops and the equalized-signal zero-gain control and indicator scheme. It is definitely an excellent value for anyone needing both a preamp and an equalizer.

Howard A. Roberson

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The bookshelf

Born to Run: The Bruce Springsteen Story by Dave Marsh. Doubleday, \$7.95.

Rock books are almost always written from the point of view of the ultimate fan, and though some might find it annoying that there seem to be no chinks in Bruce Springsteen's armor, most of those who buy this book are probably of the opinion that Springsteen is either a step above or below The Lord Himself. To them, Mr. Marsh might be regarded as a cynic. In any case, this is a fairly well-documented book on one of America's best loved and most unorthodox rockers, and for all its faults it still reveals plenty of interesting stuff about Mr. Springsteen.

For instance, there's at least one lengthy chapter per album, consisting of little more than glorified record reviews, heavily quoting lyrics and stating in most cases what should be obvious. And the book is liberally laced with the author's personal theories about rock 'n' roll, its social significance, and why it exists. This is all presented in such a way that the casual reader might take them as fact rather than Mr. Marsh's presumptions, and although they never collide with Springsteen's persona, one could make a good argument against their intrinsic fallacies. However, for all of this there is much juicy narrative about early Springsteen (although not enough, through no fault of the author—unless you actually saw his early shows, it's pretty much second-hand and third-hand reportage), quotes from the artist himself, recording information, and verbatim transcripts of his performance raps. The author's accessibility to the artist comes through his friendship with Jon Landau, Springsteen's current manager/producer (a former employer of Mr. Marsh), and so there is a very strong pro-Landau slant and villainizing of Mike Appel, who performed the same function in the past. And one wishes for a straight Q & A with Bruce to get more of a feel for his ideas as he presents them, rather than Bruce as seen through the eyes of his biggest fan. Still, there's enough here to make the reading of this book both informative and pleasurable, and besides, there's all the Springsteen photos a fan could want. But Dave, Bruce did *Raise*

Your Hand with Eddie Floyd, not *Knock on Wood* when he played Memphis—I mean, just the facts man, just the facts.
 Jon Tiven

The Illustrated History of Rock Album Art by Angie Errico and Steve Learning. Octopus/Mayflower, \$9.95, paperback. When *The Album Cover Album*, brilliantly assembled by cover designers Hipgnosis and Roger Dean, was released with a \$10.95 price tag about two years ago, it immediately became the coffee table book of album art and has remained so even after a half dozen more album art books came on the market.

The newest challenger is *The Illustrated History of Rock Album Art*. Published at a surprisingly low price of \$9.95, it is the first book to seriously rival *The Album*. It weighs in with 160 pages of heavy stock with the *de rigueur* color reproduction. Its format varies from *The Album* in that it includes commentary about how the covers relate to the albums, to the music inside them, to the marketplace they try to reach. *The Album* did not even attempt this except in its preface. And *Rock Album Art's* prose even manages to be somewhat enlightening and insightful, even entertaining, without lapsing over into the fatuous as some of the challengers have.

As for layout, *Rock Cover Art* is the most aggressive of its genre since *The Album*, and still the only one to successfully display fold-out covers folded out for the full view. There are lots of full- and near-full-page reproductions, and some display clever counterpoint with quite telling visual comparisons.

Rock Album Art does not include nearly as many covers as *The Album*, but it does have a careful selection, especially since it deals with the implications of the covers in addition to the art as art.

It boils down to this: *The Illustrated History of Rock Album Art* is a surprisingly good book at a surprisingly low price that offers the right production values. It is the only book of its kind besides and since *The Album Cover Album*—still the cream of the crop—even worth considering. And it is worth considering. Michael Tearson



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Edwin H. Armstrong in World War I.

Edwin Armstrong

GENIUS INVENTOR

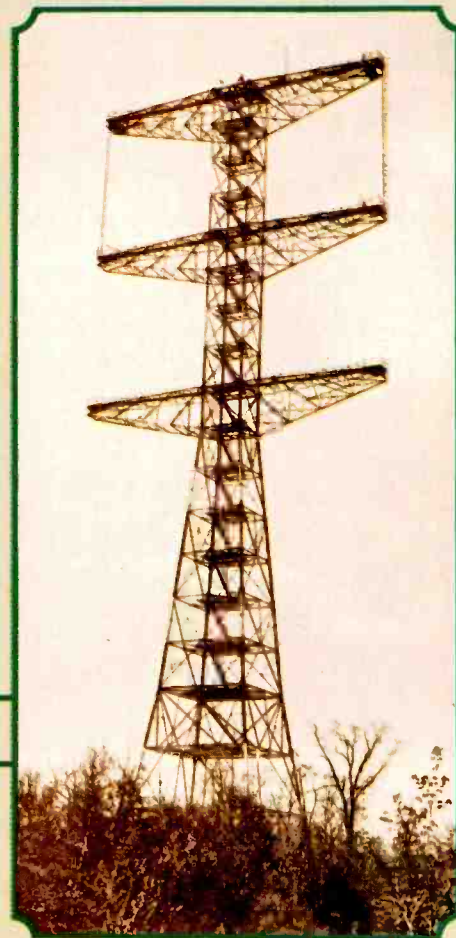
Gary Stock

Sophocles or Shakespeare would have made a superb drama of the story. A 22-year-old inventor of patrician breeding develops one of the most important new ideas of his time. Wealth, fame, and influence all come to him as he develops other similarly fundamental inventions which influence many segments of his society. But as his ideas become more and more valuable, he is enmeshed in legal difficulties against powerful corporate interests until finally, in the autumn of his life, worn down by constant legal struggle and acrimony, he takes his life in a leap from a tall building.

Unfortunately, both Sophocles and Shakespeare lived too early to observe the grand story of Edwin Howard Armstrong, born in 1890, who developed three inventions that changed our lives, the feedback circuit and the superheterodyne principle that, individually or in combination, form the basis of almost all modern radio and radar communications, and FM radio itself, which first brought high-fidelity music to millions and spurred the development of home audio components. It has been said that Armstrong's extraordinary contribution to technology was as great as that of Marconi, the

Italian inventor of AM radio, or even Edison.

Edwin Armstrong grew up in the straightlaced eighties and first years of this century. His family, like many other prominent families of the time, was involved in the business of business. From an early age Edwin was fascinated by electronics — not the electronics of huge dynamos and power plants — but the ghostlike electrical currents of “wireless,” the dot-and-dash radiotelegraph communication of the day. Except during laboratory experiments, there was no such thing as voice or music transmission by radio; he would later make it possible. Armstrong converted the attic in his family's Yonkers home into a radio lab filled with the ponderous primitive equipment of the day, huge foil-lined glass jars, outsized wire coils, and long antenna leads. The huge tower antennas typical of the time were necessary simply because the radio receivers were so insensitive and required such large input signals. Radio operators had to wear viselike headphones and hold their breath while listening for messages, and most long-distance communication was conducted at night when the faint static generated by the sun was not present. Every additional foot of antenna height was



The 400-foot broadcasting tower constructed by Armstrong on the Hudson River Palisades in Alpine, New Jersey.

valuable in collecting the quantities of radio-frequency energy needed by early receivers.

By the time Armstrong went off to Columbia University in 1909 to earn his degree in electrical engineering, he knew more about the history of electronic developments and more about esoteric points of theory than many of his professors. Beyond this, however, he had an intuitive understanding of the movement and flow of electricity in circuits, derived from thousands of experiments. It was this seat-of-the-pants understanding of electronic circuits that brought Armstrong to the first of his major inventions in 1912. Late in the summer of that year, just before returning to finish his senior year at Columbia, an idea occurred to him while on vacation in the Vermont mountains. The idea, which is now used in virtually every television, radio,



Armstrong and his wife with the first "portable" radio while on their honeymoon in Florida.

and radar in existence, was to send part of the radio signal that arrived from the antenna in a loop, or "wing" as he called it in his notes, back to the beginning of the circuit after it had reached the end. When properly done, this reamplified the incoming radio signal again and again with each movement of the electrons through the loop. The principle, for obvious reasons, he called regeneration, although the more literal term "feedback" is now commonly used. The effect of this arrangement on his homemade radio receiver was astounding. Radio stations in Ireland, Nova Scotia, and Europe which had been lost in static emerged from the headphones with complete clarity. Many local stations were suddenly so strong that he could no longer bear to wear headphones, and he listened to their signals from across the room with the phones lying on a table. In his attic in Yonkers, as an undergraduate student in engineering, Armstrong had built the world's best radio, and redefined the basic principles of radio reception. He would also find during the next couple of years that feedback could be used to develop a new type of

transmitter, capable of bringing the spoken voice and music over the airwaves for the first time.

Armstrong's father, a solid Republican sort, didn't see the potential impact of his son's experiments, however, and refused his son the \$150 then needed for a patent application. After a hurried and unsuccessful canvass of friends, who were just as broke, Armstrong settled for having his lab sketches notarized and dated. Finally, a few months after his graduation, he applied for a patent on regeneration. It was issued in 1914, just after the beginning of the First World War.

America did not become directly involved in the War for another three years, and during this period Armstrong's fame began to spread. Use of his feedback circuit became *de rigueur* on the amateur radio set, and rights to various aspects of his patent were bought up by American Marconi. But American Telephone and Telegraph also began to use the circuit for long-distance telephone communications, without paying royalties to Armstrong,

and backed in a court action an inventor who claimed to have made essentially the same invention. It was to be the first of many legal battles for Armstrong.

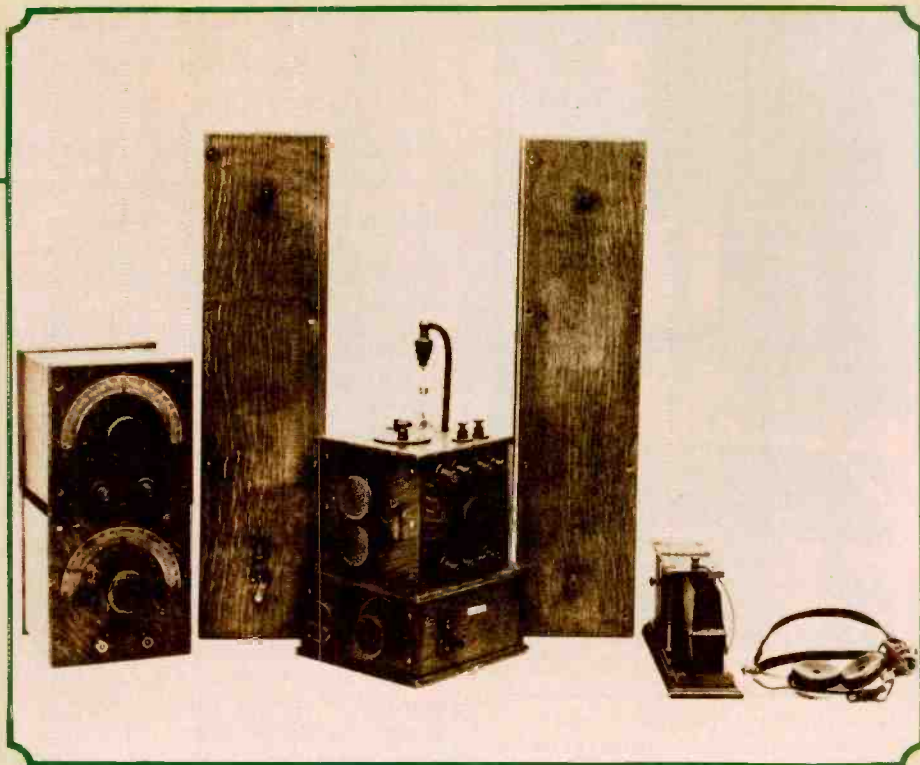
The entry of the United States into the war in 1917 took him from the world of patents and inventor's claims to France. Predictably, he became a member of the Signal Corps, and spent most of the war rebuilding allied radio sets to use the feedback circuit. In Paris, just before the end of the war, Armstrong, then 28, made his second great invention. It was called the superheterodyne circuit, and unlike feedback, it is a development of such subtlety that it defies easy description in layman's terms. Radio waves consist of electrical currents which vary rapidly; the exact number of variations per second is called their "frequency." These variations are unimaginably rapid to us. In 1917, radio engineers had learned how to construct transmitters and receivers capable of working with frequencies up to about 1,000,000 cycles, but above that they could not produce reliable results. The superheterodyne circuit was an arrangement by which very high frequency radio signals could be transformed into more easily handled lower frequency signals. This was accomplished by mixing the incoming radio signal with a second signal generated inside the receiver that differed slightly in frequency. The mixing produced a signal that was precisely the arithmetic difference between the other two, which in effect subtracted one wave from another, thus producing a third that could easily be processed and amplified. This development is found, in one form or another, in almost every broadcast reception device available today.

At the end of the war, decorated by the Allied governments for his assistance in improving field communications, Armstrong returned to New York, carrying the superheterodyne circuit in his head. At that time, rights to inventions developed by Army per-

sonnel could be retained by the inventor and sold. In short order, Armstrong did just that, selling commercial rights to both the feedback and the superhet patents to Westinghouse for a huge sum. He also defeated his opponent AT&T in the first court battle, and sold a refinement of the feedback principle called superregeneration to the newly formed Radio Corporation of America for another six-figure sum, plus 60,000 shares of RCA stock. Armstrong was all at once a wealthy man, young, full of new ideas, a celebrity living in the roaring twenties, the dawn of radio's golden age. He had, by the age of 30, accomplished the American dream in most every particular.

Armstrong fell in love, as young men of every era are wont to do. She was a tall, attractive secretary to RCA's legendary David Sarnoff, at that time Armstrong's friend. He approached her with the irresistible force of a successful entrepreneur accustomed to achieving his objectives. "How would you like to take a drive in a fast foreign car?" he asked her. "I'm leaving for France on a vacation tomorrow and I intend to buy the biggest and most expensive car I can find to bring back." He returned with one of the most exotic cars of the era — a magnificent fawn-colored Hispano-Suiza touring car, with which he courted Miss Marion MacInnis through the spring and summer of 1923. They were married in the winter of that year and honeymooned, in the style of the times, by driving the Hispano-Suiza to Florida. It was certainly one of the happiest years of Armstrong's life, and the last before the legal struggles enveloped him.

The AT&T-backed inventor Armstrong had beaten in court on his return from the First World War was Lee DeForest, a man justly renowned for the audion tube, an important building block in early electronics, but one also known for the formation of dozens of short-lived and ultimately bankrupt companies. DeForest, backed again by AT&T and later by RCA, fought a shrewd battle through the twenties to gain control of almost all of Armstrong's patents. Attacking



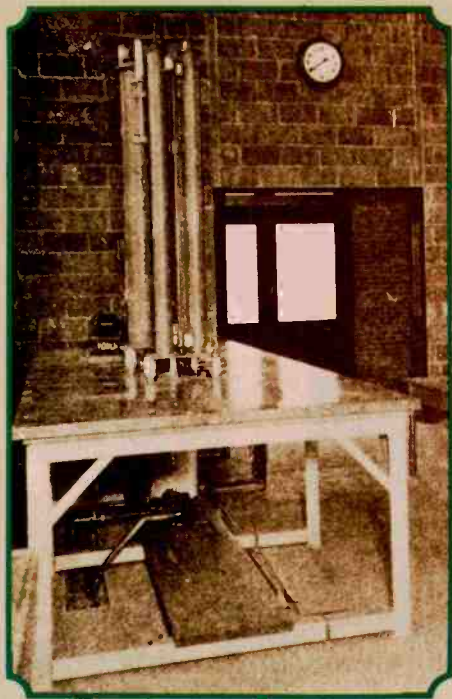
Armstrong's regenerative circuit apparatus, for which he was issued a patent in 1914.

again and again in different suits, he finally found a favorable issue for one suit, won a decision, and parlayed that decision into a stunning Supreme Court victory over Armstrong in 1934. It was one of the longest and most complex patent actions in American history, all the more extraordinary because virtually the entire scientific community as well as the lower courts rejected DeForest's contentions as clearly and obviously incorrect in the technical sense. When Armstrong, at a convention of the Institute of Radio Engineers, attempted to return the awards given him by the IRE for the developments, a unanimous motion of the membership reaffirmed his rights to the awards and requested that he keep them. But in the legal sense, and in much of the popular press, Armstrong had become a discredited inventor, with no right to take credit for radio's development.

But Major Armstrong, as he had come to be called because of his former Signal Corps rank, had one great idea left. Throughout the long le-

gal fight with DeForest, he had continued his laboratory research, searching, as were many engineers of the day, for a solution to the problem of static in radio reception.

Static is the electrical byproduct of natural events such as lightning and sunspot flare-ups, and to this day all AM radio reception is afflicted with it, since such natural events amplitude modulate the airwaves just as an AM radio transmitter does. Any radio receiver designed to pick up conventional AM radio signals must also pick up random natural electrical events and translate them into static. After 10 years of work, Armstrong had concluded that there simply was no way around this fact. The only means to achieve static-free radio reception was to change the way in which radio signals were broadcast and received so that natural events could not interfere with them. One way of doing this was to broadcast a radio signal in which the signal's *frequency*, rather than its *amplitude*, was constantly varied; this was FM (Frequency Modulated) radio. Between 1930 and 1933, Armstrong, now wiser about legal questions, filed a series of seemingly airtight patents



The construction of the coaxial circuit (on the table) for r.f. power amplifiers at station W2XMN.

which he believed gave him undeniable rights to FM broadcasting.

FM, however, would require both new transmitters and new receivers; neither broadcasters nor the public would want to buy one element unless the other were in place, a chicken-and-egg situation that could be resolved only by the formation of an FM network. Armstrong approached his old friend Sarnoff at RCA, which controlled the NBC radio network, and proposed the new system. For two years RCA conducted studies, asked for more information, and generally delayed decision on the issue. At one point Armstrong approached Sarnoff for an explanation of the delay. "There is a depression on," noted Armstrong, "and the radio industry needs something to put life in it. I think this is it." Sarnoff replied, "This is not an ordinary invention. This is a revolution." Sarnoff, the immensely successful businessman and corporate tactician, apparently realized that the higher fidelity of FM and the vast number of new stations it would require might lead to a complete, and for RCA perhaps devastating, restructuring of the broadcasting business. For these reasons, and because in 1935 he was

It can be argued that Armstrong was among the last of the great individual American inventors, a breed presently reduced in rank or perhaps extinct.

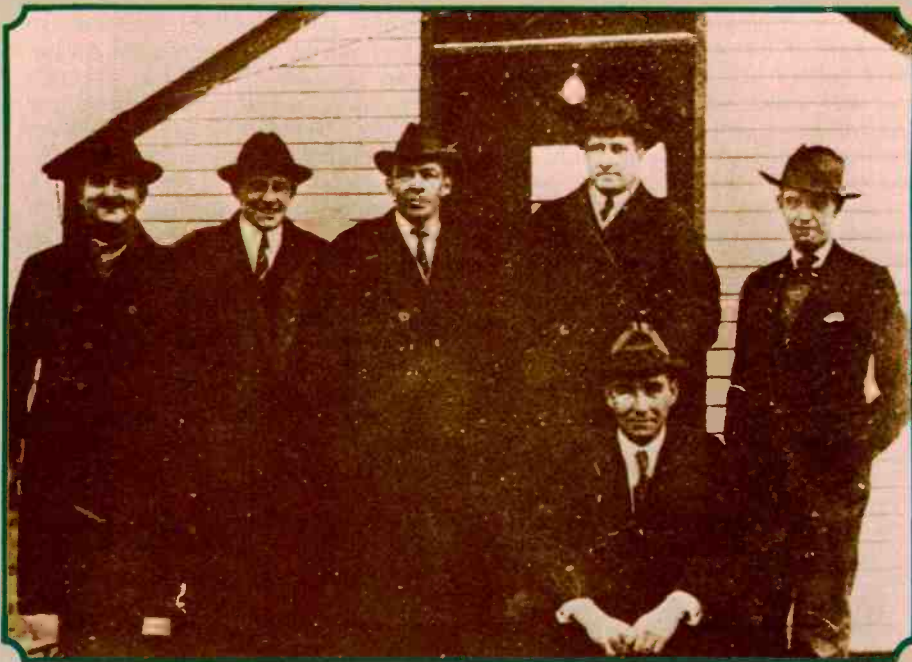
about to commission a wholesale corporate effort to develop television, Sarnoff saw no benefit to RCA in developing FM radio rapidly.

Left with no other option, Armstrong, now modestly wealthy but still a single, private individual, set out to commercially develop FM radio himself. He constructed a 400-foot broadcasting tower, which still stands on the Hudson River Palisades, and, after licensing a handful of other experimental stations to broadcast in FM, took to the airwaves himself. The first broadcasts proved false the rumors that FM wouldn't work. The quality of reception from his experimental station was beyond anything that had ever been heard on AM radio. Technically, Armstrong's station W2XMN had a wider band, lower noise, and lower distortion than any AM station in history and was static-free as well. Some 40 other FM stations, mostly small independent affairs with a few owned by large companies like General Electric,

quickly sprang up, despite maneuvering by the broadcast giants in Washington to have FM's broadcast band limited, thus reducing the number of FM stations capable of operating in any given area to five. Even RCA set up an FM station. It appeared that the new method of broadcasting was becoming established.

The Second World War intervened, however, bringing to a halt all work on new broadcasting projects, and reducing Armstrong's income enormously, since he made his patents available royalty-free to the government for military purposes. At the end of the war, Armstrong expected to pick up where he had left off and establish a commercially successful FM broadcasting industry. But a series of FCC decisions, advocated by the major broadcasting networks, dealt Armstrong and FM two telling blows. One moved FM from its old band to the present 88 to 108 megaHertz band, instantly rendering obsolete every FM transmitter and

Posing outside the transmitter house after sending a message to Scotland were (left to right) John L. Grinan, Ernest V. Amy, Armstrong, George E. Burhard, Minton Cronkhite, and (seated) Walker P. Inman.





Armstrong (at left) during a multiplexed transmission demonstration.


receiver in existence. The other cut back the maximum transmitter power of most FM stations. Armstrong spent the next two years attempting to recover from these decisions and to put FM back on the track.

All of the frustrations of his battles with the major broadcasters and radio manufacturers finally brought Armstrong, in 1948, to file a lawsuit against RCA and its subsidiary NBC for patent infringement on his FM broadcasting system. Every television set manufactured by RCA (and, for that matter, by anyone else) used FM for its sound channel, and RCA had also been manufacturing FM radios and, incredibly, licensing FM rights for several years. Armstrong sought to recover damages on TV sets made by RCA and its licensees, and thereby achieve some measure of repayment for the long struggle over FM broadcasting. This suit was to be his last battle, however. RCA's attorneys, taking advantage of the complexities of patent law, kept him on the witness stand for a full year, going over and over every detail of his invention of FM. After the courts finally cut off this interrogation, Armstrong's attorneys spent an addi-

tional two years examining every RCA record pertaining to FM — a monumental quantity of paper. Throughout this period, RCA held fast to its claim that Armstrong had only refined certain FM principles, and that most of the real work on bringing FM to commercial fruition had been done in RCA laboratories. On the witness stand, RCA Chairman Sarnoff stated that RCA and NBC had done more to make FM a reality than anyone else, including Armstrong, a statement which killed any remaining affection Armstrong might have felt for his former friend. During this period Armstrong devoted every waking hour to the trial, driving himself to exhaustion. And, toward the end of this period, he and his wife Marion separated, she to live for a while in Connecticut with a sister. The strain of being denied recognition of development of FM, as previously with feedback and the superheterodyne circuit, combined with the stress in his personal life finally proved too much for Armstrong. On a Sunday night in the late winter of 1954, he stepped out the window of his apartment 13 stories above Manhattan.

Ironically, his estate was ultimately victorious in each of the suits that had been filed against RCA and its licensees, settling most by agreement. And

the verdict of history, as represented by The Edison Medal, The Franklin Medal, and his inclusion among the 20 Great Men of the Union Internationale des Telecommunications, is clearly that he was the developer of all three of the devices in question and a world-class inventor on the scale of Bell or Whitney.

Armstrong, it might reasonably be argued, was among the last of the great individual American inventors, a breed presently reduced in rank or perhaps extinct, in a period during which vast corporations came to dominate virtually all scientific and technological development in this country. The Armstrong story would indeed make a superb play, all the more significant because the story is true. 

Note: Edwin Armstrong's biography, from which this article is in part derived, is called *Man of High Fidelity* and is by Lawrence Lessing. It is available from The Armstrong Foundation, Columbia University, New York, New York 10022. Price: \$2.00.

Armstrong on his broadcasting tower in Alpine, New Jersey during its construction.



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and the stiff needle suspension. As for other aspects of "convenience," the 1928 *Rigoletto* set (HMV C 1483-7, etc.; Vic. M 32) consisted of 15 discs weighing in at about 11 pounds, and the 1929 *Aida* (HMV D 1595-1613, etc.; Vic. M 54), comprising 19 discs, at about 15 pounds. (Today, there would be only three discs, at a little over a pound; tomorrow, who knows?) The music was interrupted every four minutes or so for a change cycle lasting 20 seconds. Nevertheless, you could relax while an entire work, up to three hours of music, played without effort on your part.

The machine which made this possible was by no means the only example of a record changer that played both sides of a disc. Many experimental changers were built during the late 1920s, generally using two turntables 45 degrees from the horizontal and mutually at right angles. The stack was placed on one of these, and after the top side of one disc was played, the record was transferred to the other turntable and the reverse side played. None of these large, costly, and tricky devices ever saw production. Just before the war, RCA Victor announced a "Magic Brain" changer which featured a single pickup with dual needles and first played the underside of the stack (rotating the disc by means of rollers) before dropping each disc in turn to the regular turntable. The contemporary paper record jackets illustrate this device, although I have never seen the device and it may not have been in production at all. A few such devices were actually manufactured (not by RCA) during the early LP era, but they were not satisfactory.

On the other hand, there was one

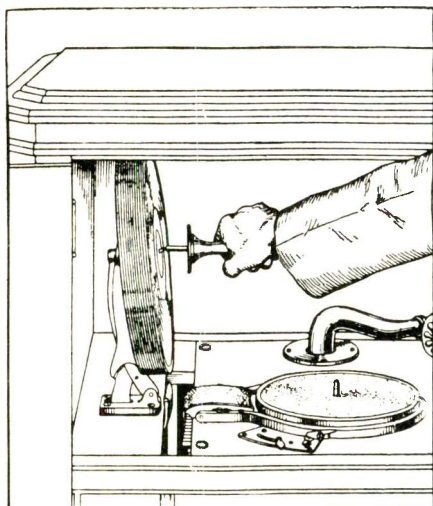
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Source Engineering,
Wilmington, Mass. 01887.

Fifty years ago, you could bring home a complete recording of *Rigoletto* or *Aida*, put it on a record changer, and sit back while the entire work played through without further attention to the records or mechanism. De-

spite the conveniences we have now that weren't available then, ironically this is not possible today.

True, the fidelity was far from high. The recordings were electrical, but the reproducer cut off at perhaps 4,500 Hz; if there was bass equalization, it came from resonance between the tonearm

Capehart

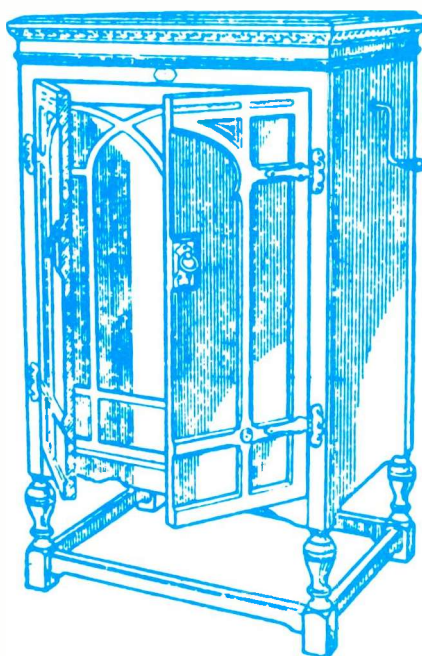


Victor's Automatic Orthophonic Victrola used a loader to stack discs on a magazine from which they were fed.

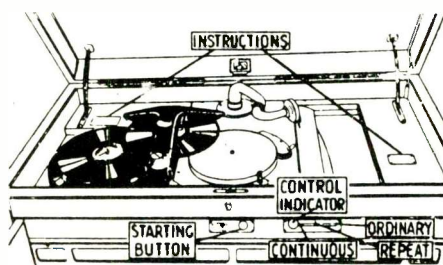
mechanical marvel, the Capehart, which was highly successful, remaining in production from 1930 to 1948. It performed the remarkable feat of literally turning each record over, and there was never more than one disc at a time on the single turntable. In a sense, it was the only true record changer which has ever been offered the public, in that it accommodated albums as they actually were at the time and did not demand that long works be pressed in any special sequence. It would, incidentally, play both 10-inch and 12-inch discs intermixed in any sequence.

The first commercial automatic changers were made in 1927 by the Victor Talking Machine Co. in the United States and by its affiliate HMV (the Gramophone Co.) in England. They both used acoustic reproducing systems and discharged records in turn into a hopper. But in other respects, these machines were quite dissimilar. Victor's Automatic Orthophonic Victrola required records be stacked on a magazine from which they were fed, one at a time, to a ring which lowered them to the turntable. After each record was played, the rising ring discharged it into a hopper before accepting the next disc. Unlike the Victrola, the HMV Automatic Gramophone would play intermixed 10-inch and 12-inch discs. It had a stack beside the turntable and a suction arm which lifted the topmost record off the stack and carried it to the turntable. After the disc played, the arm deposited it in a hopper before returning for the next

disc. (Incidentally, the exponential-horn acoustic reproducers of these instruments sounded a great deal better than many contemporary electronic systems and, if anything, did less damage to the records.) In 1928 Victor introduced an electric version of the same machine, using a magnetic pickup on the same tonearm in place of the sound box. HMV waited until 1930 to introduce the Automatic Electric Gramophone No. 12, which was a redesigned version of the suction-operated changer, but with shorter arm travel and a true electrical pickup. The



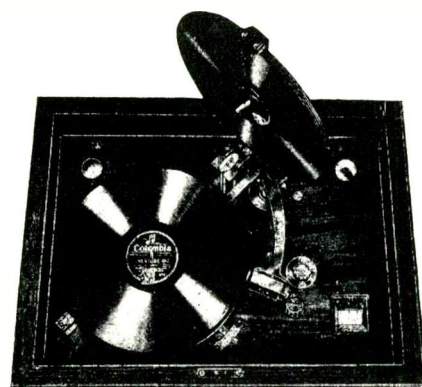
HMV Upright Grand, Model 202



The HMV played up to 20 records, 10 or 12 inch, in any prearranged sequence.

HMV machines are illustrated respectively in the contemporary catalog and in Ernie Bayly's book *The EMI Collection* (of early record-playing equipment). Mr. Bayly states that the HMV machines had a disconcerting habit of flinging records across the room!

Neither these machines nor the Eng-



G. Wilson's book showed the English Columbia 604 with the arm in the up or loading position.

lish Columbia "drop" changer then under development (illustrated from a 1932 book, *Gramophones, Acoustic and Radio*, compiled by G. Wilson of the still very much extant English magazine *The Gramophone*) would play both sides of a disc in sequence. Therefore, longer works had to be made available in sequences which would allow the changers to play them. A four-disc set could be coupled in two ways for this purpose: Side 1 backed by side 5, side 2 by side 6, and so on; or side 1 backed by side 8, side 2 by side 7, and so on. Of these, the first was more convenient if the operation of the mechanism had the effect of reversing the sequence of the stack, and the second (which is the one used with modern "drop" changers) if the stack remained in its original sequence. The two HMV Automatic Gramophones reversed the stack, while the Automatic Orthophonic Victrola did not. Thus, the earliest British HMV automatic sets used the first sequence, and the Victor AM sets (until 1932) used the second or "modern" sequence.

This was the background against which, in 1928, the Columbia Phonograph Company of New York (at the time, and from 1925 until 1931, controlled by Louis Sterling's Columbia Graphophone Co., Ltd., of London) built what was described to me by R. D. Darrell as a "Rube Goldberg contraption." This unit was designed to drop a record from a near-vertical stack, lower it by means of a ring like that of the Victor machine, play one side, turn the disc over, play the second side, and then eject it to a hopper. The process was to be repeated with succeeding discs. American Columbia was then marketing, with only moder-

Capehart

ate success, a line of radio sets and electric record players (with electronics from the Kolster Radio Co.). The firm decided that the cost of engineering this prototype for production was too high for that not very profitable branch of its then otherwise financially successful activities.

Enter Homer E. Capehart. Later a senator from Indiana, he had begun in 1928 to market a 56-selection jukebox called the "Orchestra"; this enterprise had prospered, and in 1929 he decided to enter the home-entertainment market by buying the Columbia patents. Capehart re-engineered the

changer for 1930 production in an interesting way — instead of ejecting records into a hopper, the machine replaced them on the stack. The space occupied by the changer was thus significantly reduced, and there was another consequence, good or bad depending on the point of view — the machine could not "know" when it had played through the stack once, and would go on playing indefinitely unless some outside agency intervened. It would accommodate up to 20 discs, 10-inch and 12-inch in any order, providing up to 180 minutes of music before repeating.

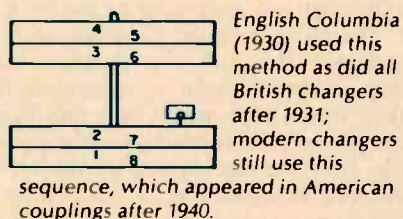
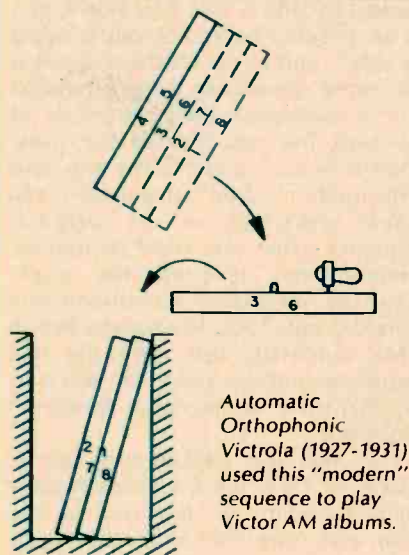
Another useful feature added was a one-side-only mode. By this time, Victor's AM automatic couplings were well established, and they had to be taken into consideration. One minor nuisance was that the discs were replaced on the stack the "other way round," effectively in reversed sequence. That is, the machine would play sides 1-2-3-4 of the four-disc example, but the fifth side would be the reverse of side 1, that is, side 8. So the machine would play the stack as 1-2-3-4-8-7-6-5, unless the operator intervened.

A lucky accident (from Capehart's

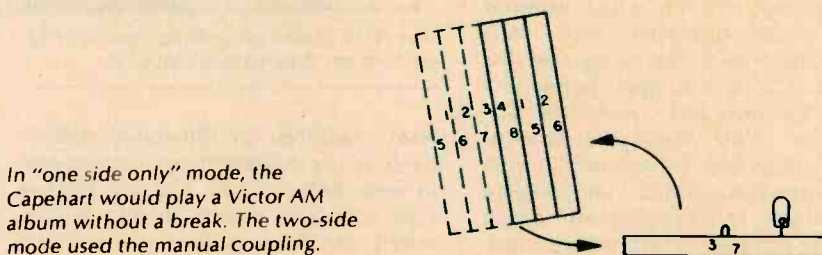
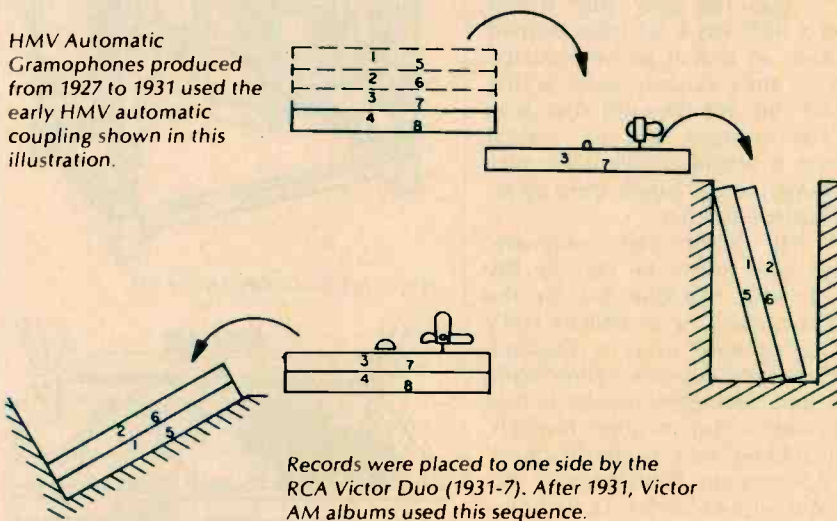
Album Sequencing for Changers

These changers are for the 1-8, 2-7, etc. sequence and leave the stack unaltered. When the second sides are played, the first to play is the reverse of the last record to drop.

These changers use the 1-5, 2-6, etc. sequence. The top two invert the stack; in playing the second sides, the first played is the the reverse of the first record.



HMV Automatic Gramophones produced from 1927 to 1931 used the early HMV automatic coupling shown in this illustration.



Capehart

point of view) occurred in late 1931 to remove this irritation. In conjunction with its new 33 $\frac{1}{3}$ -rpm LPs, Victor had introduced a new and appalling changer as part of the "Duo" series of reproducers. In this model, all discs were initially stacked on the turntable. Each record in turn, after its top side was played, was literally scraped over the rotating stack (scuffing it grievously) and slid into a padded bin. This had the effect of reversing the stack, which could then be picked up, turned over, and replaced on the turntable to play the second sides of the discs. Victor's older AM albums required restacking before the second sides would play in proper sequence on this machine, so from 1932 until 1940 AM albums were pressed in the 1-5, 2-6, etc. couplings.

In passing, we may note that in 1931 HMV began production of a "drop" record changer, which is shown in *Gramophones, Acoustic and Radio*. I once owned one of these incredibly well-made and powerful devices, which could easily crush a record that happened to catch in its jaws. Then the next year, Garrard introduced another type of drop record changer (illustrated from an E. H. Scott console in my collection). As a result, in the United States Victor went from the 1-8, 3-7, etc. couplings to the 1-5, 2-6, etc., while in Britain HMV and Columbia (both now part of EMI) went the opposite way.

Victor's new couplings were very convenient for Capehart, because the machine would then (and until 1939) play any American album all the way through, in the proper sequence.

The first Capeharts, like all of the other electric record players of their day, used a primitive precursor of the modern moving-iron (induced-magnet) cartridge. But there was a massive needle chuck and armature, so the damping material had to be made of very stiff material to raise the resonant frequency to an acceptable range of 4 to 5 kHz; the needle behaved like a compliance. As a result, very large needle pressures, often greater than those of acoustic machines, were required for proper tracking. The Victor "Duo" used almost half a pound, even on the Vitrolac LPs, which thus had a very short life. The earliest (1930) Capeharts also had power amplifiers, but no radios. The lack of a radio was not uncommon at the time, but by 1933 it was almost impossible to sell such an

instrument without one, so a very good radio set was included. This model and its successors, the prestige-laden "Four Hundred" series, became established as *the* home-entertainment center for those who remained well-off (there were some, of course) in the depressed '30s.

By 1933 Homer Capehart had been forced out of the company named for him; he went to Wurlitzer, which was making jukeboxes as substitutes for its once lucrative theater-organ business. Capehart's former company was taken over by the Farnsworth Radio and

1938, it still received a good deal of attention. Unlike other more serious problems, it is fairly easy to explain and is solvable in a manner obvious to the naked eye. (The parallel-motion idea was revived a few years ago. In the postwar years, Capehart sensibly abandoned its "True Tangent" pickup system.)

About this time, RCA Victor and other American manufacturers introduced drop changers very much like the inexpensive models of today. During the winter of 1939-40, Victor began to issue albums in the drop sequence



RCA Victor's Duo was made from 1931 to 1937. Note huge pickup head.

Television Corp. and concentrated on home entertainment.

An advertisement from the October, 1938 issue of *Country Life & The Sportsman* (a suitable choice because of its well-to-do readership) shows the later prewar Capehart changer with a crystal pickup, which at that time was in general use in the United States. This wasn't true in Britain, where its inadequate treble was unacceptable and where the magnetic pickup was being steadily improved; the half-pound ironclads had given way to two-ounce lightweights with quite reasonable treble response. The Capehart's tonearm is rigidly mounted in the pivot bearing, and only the head is free to tilt vertically. Notice the parallel motion which keeps the head tangential to the groove. Although tracking error is still a relatively small factor in distortion, as it certainly was in

as well as in the manual and what it called "slide automatic" sequences; the new (actually old) sequence was issued in DM albums. (After 1941, special pressings had to be ordered for slide automatic changers.) While owners of Capeharts would never have a real problem so long as the albums were still issued in the manual sequence, there was always the possibility that they might purchase or receive gifts of the wrong type of album. At any rate, Capehart felt obliged to provide some means of turning the changer off after a predetermined number of playings. This was incorporated in the more expensive prewar models via a stepping switch that could be preset by the operator; this was simplified in postwar models through the use of a mechanical ratchet wheel.

My changer was originally essential-

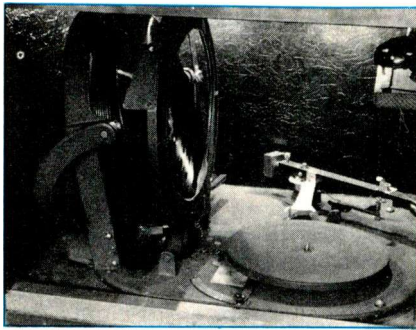
Capehart

ly like that in the advertisement, but it was taken from an electrically good (including the old 42 to 50 MHz FM band) but physically poor 1941 console of the less costly variety (no play control). One has the choice in such cases of trying to restore the equipment to mint condition or adapting it to present-day requirements. In this instance, I opted for the latter course. The cabinet was in very poor condition, and the changer itself needed extensive repairs since many of its pot-metal parts had rotted between 1941 and 1979. Such a changer is a very desirable possession to one who, like myself, has a large number of manual-sequence 78-rpm discs. Restoration would have meant in effect not using the machine, because the "featherweight" pickup was hardly acceptable for use on now irreplaceable records; it tracked at three ounces (say 90 grams) and cut off at 5000 Hz. So I decided to go the whole hog and adapt the machine to accommodate modern cartridges.

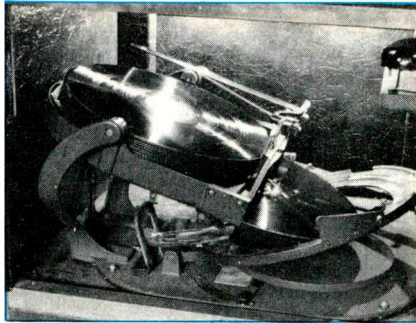
This entailed making the cabinet shown; amateurish, no doubt, but neat and sturdy. It was also necessary to make a completely new pickup which would not have to turn the original heavy pivot. A friction drive frees the pickup when it is playing, and lifts and turns it during the change cycle. The arm had to have the correct offset and overhang for a 10-inch pivot distance, so no standard arm could be used; I made it from scratch. It now accepts interchangeable cartridges in inserts also used with an Elac "umbrella" drop changer.

It was also necessary to make a new trip mechanism; again, the original was too stiff to be actuated by a modern cantilever assembly. Fortunately, the original trip mechanism was not part of the pivot (see the advertisement picture). The only work done by the pickup is to interpose an arm so that a pin on the turntable can do the work of putting the mechanism into cycle; the trip is of the velocity type, and works with any run-off groove, including those of large diameter. Play control was added by means of a stepping switch actuated by the trip solenoid and separate units and decades rotary switches.

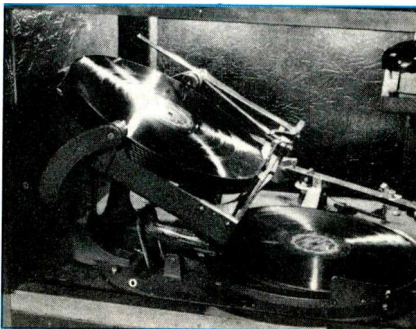
The new pickup was originally intended to track in the usual way with the cantilever supporting the head, at about 8 grams, which it did very satisfactorily. However, until about 1937



Stages in Capehart operation: Ring replaces previous disc, while . . .



. . . the basket moves the next disc from the stack and into . . .



. . . the turntable for play until the mechanism trips again.

there were no feed or lead-in grooves. With a heavy pickup there was enough friction to cause the needle to "skate" into the first music groove, but with 8 grams on hard shellac there is almost no friction (on vinyl it's another matter, of course). A small brush was added to the head in such a way that, with the needle on the rim, the bristles are in the first music grooves, and in two or three revolutions they drag the needle into the groove. As a consequence of experiments with optimum tracking, however, the brush is now so arranged that it does most of the work of supporting the head, so the force has been increased to about 20 grams. The bristles bend to the point at which the force on the cantilever is about 8 grams, measured by the deflection of


the cantilever relative to the cartridge. Greatly improved tracking is obtained, especially with warped records. The ostensible cleaning function of the brush, though of course present, is trivial compared with its other duties!

Apart from repairs and a few out-of-sight holes, the original parts of the changer were not modified. They were removed altogether and kept, new parts being made where necessary, so that it would be possible to "restore" the changer to its original appearance. The Capehart pickup, a pretty thing in its way, is displayed on a shelf inside the playing compartment.

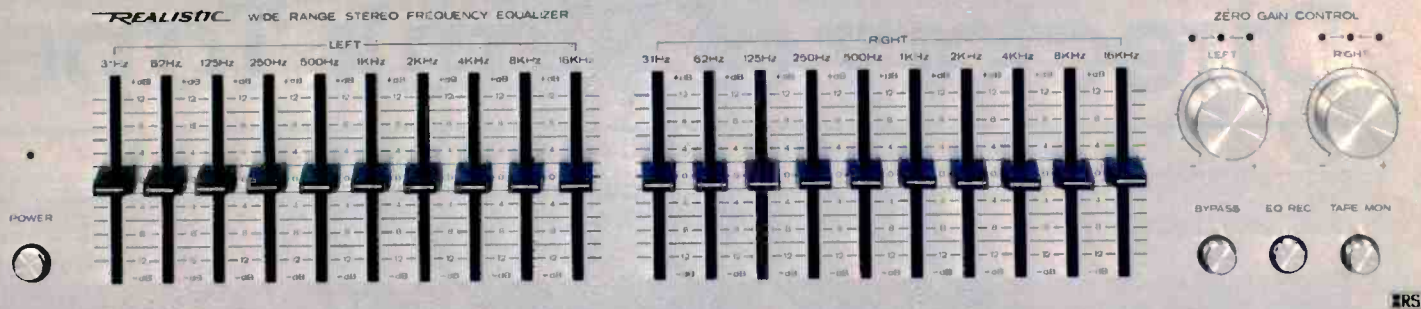
The machine is in daily use and, once the rather tricky adjustments which prevent it from taking bites out of records were completed, has proved very satisfactory and reliable. Rumble in particular is remarkably low, considering the massive motor; the leather universal joint and long effective turntable bearing (about 7 inches) provide excellent isolation.

Could a similar device be made today for LPs? Undoubtedly; and the fact that for operas only 12-inch albums now have to be handled would simplify the task somewhat. It would not have to be anything as massive or complex; compare a modern drop changer with a drop machine of the early 1930s and imagine comparable improvements.

Altogether, the Capehart was a remarkable machine. Its greatest appeal was in the 1930s, when it alone of all changers would play any American album, even those containing both 10-inch and 12-inch records, all the way through in proper sequence. It began to lose ground at the end of the decade, when inexpensive American drop changers appeared. There were also difficulties with the rough postwar "knife-edge" pressings which had begun to replace the smoothly rounded prewar rims (I cured these with a little work with a Swiss file.) But the appearance of the LP in 1948 doomed the Capehart; it probably cost too much to make by that time, as well.

No other changer has ever played both sides of a disc in such a satisfactory way, none has ever been gentler (with proper adjustment, otherwise, disasters happen), few have been better made, and probably none has remained in production with only minor changes for anything like the Capehart's 18-year span. Truly, it was a Mechanical Marvel. 

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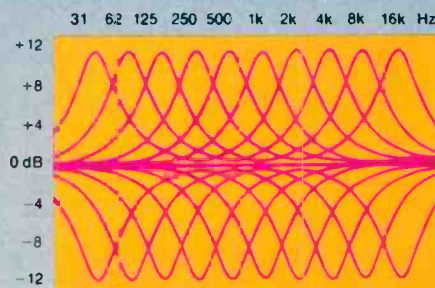
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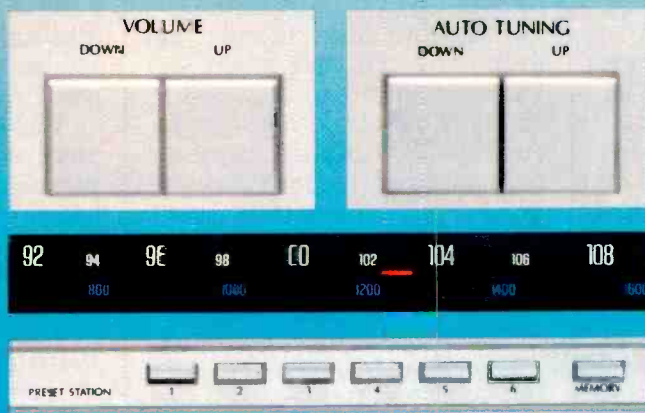
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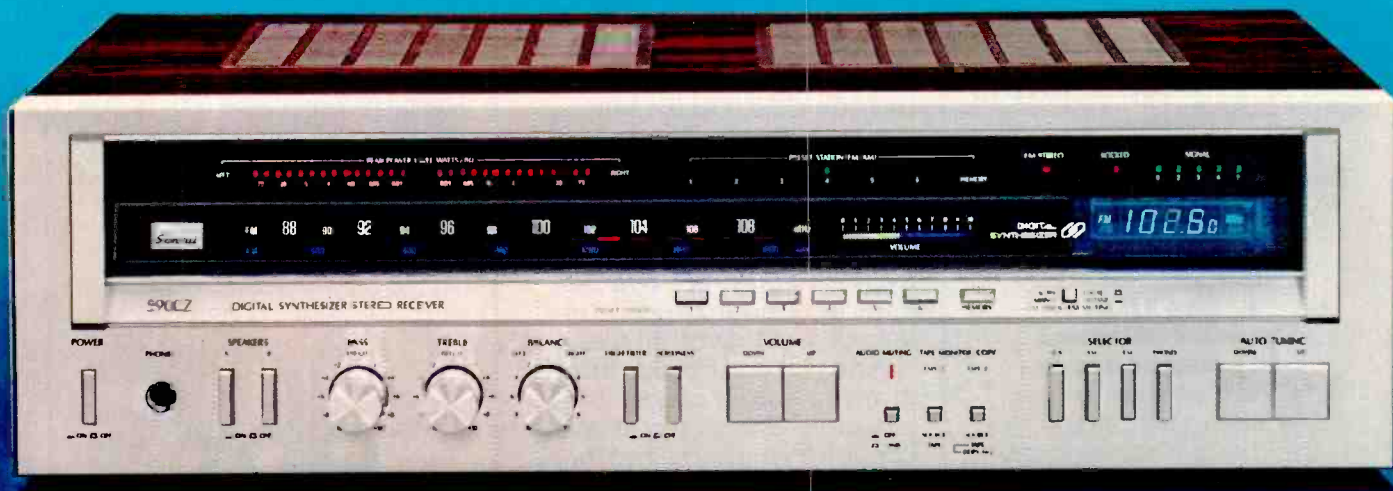
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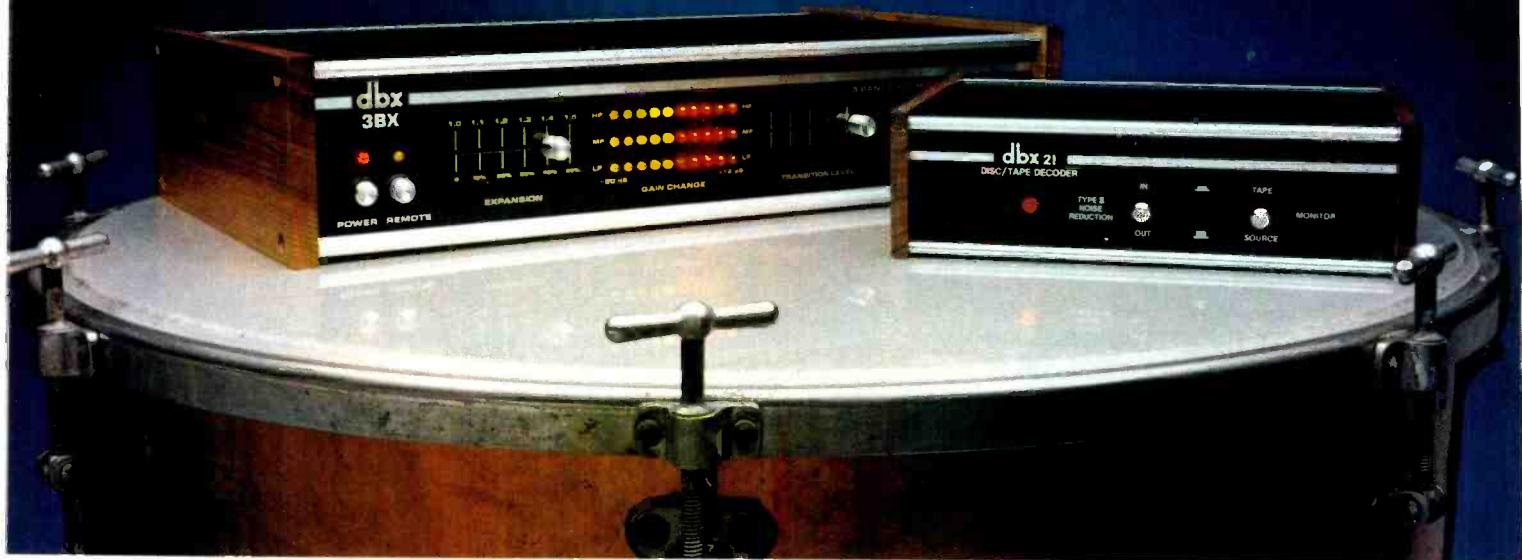
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Enter No. 11 on Reader Service Card

Blank Tape

MANUFACTURER	Brand	Recommended Bias Level	Cassettes						Open-Reel				Notes
			C-30	C-45	C-60	C-90	C-120	1200 Ft.	1800 Ft.	2400 Ft.	3600 Ft.		
MAXELL	LN	Normal		2.45†	2.70	4.10	5.30	8.70	10.00	14.95	21.25	†C-46.	
	UD	Normal		3.70†	4.00	5.90	7.90	9.95	11.50	28.30	31.90		
	UDXL	Normal											
	UDXLI	Normal			5.25	7.25		12.45	14.00	33.75	38.50		
	UDXLII	Normal			5.25	7.25							
MX	Chrome Metal		11.25†	12.50	14.95								
MEMOREX	MRX3 High Bass	Normal Chrome	2.99	3.19	3.39 4.39	4.99 5.99	6.79						
MR. CASSETTE INDUSTRIES	Correct Replacement DE	Normal			4.50	6.00	8.25						
	Correct Replacement HE	Normal			3.00	4.50	6.75						
	Correct Replacement LN	Normal			2.50	3.50	5.50						
	Grand Master	Normal				6.00			10.00				
	Grand Master Toyota	Chrome Normal			3.00	4.50	6.00		100.00				
NAKAMICHI	EX	Normal			5.30	6.60							
	EX II	Normal			6.00	7.80							
	SX	Chrome			6.30	8.00							
	ZX	Metal			9.75								
RADIO SHACK	Super Tape M	Metal			9.95								
	Super Tape C	Chrome			3.49	4.49							
	Super Tape Gold	Normal	1.49	2.59	2.99	3.99	4.79						
	Realistic Low Noise	Normal			1.89	2.59	3.19	3.49	4.49	5.49	7.29		
	Super Tape Ferric	Normal						4.99	5.59		9.99		
	Concert Tape	Normal							2.19				
RECOTON	RC	Normal			1.19	1.49							
	RU	Normal		1.29	1.49	1.79							
	STM	Normal						4.49	6.99			Five-inch reel. Seven-inch reel.	
	STM	Normal					3.99	5.99	7.49	11.99			
REVOX	621	Normal								36.00			
RKO TAPE	Ultrachrome Broadcast I	Chrome			4.20	5.99							
	XD	Ferric		2.36	2.60	3.66							
SONY	FeCr	FeCr		4.35†	4.75	6.10			14.00		39.00	†C-46.	
	EHF	Chrome		3.70†	4.15	5.75							
	Metallic	Metal		8.00†	10.00	13.00							
	SHF	Normal		3.40†	3.85	5.20							
	HFX	Normal		3.00†	3.20	4.55	6.20						
	LNx	Normal		2.05†	2.25	3.20	4.15						
	ULH	Normal						9.00	11.50		31.00		
SWIRE	XL	Normal		1.09	1.29	1.89	2.29						
	Laser	Normal		1.39	1.89	2.29	2.89						
TAPE 5	Wide-Latitude	Normal		2.99†	3.59	4.49	5.99					†C-46.	
TDK	MA-R	Metal			15.60	21.60						†C-46. C-180, 7.00.	
	MA	Metal			11.60	16.25							
	SA-X	High			6.00	8.40							
	SA	High			5.25	7.40							
	OD	Normal			4.70	6.60							
	AD	Normal		3.60†	3.85	5.60	7.75						
	D	Normal	2.50	2.75†	3.00	4.15	5.00						
Audua (LB)								10.00	15.65	42.50			
Audua (L)									12.50	35.00			
Audua (S)									10.00	23.75			
TSI	Agfa	Ferric		1.89	2.19	2.69	3.19						
	Concert	Ferric		1.69	1.99	2.49	3.00						
ZENITH	LN-HP	Normal		2.95	2.99	3.89	5.25						
	Budget	Normal		1.84	1.99	2.63							
	Ferrichrome	FeCr				8.50							

Noise-Reduction & Filter Systems

The Ace Audio Model 4100 Stereo Electronic (Active) Filter is intended to eliminate both low-frequency interference below the audio band and high-frequency interference above it. The subsonic filter section acts to prevent signals caused by record warps, off-center spindle holes, turntable rumble, tonearm mass/stylus compliance resonances, or accidental stylus drops from being fed to an amplifier (and wasting power) or loudspeakers (and causing excessive cone motion). The ultrasonic section may help prevent tweeter burnouts by removing the effects caused by r.f. interference, wideband noise, switching transients, and high-frequency harmonic distortion components. Price: Kit, \$66.50; wired, \$97.00.

The Allison Electronic Subwoofer is an audio bandpass filter and bass equalizer that can extend the response of Allison speaker systems flat to 20 Hz. Price: \$290.00.

The Burwen Research DNF 1201A Dynamic Noise Filter reduces noise levels up to 30 dB above 5 kHz and 14 dB above 400 Hz on two-channel and matrix-encoded material. The sensitivity control has LED readouts. Price: \$379.00.

Burwen's TNE 7000 Transient Noise Eliminator has an impulse suppressor to reduce or eliminate normal pops, ticks and clicks from turntables and tape decks. Price: \$299.00.

The Cerwin-Vega DB-10 Bass Turbo-charger boosts information in the 30 to 45 Hz range by 5 or 10 dB (switchable). The unit also acts as a rumble filter to remove undesirable subsonic noise caused by warped records, turntable rumble, etc. Price: \$90.00.

The Mitchell A. Cotter Co. Noise Filter Buffer is a time-domain corrected subsonic-ultrasonic filter which limits the bandwidth of the signal to the amplifier, allowing it to operate only in the audio spectrum. Price: \$500.00.

The dbx Model 128 incorporates an expander and the dbx II tape noise-reduction system in the same unit, allowing tape copies to be made with more dynamics and less noise than the original. Price: \$499.00.

The LT Sound D-2 Thompson Vocal Eliminator "subtracts" a recording's left channel from its right channel, greatly reducing or eliminating voices while leaving instrumentals intact. The unit has Delay, Level, and Pre-Bass controls and a microphone preamp and mixer circuit. Model TC-1 is similar, but it features a longer delay correction capability more suited for use with slow-speed tape formats such as cassette and eight-track. Prices: Model D-2, \$249.00; Model TC-1, \$495.00.

The LT Sound Model NR-2 provides both a 2:1 compander noise-reduction system and an independent dynamic range-enhancement system capable of 2:1 compression through 1:2 expansion. The sections can be made dual tracking or independent tracking. Price: \$195.00.

The LT Sound Model NR-4 provides four channels of noise reduction switchable from the record to the play mode two inputs at a time. Two-channel simultaneous record and tape monitor decode are also possible. Price: \$185.00.

Orban Associates' 516EC Dynamic Sibilance Controller contains three separate de-essing channels for vocal tracks with 8000-Hz minimum. Price: \$629.00.

Phoenix Systems' Tape Noise Reduction unit is a two-to-one compander with 12 dB of high frequency pre/de-emphasis. Prices: P518-S (kit), \$65.00; P518-SA (wired), \$99.00.

The SAE 5000A Impulse Noise Reduction System is designed to reduce the clicks and pops present in phonograph records and other program sources. Price: \$275.00.

The Source Engineering Noise Suppressor processes signals in four frequency bands. The top three are gated to transmit the signal and reject unmasked noise by 14 to 20 dB. Options are steep-cut 7 kHz or 3 kHz filters. Price: \$319.00.

The UREI 501 Sub-Sonic Processor removes subsonic sounds from turntable rumble, warped records, acoustic coupling of turntables to speakers, and wind blast in microphones. The unit has a two-position response switch: In the "Flat" position, response is -3 dB at 30 Hz and down more than 50 dB at 5 Hz, with a roll-off of 18 dB/octave. The "Boost" position adds a 5 dB peak at 40 Hz, down 3 dB at 27 Hz, and more than 40 dB at 5 Hz, also at 18 dB/octave. Price: \$84.00.

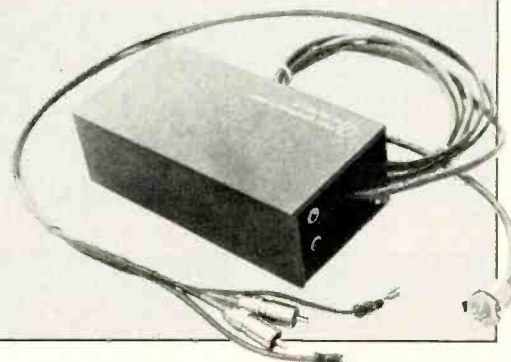
The VSP Labs Model 101 is a subsonic filter with a roll-off of 24 dB/octave. There are four selectable cut-off frequencies (20, 40, 80, and 160 Hz), a switchable bass boost of +6 dB at 40 Hz, and a tape monitor circuit. Price: \$129.00.

Cerwin-Vega DB-10



UREI 501

M. A. Cotter Co. Noise Filter Buffer



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Ambience & Time-Delay Units

The ADS 10 Acoustic Dimension Synthesizer is a digital time-delay system combining analog and digital technology with built-in amplification and accompanying loudspeakers. The system produces the time delays of the small to large acoustic spaces where live music is heard and extracts "hidden" hall ambience signals from many recordings and broadcasts. Model 1001 has similar features, but no built-in power amplifier or speakers. Prices: Model 10, \$1,150.00; Model 1001, \$700.00.

The Advent 500 SoundSpace Control is an acoustics simulator which models spaces up to 180 ft. in length through an additional amplifier and pair of speakers. The unit features a 32k Random Access Memory, and its THD at rated output is 0.1 percent. Price: \$799.95.

The Audio Pulse 1000 Digital Time-Delay System is an ambience simulator with a built-in dynamic-range expander. Features include digital display of delay and decay times, six initial delays from 7 to 95 mS, possible 8-channel operation, ambience defeat for FM mono voice, headphone amplifier with ambience mix control, separate rear-channel ambience control, and individual level controls for input and output. Ambience is continuously variable from 0.0 to 1.2 S, the expansion

ratio is from 1.0 to 1.5, and rear-channel output is completely noncoherent. Frequency response in the delay mode is 20 Hz to 10 kHz, ± 3 dB. Price: \$1,000.00.

The Audio Pulse Model Two Digital Time-Delay System has a built-in 25 W/channel integrated amplifier. The unit features input and output level controls with LED peak level indicator, three initial delays from 19 to 103 mS, continuously variable ambience from 0.1 to 0.6 S, and bass, treble and balance controls for precise adjustment of rear channels. Frequency response in the delay mode is 20 Hz to 8 kHz, and the rear-channel output (delayed) is noncoherent. Price: \$680.00.

The Audionics Space & Image Composer uses the Tate Directional Enhancement and Audionics Shadow Vector Systems to reproduce SQ² quadrophonic and stereo records and tapes with an ambient and directional quality said to be subjectively indistinguishable from four-channel master tapes. Its Stereo Enhance mode retrieves ambience and directional information from conventional stereo discs regardless of age. Price: \$1,095.00.

The Bang & Olufsen Ambio Box offers delay line performance without the necessity of a rear amplifier. Price: \$50.00.

Biamp Systems' SR/240 Stereo Reverb System helps attain additional separation. It has two type-9 Accutronics three-spring assemblies and an automatic hard limiter with LED. The EQ system has four frequency controls. Price: \$489.00.

The Bose Spatial Expander is a time-delay unit designed for integrated stereo systems of the firm's components. The CCD (charge couple device) time-delay process is said to add a lifelike ambience without reverberation to give the listener control over the three dimensions of sound: Frequency, time and space. Price: \$449.00.

The Dynaco SIE-1 is a stereo image enhancer that relies on the phase coherence of the two-channel information to sharpen and localize individual instruments. The unit's frequency response is better than ± 0.5 dB, 20 Hz to 20 kHz. Price: \$200.00.

Eventide Clockworks' 1745M Digital Delay System can double voice or instrument sound signals with an insertion of 12 to 40 mS delay. Audio recirculation switches can repeat 640-mS of signal. Price: \$4,100.00. 03 — Extra outputs, fully switchable, \$550.00 each; 08 — Variable pitch and high resolution readout, \$850.00; 09 — Remote control feature, \$550.00.



Audio Pulse 1000



Bose Spatial Expander



Audionics Space & Image Composer

Ambience & Time-Delay Units

Klark-Teknik's DN70 Digital Time Processor has digital readout, 625 mS maximum, in each of three main outputs. The unit also includes a quasi 15-bit analog-to-digital converter. Price: \$1,600.00. The DN34 Analogue Time Processor is a one-channel time delay system, having two separately controlled delay sections. Price: \$1,600.00.

The Koss K/4DS Digital Delay System includes an ambience amplifier and two loudspeakers, a crossfeed circuit, optional rack-mount handles, and an isolated headphone function with twin jacks. A bass rise switch permits equalization from 40 to 60 Hz, and delay time is in four steps from 13 to 70 mS. Price: \$459.00.

The LT Sound RV-2 Stereo Reverberation Unit is for line-level inputs only. To attain additional separation in the mix for a more apparent reverb effect, a Parallel or Cross Mix switch enables the user to cross the reverb produced by the right-channel input over the left-channel output, and vice versa, thereby attaining additional stereo effect. Price: \$305.00.

LT Sound's Reverb Control Center is a monaural device providing preamplification and volume adjustment for 2 low-impedance microphones and an equalization section. It is a three-section, paired-spring unit and has a decay time of 2 to 2.5 S without echo capability. Price: \$195.00.

LT Sound's Thompson Analog Delay, Model TAD-4, is designed to provide the type of ambience used by recording studios. It is stated to be capable of delays as long as 240 mS, or as short as under 50 mS. Greater depth and realism of the reverberation effect are produced by delaying the signal sent to the reverberation unit so that it already processes the echo effect. Price: \$650.00.

The Opamp Labs 1155 Mono Reverb System has a dual 14-in. spring assembly for line-level operation. Price: \$275.00.

The Orban Associates 111B Dual Spring Reverb is an independent, two-channel dual reverb with four springs per channel as well as controls for bass, midrange, EQ, and bandwidth for each channel. Also included are an LED fixed mode indicator and a floating output switch for each channel. Delay time is 30 mS. Price: \$749.00.

Phoenix Systems' P25 Analog Delay Line kit has a continuously variable delay of 5 to 100 mS with full 15-kHz bandwidth to 70 mS. The P25-SDL stereo version of this kit consists of two independently adjustable mono delay lines stacked in a single chassis. Prices: P25, \$150.00; P25-SDL, \$250.00.

The SAE 4100 Time Delay Ambience System features three variable delays that allow it to create literally any kind of desired spatial environment. Price: \$600.00.

The Sansui RA-700 Reverberation Amplifier features continuously adjustable reverb time with visual indication. It can handle two tape recorders simultaneously and add echo effects during recording or playback. Reverb time is 1.9 to 3.2 S (at 1 kHz). Price: \$190.00.

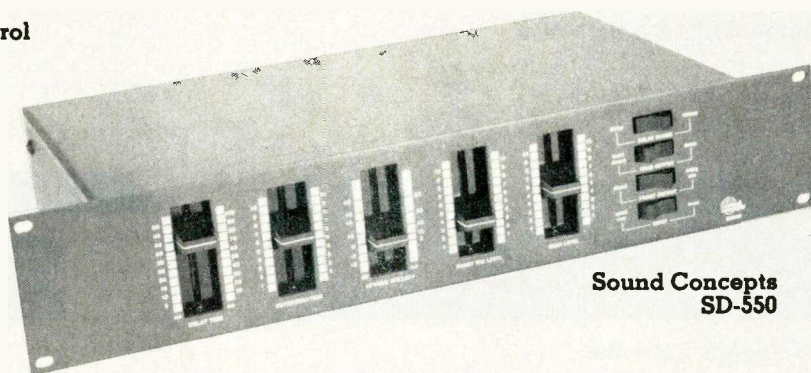
Sound Concepts' SD-550 Ambience Restoration System is a dual channel type system with a high-frequency contour from -3 to +6 dB. The 5 to 100 mS variable delay helps reproduce natural ambience from conventional sources without artificial reverberation. Price: \$729.00.

The Sound Concepts IR2100 Image Restoration Control cancels interference between speakers to focus and expand width and depth of stereo image. Price: \$229.00.

The Sound Workshop 242C Stereo Reverb allows mixing of one or two mono signals via active input. Output mixing will allow any signal ratio, dry to reverberant. Price: \$400.00.



**Advent Model 500
SoundSpace Control**



**Sound Concepts
SD-550**

Compressors/Expanders

Advanced Audio Systems' NR-2 compander unit needs no specially encoded material. The system utilizes a non-complementary noise reduction integrated circuit, and it provides a 14-dB reduction of source noise with an attack time constant of 1 mS and a release time of 50 mS. Price: \$144.95.

Biamp Systems' Quad Limiter has four independent channels to prevent excessive signal levels, with a variable threshold from -40 to +18 dB. Attack time is 1 mS; release time — 150 mS to 1.5 S. Price: \$249.00.

The dbx Model 3BX is a three-band dynamic range expander capable of increasing the dynamics of records, tapes, and radio broadcasts up to 50 percent, while reducing interference noise. Price: \$759.00.

The Draco Digital Expander processes the audio signal digitally, eliminating distortion and "breathing." THD and IM are said to be less than 0.05 percent, 20 Hz to 20 kHz (at any expansion rate). Price: \$650.00.

The Heath AD-1304 Active Audio Processor Kit can add up to 17 dB of dynamic range to program sources, with a 7-dB expansion range and 10 dB reduction. Price: \$200.00.

The MXR Comander is said to double the range of most tape decks with compression-expansion ratios of 2:1 and 1:2. There are no critical level adjustments, and continuous monitoring on three head decks is afforded by simultaneous compression and expansion. Price: \$150.00.

The MXR Dynamic Expander is a linear expander with variable expansion (1:1 to 1.6:1). It provides up to 8 dB of upward expansion and 21 dB of downward expansion and has a dynamic range of up to 110 dB. The unit's response time is signal dependent, while release time is user controlled. Price: \$300.00.

Orban Associates' 418A Stereo Limiter/Compressor has a switchable high-frequency limiter time constant of 75, 50, 37.5 and 25 μ S and a release time control. Price: \$795.00.

Pioneer's RG-2 Dynamic Range Expander improves dynamic range and reduces unwanted record and tape noise. Price: \$195.00.

The RG Dynamics RG X-15 Dynamic Processor reduces record surface noise and tape hiss, increasing musical dynamic range by up to 15 dB. The independent left- and right-channel processing was designed to sharpen stereo separation and allow the listener to more accurately place instrument location. Price: \$255.00.

The RG Dynamics RG Pro-20 Dynamic Processor features "programmed attack," a multi-stage logic circuit that provides a variable rate of processing to invert the numerous compression curves used in recording. Upward and downward processing are combined with peak unlimiting in an effort to restore transients and fine musical detail. Independent left- and right-channel stereo processing permits more accurate imaging, and each channel's action can be tracked on an LED display, with overall S/N improvements of up to 20 dB. Price: \$419.00; \$399.00 for rack-mount version.

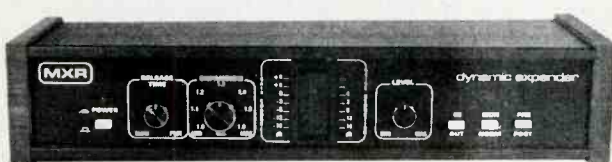
The Source Engineering VRE Dynamic Range Expander works on playback to expand dynamic range 8 dB upwards above an adjustable threshold. Alternate expansion dynamics are a combined downwards 8 dB and upwards 6 dB. Price: \$219.00.



Advanced Audio Systems NR-2



Draco Digital Expander



MXR Dynamic Expander

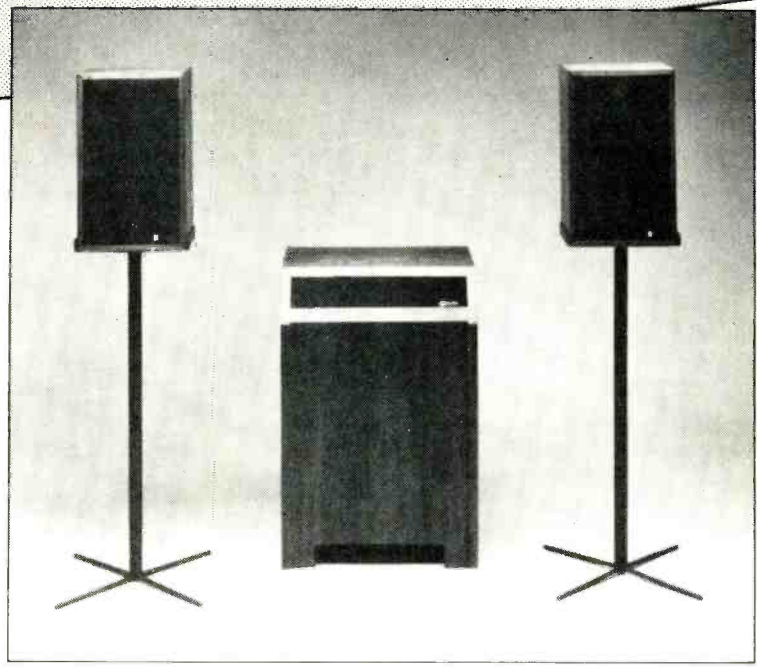


RG Dynamics RG Pro-20

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SANTA CRUZ: Water Street Stereo (408) 427-1604
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WOODLAND HILLS: Music and Sound (213) 348-4600
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GROTON: Stereo Lab (203) 447-9802
NEW LONDON: Stereo Lab (203) 447-9802
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- GEORGIA**
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MARTINEZ: The Stereo Shop (404) 863-9143
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LEWISTON: Audio Recorder Center (208) 743-4141
- ILLINOIS**
CHAMPAIGN: Audio Limited (217) 359-3774
HINSDALE: Quintessence Audio (312) 920-0170
- IOWA**
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PORTLAND: New England Music Co (207) 772-2869
- MASSACHUSETTS**
FRAMINGHAM: Natural Sound (617) 879-3556
WELLESLEY: The Music Box (617) 235-5100
WORCESTER: Natural Sound (617) 754-6856
- MICHIGAN**
ANN ARBOR: Absolute Sound (313) 662-2026
DETROIT: Absolute Sound (313) 527-2244
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GRAND HAVEN: Tri-City Sound (616) 846-5140
MIDLAND: Sound Decisions (517) 631-3781
ROYAL OAK: Absolute Sound (313) 549-7550
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MILBURN: Audio Advocate (201) 467-8988
MONTCLAIR: CSA Audio Design (201) 744-0600
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- NEW YORK**
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BUFFALO: The Speaker Shop (716) 837-1557
HICKSVILLE: Designatron (516) 822-5277
ITHACA: Stellar Stereo (607) 272-2644
N.Y.C.: American Audiophile (212) 751-9733
ROCHESTER: Gala Sound (716) 461-3000
SCHENECTADY: Progressive Audio (518) 370-4348
SETAUKET: Designatron (516) 751-0253
VALLEY STREAM: American Audiophile (516) 561-7114
WAPPINGER FALLS: Sound Odyssey (914) 297-6922
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RALEIGH: Audio Works (919) 828-7982
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HURON: Audio Connection (419) 433-6069
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PHILADELPHIA: Chestnut Hill Audio (215) 923-3035
PITTSBURGH: Opus One (412) 281-3969
- SOUTH CAROLINA**
GREENVILLE: Music Machine (803) 232-8171
HILTON HEAD: The Gramophone (803) 785-7100
SPARTANBURG: Audio Master (803) 573-9397
WEST COLUMBIA: Upstairs Audio (803) 791-1885
- TENNESSEE**
JOHNSON CITY: Sound Concepts (615) 929-1122
MEMPHIS: A. D. Studio Sound (901) 795-3963
NASHVILLE: HiFi Corner (615) 383-6600
- VIRGINIA**
ROANOKE: Audiotronics (703) 982-3619
VIRGINIA BEACH: Digital Sound (804) 424-5850
- WEST VIRGINIA**
GRAFTON: Sound Haven (304) 265-3388
- WISCONSIN**
MILWAUKEE: Audio Emporium (414) 354-5082
OSHKOSH: Audiophile Specialists (414) 426-1100

3D ACOUSTICS

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Valley Stream, NY 11581
(516)-561-7555

Directory of Manufacturers

A

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East Northport, N.Y. 11731

ADS
1 Progress Way
Wilmington, Mass. 01887

Advanced Audio Systems
4040 Moorpark Ave.
Suite 200
San Jose, Cal. 95117

Advent
195 Albany St.
Cambridge, Mass. 02139

Aiwa
35 Oxford Dr.
Moonachie, N.J. 07074

Allison Acoustics
7 Tech Circle
Natick, Mass. 01760

Ampex
401 Broadway
Redwood City, Cal. 94063

Audio Magnetics
P.O. Box B-G
Irvine, Cal. 92716

Audio Pulse
4501 Arden Dr.
El Monte, Cal. 91731

Audionics of Oregon
10950 S.W. 5th Ave.
Beaverton, Ore. 97005

B

Bang & Olufsen
515 Busse Rd.
Elk Grove Village, Ill. 60007

BASF Systems
Crosby Dr.
Bedford, Mass. 01730

Biamp Systems
10950 S.W. 5th Ave.
Beaverton, Ore. 97005

Bose Corp.
100 The Mountain Rd.
Framingham, Mass. 01701

Burwen Research
145 University Ave.
Westwood, Mass. 02090

C

Certron Corp.
1701 S. State College
Anaheim, Cal. 92806

Cerwin-Vega
12250 Montague St.
Arleta, Cal. 91331

Mitchell A. Cotter Co.
35 Beechwood Ave.
Mt. Vernon, N.Y. 10553

D

dbx Inc.
71 Chapel St.
Newton, Mass. 02195

Deñon America
27 Law Dr.
Fairfield, N.J. 07006

Direct-To-Tape Recording
14 Station Ave.
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Jon Tiven

Michael Tearson

The column



Panorama: The Cars
Elektra SE-514, stereo, \$8.98.
True Colours: Split Enz
A&M SP-4822, stereo, \$7.98.

The Cars are a triumph of style, which is obviously their strongest asset ... about three-quarters of the groups in the New Wave sound almost identical to them. Despite their sonic resemblance at times to Roxy Music and Talking Heads, the first Cars album is the record that is used as the yardstick by which many new albums are measured. It is a shame that **Panorama**, like

its predecessor **Candy-O**, doesn't measure favorably against their debut album (primarily due to songwriting stagnation and a refusal to be anything but sparse-sounding). On the other hand, **Split Enz**, a written-off underdog that one would have ascribed to obscurity one year ago, has come up with a record album in a vein similar to the first Cars LP and every bit as good.

First off, I don't think there's a smash hit single on the new Cars album (at least *Let's Go* was that), although it does have consistency. The

general approach is one of complacency, with producer Roy Thomas Baker resorting to "it's worked before, let's use it 10 times more" for the general production sound. Although they all play well, especially guitarist Elliot Easton, there is none of the melodic brilliance of *Just What I Needed* or *My Best Friend's Girl* here; what in the past seemed slightly weird now seems to be somewhat matter of fact. Much of the material is practically talked rather than sung, as if the lyrics were an afterthought to the musical tracks and didn't always work. Although they are adept at working their formula, The Cars have not really moved forward. When so many of their imitators and products of their influence are sounding more and more like Cars clones, it's somewhat of a letdown when Ocasek and his crew don't sound much different.

Split Enz owes a heavy debt to The Cars even though they've been around for many years; only recently have they fallen into this particular bag, but it fits like a glove. They are *truly* odd sounding — throwing chords into songs that should sound wrong but *don't*, using stops and rhythms which are stranger than fiction, and making it all work. *I Got You*, the lead-off track on the record, is a smash, but no more conventional than anything else on the record. Dave Tickle, a Mike Chapman protege, produced and engineered the record in a manner which is virtually immune to criticism. This group's colors are not only true but flying — they've got the charismatic power of a new group after five years of struggling, and have made one of the most enjoyable and novel records of the year. *Jon & Sally Tiven*

Cars

Sound: B+

Performance: C-

Split Enz

Sound: A-

Performance: A-



Illustration: Rick Tulka

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Come Upstairs: Carly Simon Warner Bros. BSK 3443, stereo, \$8.98.

If the question you've been pondering for the past few months has been, "I wonder how the James Taylor/Carly Simon marriage is working out?" just put down that trashy gossip sheet. Pick up **Come Upstairs** and hear Carly tell it in her own words. "James," she sings on the track of said title, "The beauty of your voice lifts us from sadness." Marriage hasn't made *her* any less a fan. Or on motherhood she croons, "I got big and round and lovable/he saw I was immovable/he got bored, went to war/I got one baby, he's giving me more." Musically speaking, the album is mildly listenable thanks to the usual hot sessionaires led by producer/collaborator Mike Manieri, but it's very difficult not to be embarrassed by the lyrical bent. **Carly Simon Sings Come Hither Music For Young Mamas** might

have been a better title for her latest, with a disclaimer sticker declaring the album's pseudo-erotic leanings. "Come upstairs, you can take off my clothes," she sighs on the title cut. Oh Car-lee!

It Keeps You Running was her last real hit, and that was written by The Doobies, so you'd think she'd take the hint and just find one killer track written by somebody else. She's still a terrific singer, but her material is just a little esoteric. The cover photos are very nice, however, and the fact that she chooses a gifted musician such as Mike Manieri to help her along shows that there is a degree of taste left in the lady. But as far as Carly Simon, Songwriter — you better stick with her first three albums.

Sally & Jon Tiven

Sound: B +

Performance: D +

Xanadu: Electric Light Orchestra/Olivia Newton-John

MCA 6100, stereo, \$8.98.

Lights in the Night: Flash and The Pan Epic E 36432, stereo, \$7.98.

The Electric Light Orchestra's meteoric rise to chart domination is not only quite disconcerting, it seems almost directly disproportionate to their creative success. Leader Jeff Lynne's writing hardly reaches the heights that it did with either The Idle Race or The Move, although he manages to grind out a single or two per

year which keeps the John Lennon fans happy (myself included). The ELO style is too easy to knock — whatever pretensions they may have, Randy Newman's articulated it all better than we ever could — but we wouldn't find them disappointing if we didn't think that Jeff Lynne is 12 times the writer that he lets on to being. Their contribution to this soundtrack is minimally engaging, sounding like the typical ELO tracks without much individual distinction. We suppose they're pretty much tailor-made for the audience

that the artist on the other side of the record attracts, but we sure wish that they would come up with a record that sounds less like "product." In case you were expecting something more than the soundtrack to a movie, be advised to look elsewhere.

Flash and The Pan are going for a very similar sound, but fortunately are in a state of their career which at least at present has afforded them greater creativity. Granted, the two behind this project (Vanda & Young) are fairly crass individuals yet probably have a wholly workmanlike attitude toward their records. It comes out sounding a lot more interesting than the ELO records, possibly because Vanda & Young don't have the kind of success that requires them to stretch out for the most homogenized level of appeal. In short, it's far more interesting, we suppose, to listen to an artist who's trying to find his audience than it is to watch a fairly popular group trying to broaden their base of appeal.

Jon & Sally Tiven

ELO

Sound: B- Performance: C+

Flash

Sound: B+ Performance: B

Duke: Genesis Atlantic SD 16014, stereo, \$8.98.

In a lot of ways Genesis is interchangeable with Kansas — both being big and ponderous sounding bands, based most around keyboards with songs that have big and ponderous lyrics. So why does Kansas' music leave me utterly cold while I find Genesis' music consistently involving and engaging?

Maybe it is the underlying pessimism of Genesis' attitude against what I perceive as a sappy core in Kansas' very being.

Duke is the first Genesis album in about three years, and it is clearly a worthy addition to the band's works. Although it expands their musical horizon and scope not one whit, as a whole unit it hangs together very well, perking interest. The cover presentation, consisting of Lionel Koechlin's charming children's book illustrations, greatly assists in defining the very real if interpolated storyline around the theme of battered innocence (not unlike Pink Floyd's *Wall*, come to think of it). There's the *Duchess* who as a pop star briefly burned bright and then burned out. There's Duke himself before the TV, like Chance in "Being There," for the song *Turn It On Again*. There are the lost opportunities of

Misunderstanding. The key lies, methinks, in the lyrics of *Guide Vocal* which reprise in the *Duke's Travels* finale. But probably the story is best left to your own imaginative devices. This is one reason lyrics are provided. Another is that, as they characteristically do, Genesis has occasionally submerged the vocals in the tapestry of the mix.

Duke is an unusually long album, about 57 minutes in all. For sides that lengthy, the sound levels hold up remarkably well, and the pressings I've

heard have been unusually clean for Atlantic Records. (Consumer's Notice: When a record is this long the spaces between grooves tend to be very thin, allowing the record to be scratched more easily than usual. Record care is paramount).

Genesis is that rare item in rock, a band that takes itself very seriously without being pretentious. Repeated listening only enhances the album.

M.T.

Sound: B

Performance: A-

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3

Series 1, Number 3

Program-to-Program Crosstalk

In this series we are discussing the various aspects of preamplifier performance which vitally affect the overall sound of your high-fidelity music system.

The third of these is the fact that most equipment has audible crosstalk from one program source to another. This means that while trying to tape records, for example, the FM tuner is being recorded on the tape along with the record, albeit at a lower level. Many systems thus call for extreme care when doing critical listening or taping since all offending sources of crosstalk must have their power switched off.

Another curious problem involves the tape monitor switch used with three-head tape machines. An *echo* can arise due to the loop formed by the record and playback chains. The signal from the program source is recorded and a moment later played back. The playback signal is returned to the tape-monitor switch in the preamplifier, *then crosstalks back into the input of the recorder!* This arises due to the close proximity of the signal being sent to and the signal returned from the tape recorder appearing just across the tape monitor switch from one another.

The Apt/Holman Preamplifier contains extensive treatment of such crosstalk including program-to-program and tape monitor switch originated types. This is accomplished by devoting special switch sections just to the purpose of cancelling crosstalk; e.g., the tape monitor switch is a six-pole type rather than the common two-pole type, and crosstalk is prevented by multiple switching. Under real system conditions, the crosstalk is thus *always inaudible*.

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Crimes of Passion: Pat Benatar Chrysalis CHE-1275, stereo, \$8.98.

There's no question about Pat Benatar's great vocal chops and dynamic, sexy presence. Her second album with production by Keith Olsen shows improvement and increased confidence over her first.

When the material is hot, as with The Rascals' oldie *You Better Run*, her own *Out-A-Touch* or Kate Bush's evo-

cative *Wuthering Heights*, Benatar is terrific. Even when the material is dull she is still exciting. But then the weight of supporting lesser songs would hold down anyone this side of Sinatra. As a writer, Pat has helped pen some interesting stuff; still, she is clearly no great shakes. But hold it — the lady's coming on. M.T.

Sound: B-

Performance: B-

Stare with Your Ears: Ken Nordine Snail SR 1001, stereo, \$7.98.

You may not know it but you've been hearing the voice and compositions of Ken Nordine for all or most of your life (depending on age). He is one of the best, most distinctive, and classiest announcers and producers of commercials for radio and TV in the business. You have almost certainly seen or heard his work for Gallo wines, Maxim coffee, and especially his brilliant series of Levi's spots to name but three. He has also made a series of four albums under the umbrella title "Word Jazz," plus a couple of special project albums. In fact, the first of the

Levi's commercials ("One day a pair of blue jeans came into our town . . .") was adapted from *Flibberty Jib*, a classic Word Jazz piece that Ken had done for the first Word Jazz album over 20 years ago.

Those Word Jazz albums as well as the best of the series the label, Dot Records, issued are all very rare and highly treasured collectors items (some of which I've been after for years. Write c/o *Audio*). So, too, is a more recent two-record retrospective that Blue Thumb issued and might still be found with the title **How Are Things in Your Town?** after the killer last line in *Flibberty Jib*.

The new album is Ken's first in at least a decade, far too long. After enough spots and jingles and radio station ID packages, Nordine has formed his own record label, Snail Records, for the purpose of presenting some new Word Jazz-type stuff and other things that interest him. Big commercial success is not the primary goal for Snail, as time is made into an ally instead of a commodity. Ergo the name Snail.

If I haven't said it yet, it bears saying. Ken Nordine's voice is one of the finest instruments anywhere and at any time in its field. Those who would kill for pipes like his are legion.

Which at last brings us to **Stare with Your Ears**. If it does not match the intensity of the old Word Jazz things, it is not alone. Very little is that intense. Still, it is truly delightful and like nothing else. If Ken has developed an apparent affinity for meter and rhyme and occasionally speaks/reads with a jaunty melody and angelic voices in attendance, that's his prerogative. His words are as perceptive/kooky as ever. And the best pieces are still those with the more eccentric settings, where he has allowed his fertile mind the freest rein.

Ken's compositions are about mundane everyday things like blisters, the alphabet, life and death and beyond to immortality. His greatest triumph is transforming the ordinary into the bizarre and wondrous. Describing what he does is pointless; it describes nothing. Ken Nordine defies it.

Ken's own studio in Chicago is where the record was cut. Like everything he has recorded, **Stare** is quirky and imaginative in recording techniques. It is very spacious with superb stereo and excellent clarity. And that voice that can move mountains with a word.

To call **Stare with Your Ears** a joy is to be too mild. Ken Nordine has been one of my greatest heroes ever since I was turned on to him through WDAS-FM's early progressive rock programming in Philadelphia fully a decade back. **Stare with Your Ears** is a godsend that I've hoped for for years. It is not as powerful as the old Word Jazz, alas, but what is? It is Ken Nordine doing what he likes and wants to do, and that's enough for me. I only hope it won't be 10 more years until his next album. He's first cousin to a national resource.

Oops, I see the spot with the dancing trousers coming on the TV. Gotta go. It's the best thing on. M.T.

Sound: A Performance: B

Uprising: Bob Marley & The Wailers
Island ILPS 9596, stereo, \$8.98.

Bob Marley has stagnated somewhat and on his latest album seems to be perpetually writing in the key of B flat, but aside from these relatively minor complaints he's written yet another chapter of his continuing saga which, by the way, makes the 2-Tone bunch look absolutely vapid by comparison. The fact that groups like The Specials and Madness have achieved recent fame and fortune is somewhat unsettling in the light of talents like Marley — then again, The Flash Man will always attract followers more easily than a man who speaks with quiet integrity. Bob Marley is the reggae gospel preacher, regardless of how good or bad his recent album is, and the rest of the recent ska bands are simply taking advantage of a style that they really have nothing to do with.

Not that Marley's latest needs apologies — I'd like to hear him back with producer Lee Perry once again. Like most Marley albums there's one cut here, *Could You Be Loved*, which makes the rest paler somewhat by comparison. But there is practically no one else even in his ballpark (whatever happened to Peter Tosh and when is Junior Murvin going to make an album again?), and those who can even come close are mostly former members of his band (like the aforementioned two and Bunny Livingston). For the moment, this is the only reggae album of the year — he's been better, but by everyone else's standards this is superior stuff.

Jon & Sally Tiven

Sound: B Performance: B



3

Series 2, Number 3

Load Drive Capability
(continued)

In this series we are discussing the various aspects of power amplifier performance which vitally affect the overall sound of your high-fidelity music system.

The third of these is that loudspeakers produce a widely varying and complex load on the amplifier since they are complex impedances which can store power and return it to the amplifier. This calls for a large measure of conservatism in rating the capabilities of an amplifier, since the complex "load line" caused by speaker impedances is much more difficult to drive than the usual test-bench resistive load.

The classical understanding of reactive loads has accounted for a straight load line caused by a resistive load, and an elliptical load "line" caused by load reactance. These "lines" describe safe-area excursions within the amplifier's output stage and determine the amplifier's required output stage power capability. Recently we found and published the fact that loudspeakers demonstrate at least two effects not accounted for in theory up to this time: many loudspeakers exhibit non-ideal load lines that use up more safe-area than might be expected, and many show a strong drive level dependency, requiring more capability than small signal measurements would lead one to believe.

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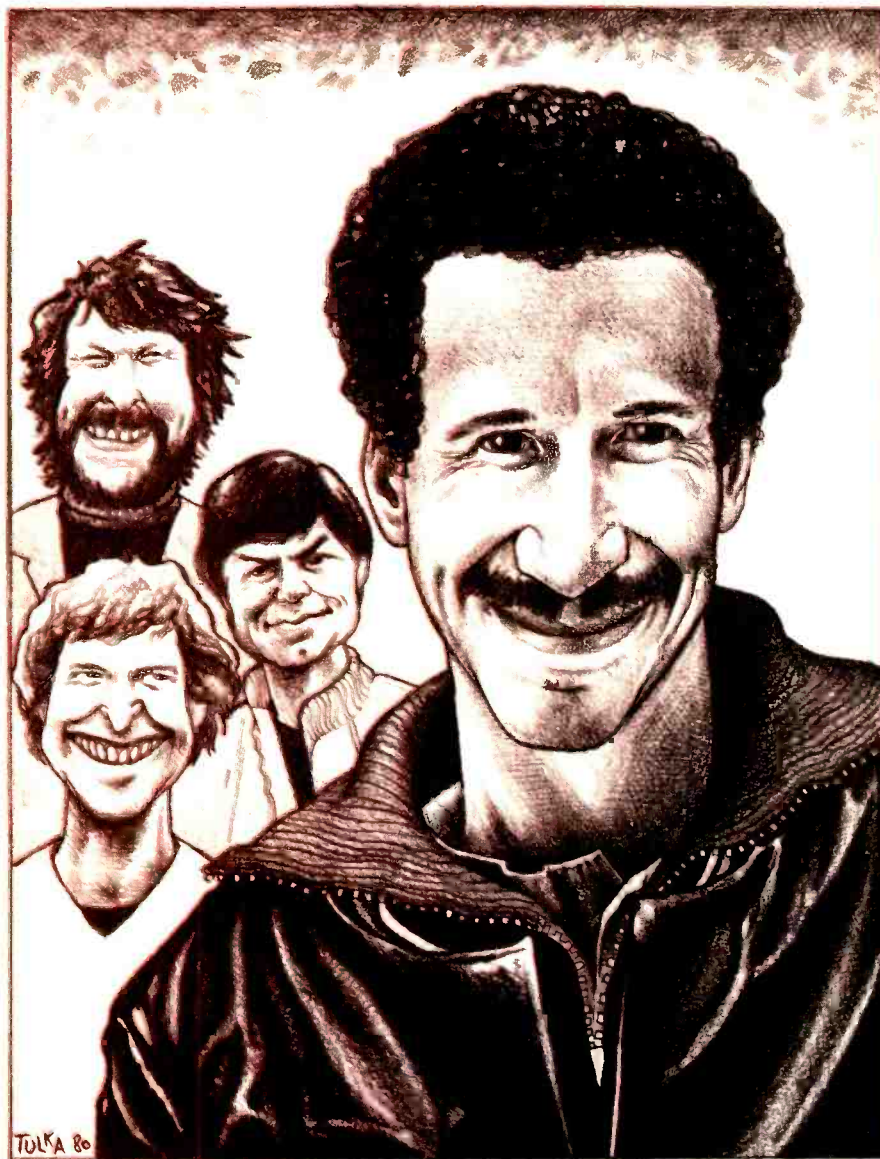
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Jazz & blues



Nude Ants: Keith Jarrett
ECM ECM-2-1171, 2 discs, stereo,
\$13.98.

The music of Keith Jarrett has grown progressively more varied over the years as he seeks to embody several often divergent disciplines. His popular solo piano excursions are free flights of spontaneous improvisation while his orchestral recordings, **In the Light** and **Luminescence**, offer a tightly controlled and executed insight. He's shown himself to be a grossly self-indulgent multi-instrumentalist and vocalist on the early **Restoration Ruin**

(Vortex Records) and a daring experimentalist on his two-record set of impressionistic pipe organ improvisations, **Hymn/Spheres** (ECM).

But Jarrett's most documented and overlooked performing format is that of the quartet. His early '70s group of Charlie Haden, Paul Motian and Dewey Redmen was a model of provocative improvising and is well-chronicled on several Impulse Records. With his move several years ago to the ECM stable, Jarrett began playing with several European musicians, and a group composed of Jan Gar-

barek on sax, Palle Danielsson on bass, and drummer Jon Christensen has become his most frequent collaborator. This group is well attuned to Jarrett's move towards a more classical form of improvisation.

In many regards this group is analogous to the Dave Brubeck quartets from the *Blue Rondo* and *Take Five* period. Like that group, **Nude Ants'** tunes are strongly melodic with a pervasive classical ambience and stateliness. Jarrett's own playing features more classical motifs than blues or jazz, and he uses these to channel the spontaneity of his avant-garde days into a more focused concept.

The 30-minute *Oasis* is highly structured with several movements and orchestrated crescendos. Jarrett blends an Asiatic aridness with Chopinesque delicacy. Garbarek's soprano whines like an Indian *shenai* as he builds his solos to swirling climaxes around the liquid drops of Jarrett's piano. Christensen proves to be the perfect textural drummer who shifts and sways in floating time rather than laying down a clearly demarcated pulse. Throughout the piece there is a sense of careful planning. Even though the solos are improvised they clearly follow a structure of climaxes and instrumental groupings.

Other songs on the discs show the same tendencies. *Procession* begins as a dirge that builds to heavily chorded rhapsodics from Jarrett. He settles into a minimalistic four-note section while the tenor and bass play long phasing drones that culminate in a soaring Garbarek leap into the stratosphere. He comes down amidst a twinkling brightness of little percussion and ringing at the high end of the instruments.

There are some nods to his earlier quartets such as *Innocence*, which sounds like a lethargic version of *De Drums*. The bouncy bossa nova feel of *New Dance* is a bit forced, and the concluding *Sunshine Song* serves only as a flashy vehicle for some Jarrett pianistics.

Overall this album has the feel of consolidation of Jarrett's many influences over the last 15 years. His solos are channeled through a ringing romanticism and, in spite of accusations of egotism, Jarrett never sacrifices

the mood of a piece so that he can flash his chops. His role is a well-tuned funnel that locks in with his sensitive rhythm section and pushes Garbarek to some stunning torrents of sound.

The recorded sound is up to the usual ECM standards and for a live performance it is especially excellent.

John Diliberto

Sound: A- Performance: B+

Swinging The Blues: Little Willie Anderson

B.O.B. 2701, stereo, \$7.98.

If imitation is the sincerest form of flattery, then the late blues harp genius Little Walter Jacobs left a legacy in which his admirers can take continuing pride. His music has survived his death, living on in the work of scores of fellow harpmen like Little Willie Anderson, who's also known around Chicago as Little Walter Jr.

With **Swinging The Blues** Anderson pays tribute to his mentor in fine fashion. The album features a scattering of Walter's songs and original numbers solidly cast in a '50s Chicago mold, all performed by a band perfectly suited to the task.

Robert Jr. Lockwood, who was a major force in shaping Little Walter's arrangements, contributes jazz-inflected guitar runs that are closer to his '50s work than his more recent Trix recordings. Former Muddy Waters guitarist and popular session musician Sammy Lawhorn picks crisp, contemporary blues leads. Anderson blows throaty, amplified harp with obvious feeling for the material: He phrases his harp lines much like Walter (especially on the cumbersome chromatic harp) but without the stupefying dedication of a mindless imitator. Not surprisingly, however, he measures up short against the late virtuoso's irrepressible sense of swing and imagination.

At times the music reaches a level of excitement that could almost let it pass for an outtake from one of Walter's lesser sessions, despite a too conspicuous spontaneity that sounds suspiciously like insufficient rehearsal. The disc is more seriously handicapped by a grievous lack of presence that robs the music of much of its punch.

So few new albums by blues harp players have been released as of late that fans of the genre will undoubtedly find **Swinging The Blues** quite a treat.

Roy Greenberg

Sound: C+ Performance: B+

In Jazz Country: Max Morath Vanguard VSD 79418, stereo, \$7.98.

Max Morath is not really a jazz pianist, but he is a devotee of ragtime, old-time songs and styles of the gutbucket jazz era. On this recent release, he tackles such tunes as *Shine on Your Shoes*, *River Stay Away from My Door*, *Poor Katie Redd*, *Moon Country*, and other songs, rags, and stomps from the early jazz period. His playing is skillful, if not always as rugged as one would hope for in a traditional jazz pianist. His accompanists — Dick Sudhalter, cornet; Johnny Mince, clarinet; Jack Gale, trombone; Sam Parkins, tenor; Vince Giordano, baritone and tenor; Marty Groz, guitar, and Ron Trexler, drums — offer lively, spirited support and fine traditional jazz colorations. Morath contributes effervescent vocals on *Sweet Emaline*, *Moon Country*, and *Temporary Baby* and demonstrates some surprisingly effective stride on Eubie Blake's *Poor Katie Redd*. Vanguard, as always, offers us vivid, ultra-clean sonics.

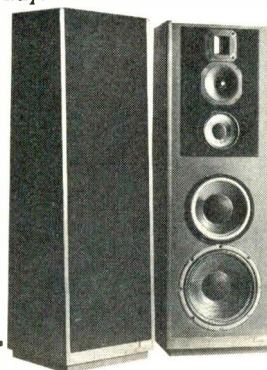
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Sound: A Performance: A



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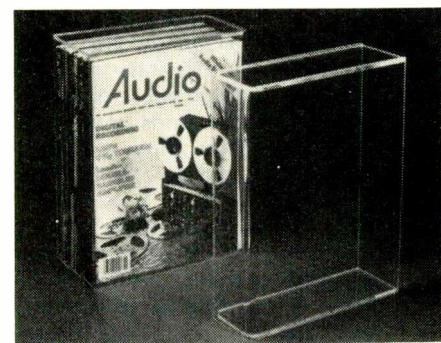
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Stan Kenton and His Orchestra

Volume 1: 1941
Hindsight HSR 118, mono, \$7.98.

Volume 2: 1941
Hindsight HSR 124, mono, \$7.98.

Volume 3: 1943-44
Hindsight HSR 136, mono, \$7.98.

Stan Kenton, who died last August in Los Angeles, was always a controversial jazz figure. While his multitude of fans were hysterically devoted to him and his music, many musicians and critics took a slightly jaundiced view. In his book, *Treasury of Jazz*, guitarist Eddie Condon wrote that "every Kenton record sounds as though Stan had signed on three hundred men for the date, and they were all on time."

Indeed, many of the later Kenton bands took on an increasingly ponderous tone, featuring a library of grandiose, overstuffed arrangements. However, the Kenton bands showcased on these three Hindsight recordings, particularly the original 1941 orchestra, were loose-jointed, punching ensembles that featured a richly scored reed section. A Jimmy Lunceford influence was evident, not only in the reeds, but in the bristling, high-strung brass.

The early Kenton band featured such excellent musicians as Jack Ordean, a Willie Smith-influenced altoist who is heard on all three albums, leading the sax section on such lustrous pieces as *Elegy*, *Opus in Pastels* and *Reed Rapture*. Two other soloists of interest are the extroverted trumpeter Chico Alvarez, who blows his head off, and tenor saxist Red Dorris. The 1943-44 Kenton band included among its personnel the extraordinarily talented arranger-tenor saxist Dave Matthews

and two other budding tenor talents, Stan Getz and Boots Mussulli. Of the three collections, this last is saturated with such World War II pop selections as *Shoo Shoo Baby*, *Hit That Jive Jackson*, and *Paper Doll*. *I Lost My Sugar in Salt Lake City* is the weakest despite the throaty, swinging vocals of Anita O'Day.

The first two volumes, on the other hand, are full of consistently rousing instrumental selections like *Tempo de Joe*, *Balboa Bash*, *Marvin's Mumble*, *A Little Jive for You*, and *Take Sixteen*. These fast- and medium-tempo selections are played with bounce and vigor sustained by a lively rhythm section headed by bassist Howard Rumsey.

The three albums have been skillfully remastered from MacGregor radio transcriptions by label owner Wally Heider, who has brought the music vividly to life. Mr. Heider, one of the industry's leading audio engineers, made his reputation recording rock groups like The Rolling Stones and The Grateful Dead, but big bands are his first love and he has admirably showcased these early Kenton transcriptions in a bright, crisp monaural sound. (Hindsight Records, P.O. Box 7114, Burbank, Cal. 91510.)

John Lissner

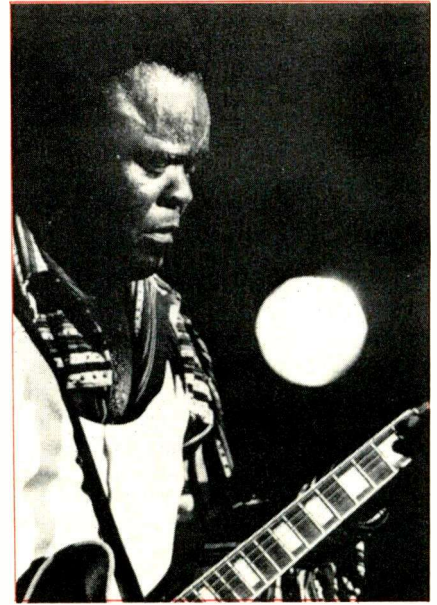
Sound: A Performance: A+

Hide Away: Freddy King
Gusto GD-5033X(2), 2 discs, \$7.98.

Legend has it that when Freddie King walked into a Chicago club, other guitarists would leave the stage rather than risk a direct musical confrontation with one of the town's most talented bluesmen. True or not, such tales are just one sign of the great respect guitarist King commanded among his peers, just as his hit singles attested to his popularity among record buyers.

Although the late blues master recorded for a variety of labels, his reputation largely rests on the sides he cut in the early '60s for the now defunct Federal of Cincinnati. Gusto has dipped into the Federal archives for a two-record set that combines a previously issued disc of some of King's biggest 45s with a second disc of more obscure tracks that should interest collectors.

Included are such classics as *Hide Away*, which has become the ultimate blues band instrumental, much like *Johnny B. Goode* has always been a rallying cry for rock bands. The track also capsulizes King's rhythmically supple handling of his material, which he coupled with outstanding technical



virtuosity as he churned out a stream of blues guitar instrumentals with rarely flagging invention. Some of his lesser efforts are included on this set's second LP.

King was also a wonderful blues singer, with a booming yet controlled voice that matched his football player-like physique, as shown by his scorching vocal on *Have You Ever Loved A Woman*. The song was later covered by Eric Clapton, who long expressed his admiration for one of his major influences. Also of special interest are King's two duets with female vocalist Lulu Reed, neither of which were previously available.

Long-time King fans take note that **Hide Away** duplicates some cuts on Gusto's **Freddie King**, a much better packaged set that features slightly stronger material, but contains 21 selections selling for the price of a single album. Pick up one or the other, since it's well near impossible to claim an understanding of electric blues guitar without a familiarity with Freddie King.

Roy Greenberg

Sound: B- Performance: B+

Blue and Lonesome: Little Walter Jacobs
Le Roi du Blues 33.2007, mono, \$8.98.

Blue and Lonesome makes a strong case for the undiminished potency of '50s Chicago blues while refueling the legend of Little Walter Jacobs, long the patron saint of blues harp players. Even if you've never followed the blues, the performances on this album are so compelling, so forceful, that given only a superficial listening it's clear that something special is happening.

When Little Walter left the Muddy Waters band in 1952 (their joint efforts are still a touchstone for contemporary blues groups) he and his changing trio of topnotch sidemen forever altered the role of the harp in blues bands. Little Walter innovatively phrased his harp lines as though the small instrument were a saxophone, as he recorded sides unrivaled for their breathtaking imaginativeness, buoyant swing, and technical expertise.

So many of the late Walter's riffs have become familiar as a permanent part of the vocabulary of the blues that his genius is too often taken for granted. **Blue and Lonesome** contains material recorded during his prime for Chess Records but never heard by most blues fans, thus offering a unique opportunity for a fresh assessment of Walter's stunning talent. His legion of fans will be pleased to note that this collection of obscure 45s, unissued tracks, and alternate takes compares favorably with his best known work.

Walter was known as a perfectionist in the studio, so consequently these tracks boast not just a professional polish, but a rare creative interplay with some of the Windy City's finest guitarists: Robert Jr. Lockwood, Louis Myers, Luther Tucker, and even Mud-

dy Waters himself.

Blue and Lonesome is one of three Little Walter retrospectives available on Le Roi du Blues, a small label that doesn't even list its address on its album jackets. This set is the best of the three and well worth tracking down in specialty shops. *Roy Greenberg*

Sound: B- Performance: A+

Tributaries: Richard Sussman
Inner City IC 1068, stereo, \$7.98.
Lighter Than Air: Arn Evans & Tradewinds
Inner City IC 1074, stereo, \$7.98.

The whole jazz/fusion area has been mined for all it is worth, especially in the more commercial areas. These records attempt to explore two different aspects of the music yet both fail to turn up anything new.

Richard Sussman is the more adventurous of the two. **Tributaries** features Sussman along with Andy Laverne as both musicians switch off between acoustic and electric pianos and synthesizers. Musicians such as Mike Oldfield, Paul Bley, Vangelis, and Herbie Hancock have successfully employed the textural interplay between acoustic and electric keyboards before. But

Laverne and Sussman use the synthesizer as a one-dimensional instrument for monophonic soloing and note-bending. It's a limited territory that Jan Hammer exhausted on the first three Mahavishnu Orchestra albums. Their acoustic work is facile and undistinguished and leaves the fleet rhythms of drummer Bob Moses as the only real interest here.

Arn Evans and his quartet bring fusion into the cocktail lounges. His repertoire spans Latin rhythms, funk, and some of the most faceless ballads you're likely to hear anywhere with Evans doing the vocals. The playing is technically adept, but pointless and emotionally vacant.

Both groups seem to be searching for an identity of their own but come up as anonymous practitioners. Arn Evans dilutes his sources to a uniform blandness, and Sussman is prevented from breaking new ground by his adherence to old techniques.

John Diliberto

Sussman

Sound: B- Performance: C-

Evans & Tradewinds

Sound: B- Performance: D

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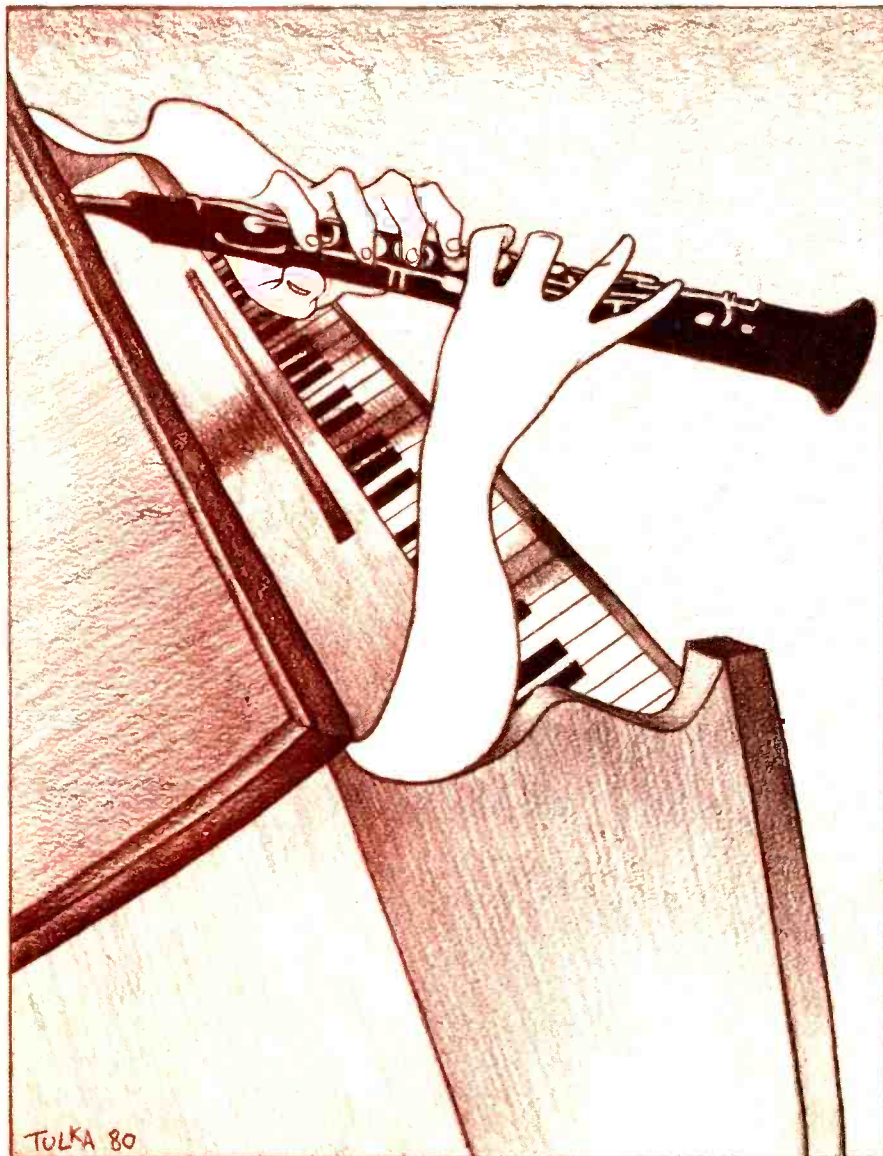


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Classical reviews

Edward Tatnall Canby



Sonatas for Clarinet and Piano. (Reger: Sonata Op. 107. Gallon: Cantabile. Martinu: Sonatina.) John Norton, Gary Wolf. **Golden Crest RE 7084**, stereo, \$8.98.

The Art of Richard Stoltzman. Saint-Saens: Clarinet Sonata, Op. 167. Honneger: Sonatine. Debussy: Petite piece; La fille aux cheveux de lin. Poulenc: Sonata. With Irma Vallecillo, piano. **Desmar DSM 1014G**, dbx encoded, stereo, \$8.98.

Mendelssohn: Clarinet Sonata. Reger: Clarinet Sonata, Op. 49, No. 2. John

Russo, Lydia Walton Ignacio. **Crystal S 334**, stereo, \$7.98.

An interesting thing has been happening these days in and around our college and university music schools: Hundreds of good American professional performers are just aching to get themselves on record—any record. For a good half century, most such professionals stuck to the old disdainful attitude towards recording, so neatly summed up by union man James Petrillo as canned music. But time moves on, and each succeeding gener-

ation has been a bit more appreciative of our audio art. Bound to happen among intelligent people, I say. So, as the benefits of ever-improving records began to sink into these minds, a lot of solo and chamber music players began looking for ways and means to get themselves down, and into a four-color LP record jacket. It figured. At first, the universities themselves tried starting up their own labels. Not a good idea. They don't know enough about record making, and even if the local audio people did a good job, there was distribution—woefully inadequate. Most of these labels haven't got very far by themselves.

Now—bonanza! Some of the wide-awake, smaller professional record labels have discovered this gold mine of material, waiting, so to speak, with tongues hanging out, a catalogue all set and ready to go. It makes for ideal team work. The music people provide the sonic input, the record labels do the production and distribution, each with the right know-how. An excellent idea and there's only one danger—glut.

If I have one tuba record on hand, I have 20. There are trombone discs, trios, quartets, brass ensembles, harp, bassoon, by the dozens of each, enough to burn up the turntable. While the big record labels lately have skimmed along with meagre releases or almost none, these littler outfits blithely ship out vast boxes of discs to every reviewer in the country. It's a phenomenon. And even more so is the generally superior audio quality which we find in these products. As I keep saying, the small labels are the leaders in the record field today.

The three records picked here are not necessarily typical of their respective labels but, rather, serve to show how easy it is to find abundant material even in the most specialized corners of music. If, for clarinet and piano, you read saxophone, flute, trumpet, it is the same. Of the three clarinet-and-piano teams, the most effective on record here is Golden Crest's John Norton, with Gary Wolf as his pianist. He puts down a splendid, intense clarinet sound, even if the piano (excellent player) is miked too far in the background. A lively and human performance of the long, turgidly Brahms-

like late Reger sonata and a spicy doing-up of Martinu, late-late Romantic a *la Francaise* in 1956.

The very young looking Richard Stoltzman is praised as a real genius and his clarinet technique on Desmar (dbx coded) is indeed phenomenal. But, on this record at least, he is curiously deadpan. Everything sounds the same. Big, fine piano sound to go with him but the record is musically unconvincing, even with dbx coding.

On Crystal, which already has an enormous catalogue of similar recital recordings, John Russo and Lydia Walton Ignacio, husband and wife, play a mixed bag. In the early Mendelssohn she bubbles, he is timid; the music suffers the fate of much music by that composer, just diddling along, vast numbers of notes and a passel of pat cliches. More could be done with it, I am sure. But on the reverse the early Reger, lighter and smoother than the big Op. 107, is played with a lot of excellent expression and I enjoyed it. This particular Crystal disc seems to have an inordinate number of noisy defects but that is not typical of the company's product and must have been just one of those things, i.e. gremlin department.

Robert Davine, Accordion. With the Lamont String Quartet, James Carroll, string bass. **Crystal S 106, stereo, \$7.98.**

Classical accordion! Contemporary music too. Crystal's ever-flowing recital series even gets to the accordion, and this is a really enjoyable disc, beautifully recorded, a profusion of colorful works ranging from turn-of-the-century stylings to some quite modern stuff. There's tonal variety judiciously added, first by a group of solo strings (note the excellent sound of the string bass in the *Pino Concertino*, side 2) and then in duet between accordion and cello. All the works are worth hearing and I particularly liked the *Pino* and the Norman Lockwood (b. 1906).

Sound: A- Recording: A Surfaces: A-

Eberley Sings Strauss. Helen-Kay Eberley, Donald Isaak, piano. **Eb-Sko 1005, stereo, \$8.98.**

Sixteen songs by Richard Strauss, and many of them fresh and new, merely through being unfamiliar. It isn't easy to review this husband and wife label because they insist on pushing their product by personal phone contact, even personal appearances, enough to annoy any reviewer, though maybe necessary to survive—who knows? But even so, I did try this one, and it is well worthwhile for anyone interested in voice or, more especially,

in that remarkably long-lived vocal composer, old Strauss. The earliest songs here are from the 1880s, the latest, 1919, but the man lived on until the late 1940s and his Four Last Songs, with orchestra, are masterpieces. Listening to 16 of these in a row, one comes to realize that not only was Strauss first of all an opera composer, but he was also very much a great song writer, following directly after Schubert, Schumann, Brahms, Hugo Wolf, in the grand German tradition.

Helen Eberley, as I once said in an earlier review, has a Strauss-type voice, powerful sweet and very high. She sings everything that way, and some of

her music is not good for this reason—but Strauss, yes. Very few singers outside the immediate European tradition, mainly Germany and Austria, can do these songs real justice. Eberley is not quite among the very top, from Lotte Lehmann to Elizabeth Schwarzkopf, Lisa Della Casa and others, but she comes hearteningly close, perhaps lacking only the longer line, the follow-through, that the best of these command. In this record there is also a lack of diction, perhaps because the language is not her native one; but it also could be in part a trick of the microphone. She is placed rather distantly, and for once—so rare—I feel a

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need to get her up a bit closer! Usually it's the other way around. Those who dislike powerful close-up voices, belting in their ears from the loudspeakers, need have no fear of this recording.

An unusual item here is a group of three songs from the Opera *Hamlet* of 1919, as sung by the mad Ophelia. I had never even heard of the opera, let alone the songs. They run us straight into the old Ophelia problem of the original play—how does one portray Ophelia's madness? No problem with the Strauss accompaniment; it is ominously mad in the manner of Salome looking at the head of John the Baptist in the Strauss opera of years before. As for the voice, singing the German version of Ophelia's mad words, Miss Eberley puts on a little-girl tone, rather startling if you haven't been following the program notes. As good as anything else, I guess! Interesting.

Sound: A- Recording: B- Surfaces: A-

Brahms: Piano Music. Variations and Fugue on a Theme by Handel, Op. 24; Fantasies, Op. 116. Daniel Graham. Vivace VCR 1101, stereo, \$7.95. (Vivace Classic Recordings, 1322 Delgany, Denver, Col. 80202.)

Vivace isn't listed yet in Schwann and there are some technical signs of opening jitters, so to speak, in this premiere release—no matter. The record is well worth the attention of those who go for Brahms and, especially, who try to play him on their own pianos (as plenty do).

Daniel Graham makes a fine, bold Brahms man, accurate and non-smudgy (Brahms is easy to smudge up with the pedal) but full of fire. Obviously he has the intelligence not to be afraid of an all-out specialty like this; most performers take on the flashier, more finger-displaying composers for their recordings. What is interesting here, too, is the complete performance of the seven pieces in Op. 116. Most pianists sample Brahms here and there, from different sets of works. Opus 116 is the passionate but tumescent, late Brahms, very thick music—Graham lubricates it beautifully. And, to complement Op. 116, he drives the early and brilliant Handel Variations (by a beardless Brahms whose picture is on the cover) straight through for 25 minutes of cumulative impact ending with the big fugue.

Technically, side 1, containing the Variations, is cut with unusually shallow grooves—my extra-light arm skittered straight across on the first play. Reason obvious: 25 minutes of straight piano with the loudest cut at the final grooves. Try that on your cut-

ting lathe. On this side the piano is a bit bangy and punchy, the bass slightly thin; on side 2 the sound seems fuller and more suave, just possibly a different recording circumstance, and with more groove leeway. All in all, not a bad job, with excellent pressing to help.

Sound: B/B+ Recording: B+ Surfaces: A-

La Notte. Vivaldi: Flute Concerto in G Minor; Biber: Serenade in C. Mozart: Serenade in G (Eine Kleine Nachtmusik). Boccherini: Quintettino in C (Musica Notturna delle Strade di Madrid). Lucerne Festival Strings, Baumgartner; James Galway, flute; Karl Ridderbusch, bass. Vanguard VSD 71266, stereo, \$7.98.

A collection of "night music" by four composers, two out of the Baroque and the other two from the late 18th century, in each pair one well-known work and the other unfamiliar. Nice symmetry! Also, very nice playing. After so much American and Japanese music making on recent digital/audiophile discs, it is worth noting that classic European music still gets played best by the Europeans whose natural heritage it is. That's what we have here, the performers ranging from Irish to Swiss.

Those who know the familiar Vivaldi *Four Seasons* will find his *La Notte* concerto quite fascinating, for it is another working-out of material also heard in that work, under "autumn"—i.e. the approaching night among the seasons. Galway's flute is superb, less flashy than Rampal's and better integrated with the orchestra. Heinrich Biber was an earlier Austrian Baroque composer and trickster with the fiddle whose music has a singular purity and charm. He's beginning to get around and rightly. In the middle of his night serenade the bass voice of a night watchman is unexpectedly heard, a bit of descriptive music. Not well managed here—it should be in the background but, instead, this enormous bass sings close-up, like a huge Hans Sachs out of Wagner. Unimaginative production.

On side 2 the familiar Mozart serenade gets an excellent and accurately casual performance in contrast to too many stumpy versions by those who have to ham up the little piece. These people just play it, and correctly. As for Boccherini, who was once ineptly subtitled "the wife of Haydn" (he does sound somewhat like Haydn), this Quintettino, out of zillions of his many Quintets, etc., does indeed give us a mildly Spanish impression (like D.

Scarlatti, he lived in Spain). It is a pastiche of local melodies as heard in the streets during the 18th century, which was a bit before Carmen and her bull ring.

A nicely recorded sound, well mixed (that bass solo aside), but there are noticeable groove echoes here and there.

Sound: B+ Recording: A- Surfaces: B+

Johannes Ockeghem, Prince of Music. Capella Nova, Richard Taruskin. **Musical Heritage MHS 4026**, stereo. (Mail order: 14 Park Road, Tinton Falls, New Jersey 07724.)

A very unusual choral recording here from a source of recorded music that, being wholly mail-order, is too often ignored by those in the hi-fi and music listening area — MHS offers an immense and impressive catalogue like a whole mini-Schwann unto itself, though not listed in Schwann because they're not available in record shops. Every so often I get hold of one of these and have seldom been disappointed in any way.

Ockeghem, who died just before 1500, was one of those absolutely first-rank artists who in our recent musical eras simply did not exist, lost in the uncomprehending mists of time. We continue moving backwards, to bring back more and more of these past great musicians of our Western culture, understanding, at last, that "progress" is not always upwards in our world and that men of 500 years ago were exactly as capable of genius as are we today — and were 15,000 years back when the cave-painting artists flourished.

Richard Taruskin is the right man for Ockeghem, a dynamic, intensely magnetic young conductor with precisely the right background, ability and resources (Columbia University) to make of this relatively old music a living thing, performed with professional exactitude and yet with enormous emotional intensity. You may find it strange music at first, but you cannot be bored unless you don't listen.

The bulk of the record, sung without instruments (an interesting new Taruskin theory for this period, in contrast to the current "in" use of old instruments in virtually all old music) is a *Mass, Missa Prolationem*, in the traditional five segments; a rich and "instrumental" texture of sonics though perhaps composed for voices alone, very unlike later so-called polyphonic music of the 16th century, the "Golden Age of Polyphony" — a misguided term, since after all any age is Golden if you think it is. (In my student times, Ockeghem still belonged in the age of


"mathematical" music, which was supposed to be unexpressive and merely technical, thus incomprehensible to the modern ear trained in "expressive" music).

A tremendous plus in this performance is the blend, and the lack of any vibrato in the voices, which sound almost like strings in their outgoing purity. A slight minus, for my ear, is a too-great tendency towards swelling-up and dying-away, a choral mannerism that is plenty effective but not necessarily out of the 15th century — more likely a faint leftover of our recent 19th-century habit of Romanticism. If

Dr. Taruskin firmly states that this IS the way people sang in those days, I cannot argue, I would not know. If it is simply an intuitive, artistic expression on his part, I must be all for it — more power to intuition I say, if it comes from such an original and powerful musical mind as Richard Taruskin's! You'll like it.

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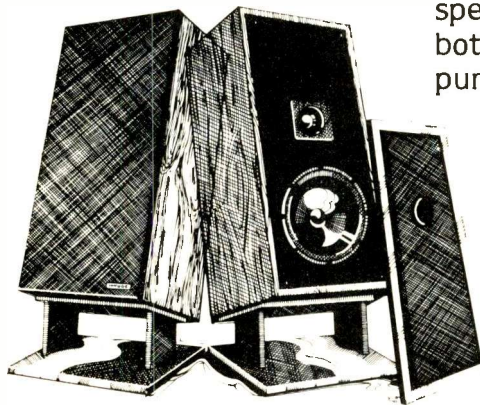
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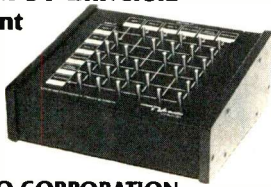
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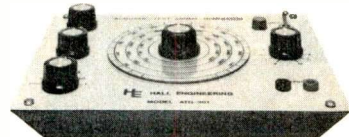
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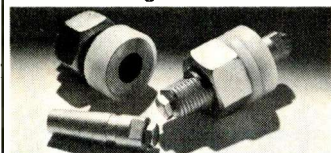
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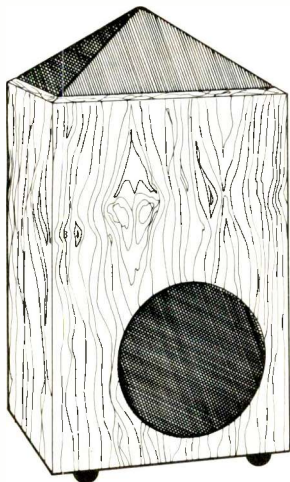
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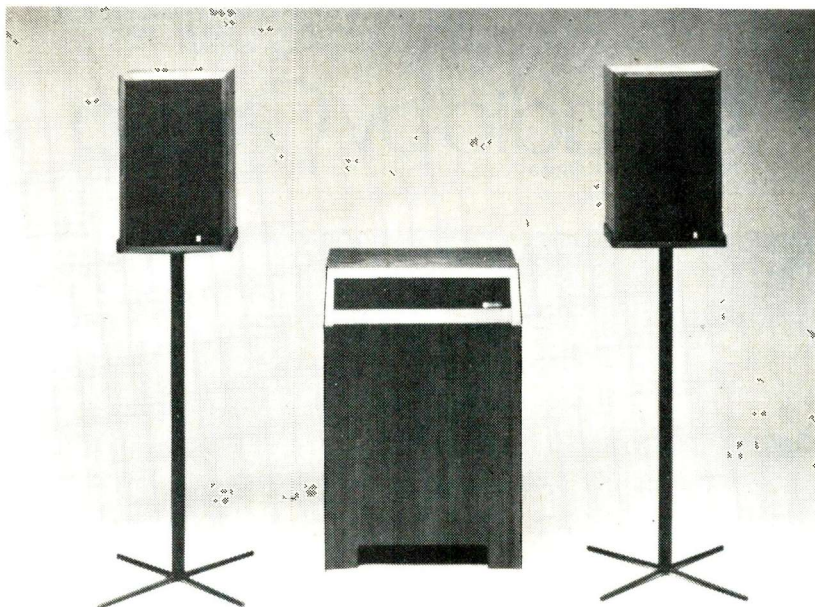
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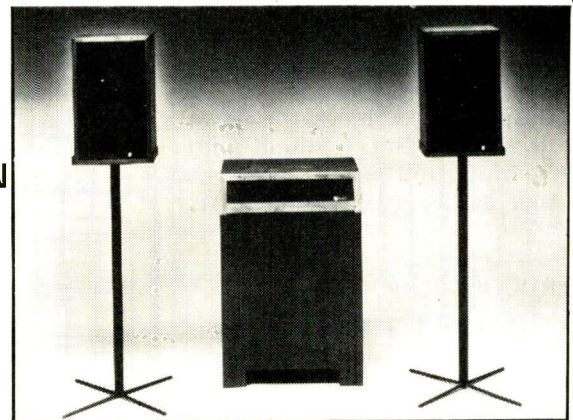
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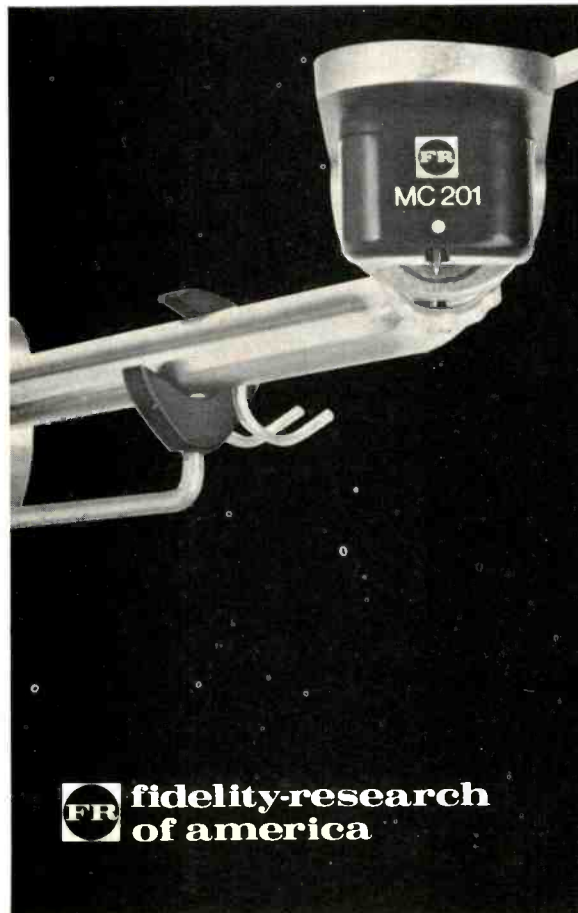
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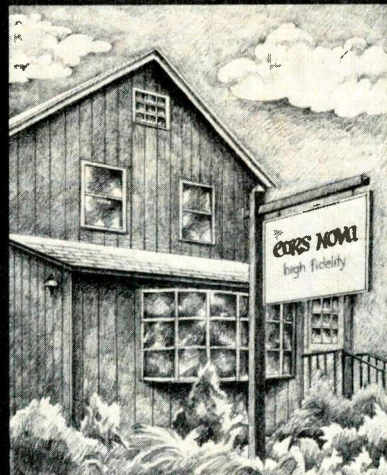
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Video Scenes

Bert Whyte

In my last Video Scenes column, I covered many of the developments at the SCES. As I noted, there was a great deal of video activity, which was only to be expected as the video revolution gathers momentum. Caught up in the hurly-burly of a show in which you are subjected to a virtual barrage of impressions and information on audio and video equipment, it is easy to be overwhelmed by "major" developments, and relegate lesser but interesting items to the group of things to be considered later at a less hectic time.

Sharp's Model VC-7400 VHS video cassette recorder falls into this category. Actually, with this model Sharp may have established a precedent in VCRs that parallels a development which was of considerable significance in audio cassettes. To the best of my knowledge, this unit is the first machine to provide a front-loading video cassette facility. You may recall that all audio cassette recorders initially used top loading for their cassettes, as do present VCR units. When front loading was introduced for audio cassette recorders, this feature proliferated so rapidly that today there are very few which still use top loading. In the VC-7400, the front-loading feature automatically loads the video cassette and closes the access door. If the access door is left in the open position for more than 15 seconds, it will close automatically. Sharp claims the front-loading feature helps keep dust from collecting on the video heads (there is probably some truth in this), saves space, and provides more attractive styling. Irrespective of the dust-inhibiting aspect, there is no denying that with front loading the recorder can be placed on shelves impossible to use with top-loading VCRs. And presuma-

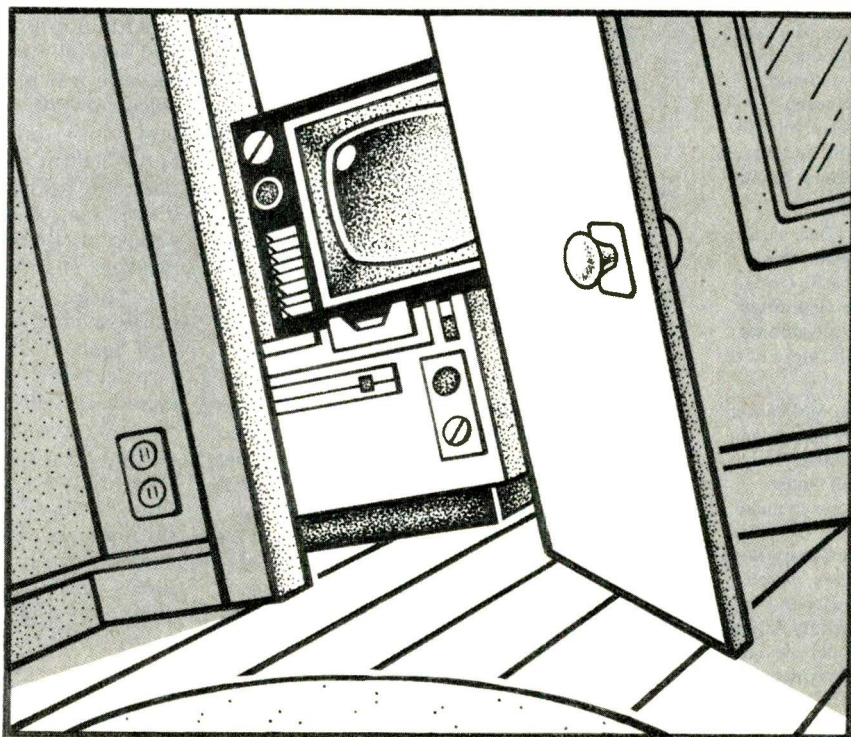
bly on open shelves, other equipment could be stacked on the unobstructed flat top of the machine. It will be interesting to see if front loading in VCR units becomes as popular as it has on audio cassette recorders. The Sharp VC-7400 also has a number of other interesting features, such as touch-button electronic varactor tuning for all 82 VHF/UHF channels, with switchable fine tuning and illuminated chan-

ally standard on top-quality VHS VCRs. Such things as two- and six-hour play capability, variable speed playback, freeze frame, and four-times normal speed scanning. In addition there are some nearly unique special features. The system has "IPLS" — instant program location search — a fast-forward mechanism which will stop at the beginning of any video sequence or program by recognizing

the absence of a video signal just before the program segments. The VCR has a companion tuner, the VU-7350, which can record as many as six events over a seven-day period over any channel. The 15-pound portable VCR utilizes rechargeable nickel cadmium batteries and has remote control features for home use. The really unusual feature on this Akai VCR is that it permits stereo recording on two audio channels with Dolby B noise reduction. With this unit's sound dubbing feature, you can record or playback in bilingual fashion for commentary or for language teaching. As

you may know, there is a proposal before the FCC to ultimately permit stereo broadcasting on TV channels. It is already underway in Japan, and insiders are guessing there will be a decision in favor of this proposal within two years. While their timetable may be off, there seems to be little doubt that we eventually will have stereo TV broadcasts, and those people who have acquired one of these Akai VCR units will be ready to swing into action forthwith.

In my last Video Scenes, I ventured the opinion that until we have a video color camera with the small size, simplicity and ease of handling of the old Brownie Cine Kodak which got 8-mm home movies off the ground, camera



nel indicators. All major tape transport controls are solenoid operated. Another innovative feature is a series of five LED indicators which display the number of minutes of unplayed or unrecorded tape remaining on a video cassette. The unit also has a 24-hour programmer/timer, and it permits either two hours standard play on a T-120 VHS cassette or six hours in the extended play mode. This Sharp VCR certainly has some nice features and, at the relatively low price of \$899.95, would seem to be quite a bargain.

Another sort of "sleeper" video cassette recorder at the SCES was the new Akai VP-7350 Activideo portable VCR. This unit has most of the features and embellishments which are now virtu-

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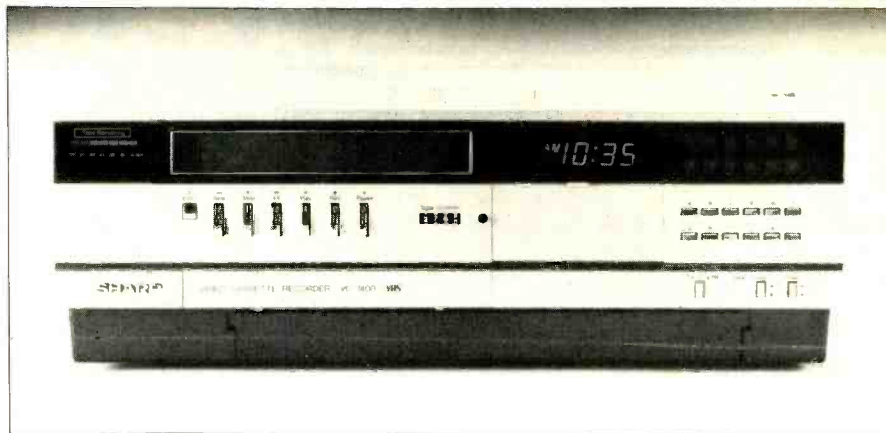
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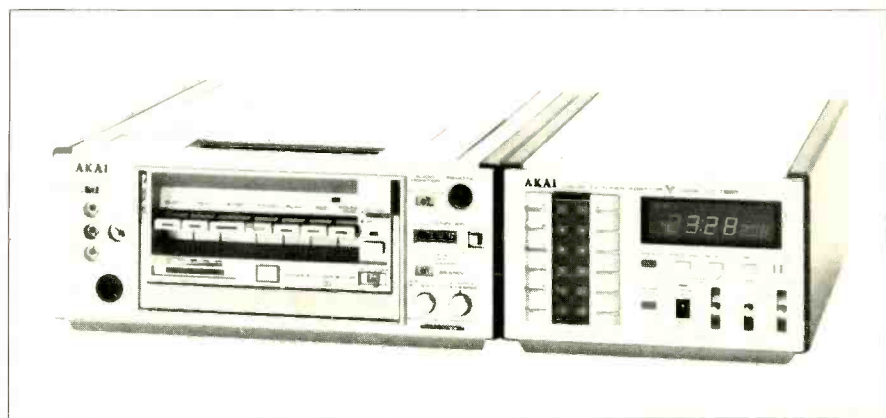
Sharp's Model VC-7400 VHS video cassette recorder.

videotaping won't get very far. Then on the heels of this, Sony announced a 4.4-pound combination camera and video recorder, using a tiny micro video cassette, which they call the Video Mate. Intriguing to say the least, but the introduction of this system is not scheduled until 1985!

A few weeks later, the Technicolor Corp. (yes, the same people who bring you those gorgeous color movies) held a press conference in New York City. It seems Technicolor has an audio-visual division, and they created a tremendous amount of excitement by announcing the introduction of their new Technicolor portable VHS video cassette recorder. So what's the big deal? Well, friends, just picture a VCR approximately 10 inches square by 3 inches in height that weighs 7.4 pounds with its rechargeable nickel cadmium battery. The system uses a mini video cassette, which is deliberately just slightly larger than a standard audio cassette (to prevent accidental insertion of same) and uses quarter-inch (6.25 mm) videotape operating at a speed of 1.26 ips. These V30

video cassettes weigh 1.78 ounces, provide 30 minutes of recording time, and will sell for \$8.95. The quarter-inch cassette was made possible by the development of a micro-helical head system jointly developed by engineers of Funai Electric Trading Co. of Osaka, Japan, and Technicolor. The video head drum has two monocrystal ferrite heads, an inscribed tape path on the drum to ensure tape alignment, and a rotary transformer to reduce mechanical wear in the head coupling circuit. The head helically scans FM modulation to NTSC standards. Resolution is stated as 240 lines. Video signal to noise is rated at 43 dB (quite good) but audio S/N is only 40 dB, and methinks they should consult with Dr. Dolby. The system plays continuously through any TV receiver using house current or for 80 minutes from the nickel cadmium battery, which will recharge in one hour. When recording with the camera, 40 minutes is possible before battery recharge is necessary. Spare charged batteries can easily and quickly be changed to continue recording or playing. The recorder can

The Akai VPS-7350 Activideo portable VCR.



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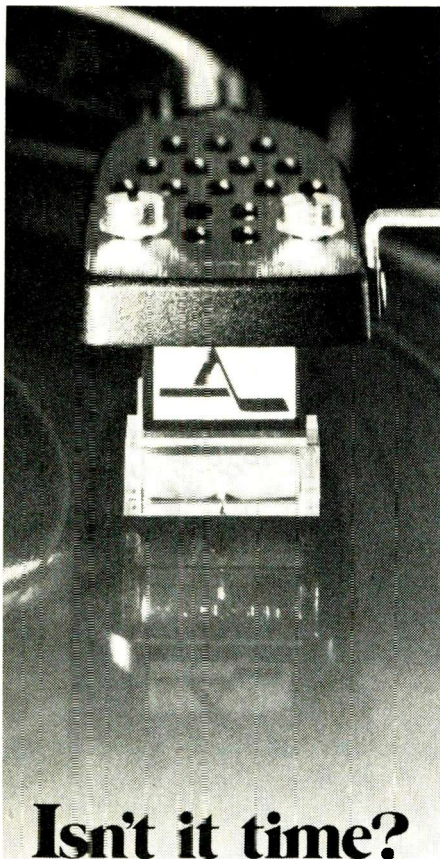
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Technicolor's portable VHS video cassette recorder, Model 212.

be used with any standard TV camera, and Technicolor intends to have its own compact lightweight camera in the near future. A TV tuner will also be forthcoming for off-the-air recording. This Technicolor VCR can record to or from another videotape recorder without regard to tape size. In spite of the small size of this VCR, it furnishes such refinements as freeze frame and variable speed play from slow motion to 1.8 times normal speed. At the restaurant where the press conference was held, a woman was recording the assembled press people with a standard Hitachi color camera and the Technicolor VCR slung over her shoulder. When the

mini video cassette was played back over a standard 19-in. color TV set, the color balance was excellent and quality of detail and resolution was comparable to that obtained from extended play half-inch video cassettes.

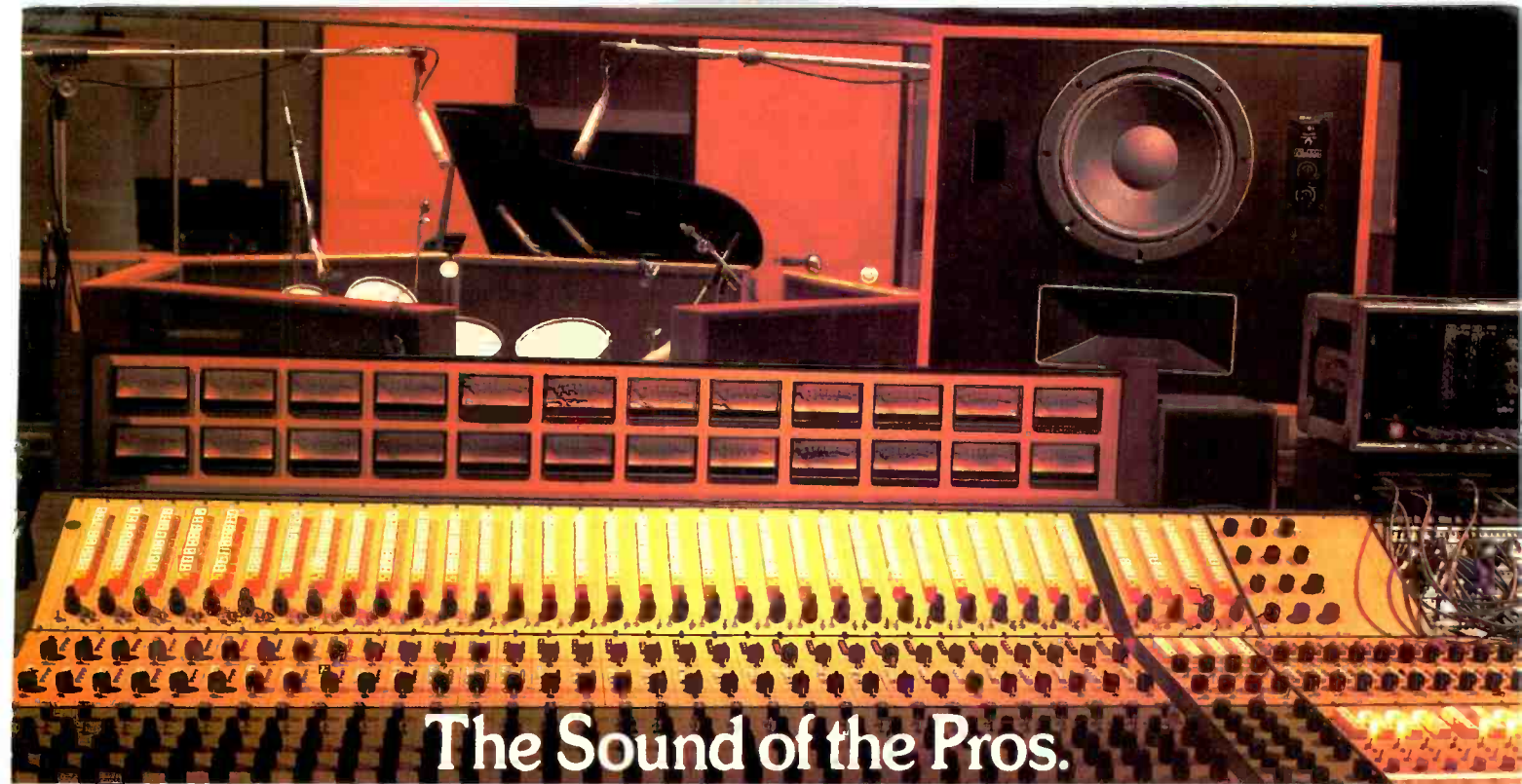
To state the obvious, this Technicolor mini VCR is not the ultimate answer to a universal "home-movie" type of system, as envisioned in the Sony Video Mate, but it is quite good, with very exciting potential in many areas. It will also be "here and now" available, by the time you read this, for \$995.00 and may well be the forerunner of Technicolor's own effort to develop a Brownie video camera. 

FLASH—FLASH—FLASH

RCA has announced plans to add stereo circuitry by 1982 in its SelectaVision capacitance video-disc system. SelectaVision will first be made available to consumers during the first quarter of next year without stereo capability, at a cost that will probably be under \$500. The stereo function is expected to be offered for an optional charge above the prevailing retail price. RCA has not revealed an intention to include random-access or stop-frame features, although its system will permit visual search (to allow both forward and reverse scanning of a pro-

gram) and rapid access (location of a desired segment through a digital time indicator).

At press time, Pioneer was introducing its laser-read optical video-disc system in selected electronics specialty stores, department stores, and catalog-showroom chains in 10 additional cities: Boston; St. Louis; Phoenix; Jackson, Miss.; Washington, D.C.; Baltimore; Richmond, Va.; Wilmington, Del.; Denver, and Houston. Pioneer's system was initially offered last June in Madison, Wisc.; Syracuse, N.Y.; Dallas, and Minneapolis.



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Behind the scenes

Bert Whyte

Seven years ago, in the November, 1973 issue of *Audio*, I reported on an unusual preamplifier I had seen at the 45th AES Convention in Los Angeles, the LNP-2 from Mark Levinson Audio Systems. The LNP-2 had performance specifications which considerably exceeded those of any preamplifier then on the market and was constructed to a Rolls Royce standard of quality previously restricted to aerospace equipment, a fact reflected in its then-outlandish price of \$1,750!

I met Mark Levinson at that convention and found him to be one of the most dedicated, uncompromising audio purists I had ever encountered. However, Mark is first and foremost a musician. He plays the trumpet, fluegelhorn, contrabass and guitar, and his musical interests include jazz and classical music. Although he does not have formal training as an audio engineer, Mark has gained a great deal of engineering knowledge through a sort of osmotic association with some very bright engineers, and a zealous, though informal, study of audio technology.

As I mentioned to Mark at the time, his dedication to high quality, and his almost cavalier disregard of the cost of attaining that quality, were "not the way to riches." Mark had produced the LNP-2 in a laboratory in his home, with a staff of five eager young audio technicians. I'm sure most of his limited capital was tied up in his pair of LNP-2 prototypes. Currently, Horatio Alger stories are not much in favor, but it is rather nice to know that a better mousetrap could then be built and ultimately reward its manufacturer. Not long after Mark demonstrated his LNP-2 at the 45th AES Convention, he received orders for it from some

broadcasters (of all people!) and a few well-heeled audiophiles in this country. To his delight, five preamps were also ordered by some Japanese companies. Subsequent orders came with encouraging frequency from this country and many parts of the world, and Mark Levinson Audio Systems became a going concern.

Recently, Mark Levinson Audio Systems moved into a spacious new man-

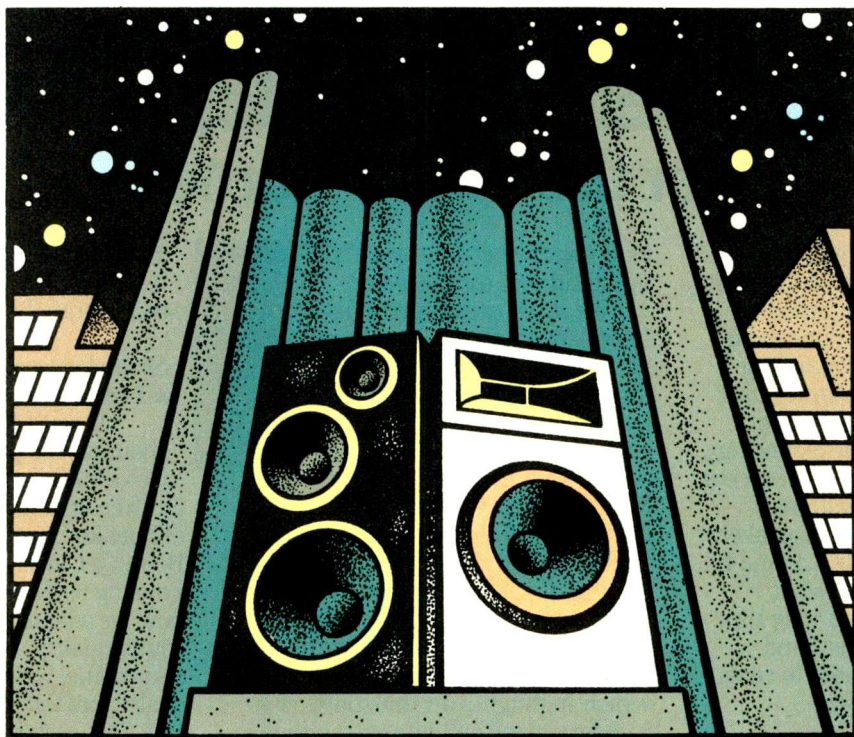
go hotel every year during the Summer CES, where he gets together with his dealers from this country and abroad as well as domestic and foreign members of the audio press. However, his suite in Chicago has no official connection with the CES. And, of course, the CES is not officially open to the audio consumer. Another point is that Mark Levinson equipment is never reviewed in the audio "buff books"

around the world for the simple reason that no equipment is ever sent to these publications. The only way the audiophile "underground" magazines manage to review Levinson equipment is by borrowing the gear from individual owners. Nor is advertising in audio publications a source of information on Levinson equipment, since Mark rarely advertises. While all these practices are contrary to those that generally prevail throughout the audio industry, Mark does not feel that he should pursue conventional marketing practices and merchandising techniques because of

the particular nature of his business.

Levinson's Line

I was surprised to learn that Mark's staff now numbers over 80 people, and as his staff has grown, so has his product list. The LNP-2 preamplifier has long since shed its original op-amp modules for ones of Levinson's own design, and the unit has been updated in other areas. In fact, before long the LNP-2 will be the recipient of the advanced technology embodied in the new ML-7 preamp. A special recording version of the LNP-2 is now becoming popular for certain types of digital recording. This LNP-2 is set up to accept a pair of B&K 4133 condenser instrumentation microphones. The response



ufacturing facility in an industrial park in Hamden, Conn. A few months ago Mark invited me to tour the new plant and promised a behind-the-scenes look at his laboratory and production procedures. While most audiophiles know about the reputation of Levinson products, they really don't know very much about the company or the way it makes audio equipment. In fact, to many audiophiles, Mark Levinson is a rather remote figure. All this has come about because, to the best of my knowledge, Mark's firm has neither exhibited at any audio fair or hi-fi show nor engaged in other activities which would have made its products more familiar to audiophiles. Mark does have a demonstration suite in a Chica-

Illustration: Leo Pando

JBL's new SFG. A geometry lesson worth listening to.

JBL

SFG, or Symmetrical Field Geometry, represents a significant design improvement in the science of building loudspeakers.

The first low-frequency ferrite magnetic structure good enough to bear the name JBL, SFG not only out-performs conventional ferrite structures, but also the Alnico structures we've used for more than 30 years. In doing so, SFG produces the lowest measured second harmonic distortion levels to date.

Most loudspeaker companies use ferrite magnets. But until SFG, we simply were not satisfied with using ferrite in low-frequency drivers. We had

always been able to obtain far better results with Alnico, a compound of aluminum, nickel and cobalt. But the rising cost and growing scarcity of cobalt caused us to take another look at ferrite. While doing so, JBL engineers identified the unacceptably high distortion levels in the competitive ferrite designs we tested and found they were caused not so much by the nature of the material, but by the *design of the magnetic structure!*

A modest technical explanation of SFG follows:

In conventional ferrite designs, the structure creates a non-symmetrical magnetic field above and below the voice coil gap.

This uneven magnetic field causes large amounts of second harmonic distortion at low frequencies. That's where SFG comes in. By reducing the diameter of the pole piece and by making the top plate and the pole piece an integral part of the design, *SFG creates a symmetrical magnetic field to substantially reduce second harmonic distortion at low frequencies.*

SFG also solves another form of distortion—a flux change resulting from the interaction of the voice coil and conventional magnetic structures. The JBL solution, a unique Flux Stabilizing Ring, is yet another tribute to the

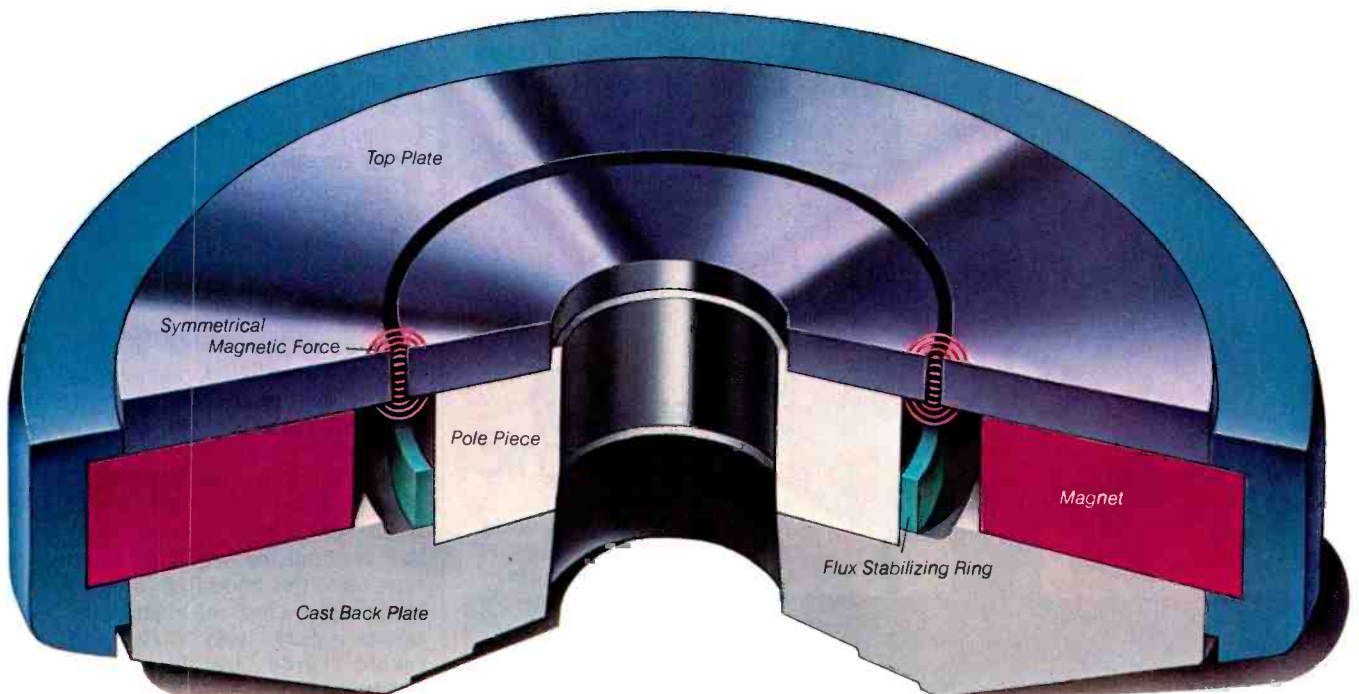
ingenuity of JBL engineers. It maintains a constant level of magnetic energy in the voice coil gap, reducing second and third harmonic distortion to less than 0.1%.

Our tests showed we'd reached our goal: A low-frequency ferrite magnetic structure with distortion levels typically far below 0.5%, over the full operating range of the speaker.

But, as always, the real test is in the listening. So, here's your assignment: Go to your nearest Authorized JBL Dealer and listen to the difference SFG makes.

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JBL First with the pros.



■ A unique *Symmetrical Magnetic Force* above and below the voice coil gap is created by the relationship between the *top plate* and the

reduced-diameter *pole piece*. This symmetrical force substantially reduces second harmonic distortion at low frequencies.

■ Exclusive *Flux Stabilizing Ring* counteracts the distortion caused by the interaction of the voice coil and magnetic structure. It maintains

a constant level of magnetic energy in the voice coil gap, reducing second and third harmonic distortion to less than 0.1%.

of these mikes is flat from 2 Hz to 40 kHz, and they are capable of handling 165 dB SPL!

The ML-1 preamplifier, a slim-line purist model, devoid of any meters, tone controls or other "convenience" devices, evolved from an earlier design. It is also modular, with epoxy-encapsulated phono and line amplifiers, and features plug-in RIAA phono modules of different gains to accommodate various phono cartridges (including moving-coil types). Extremely low noise and distortion and long-term reliability have made the ML-1 a much

desired preamplifier. Here again, the new technology of the ML-7 preamp will affect the ML-1, but in this case it will mean a gradual reduction in the number of ML-1s produced until it is supplanted altogether by the ML-7.

The ML-2 is Mark Levinson's near-legendary Class-A power amplifier, probably the item most familiar to audiophiles. A mono design, the ML-2 is pure Class A, with no recourse to dynamic biasing or similar circuitry. A mono amp, the ML-2 delivers 45 watts into 8 ohms over the full audio bandwidth, 85 watts Class A into a 4-

ohm load, and the same power right down to 2 ohms. If you bridge a pair of ML-2s into 8 ohms you will get 160 watts of Class-A power with virtually unmeasurable THD, IM, and TIM.

In spite of the low model number, the ML-3 power amplifier is one of Mark Levinson's newer products. It is the pride and joy of Tom Colangelo, a gifted young engineer who is vice president in charge of engineering. The ML-3 is a Class AB amplifier and a real brute physically (120 pounds) and electronically. This stereo amp puts out 200 watts per channel into 8 ohms and clips at 290 watts, but this by no means indicates how powerful the amplifier really is. It will pass 60-volt pulses, with a phenomenal current output of over 30 amperes. Even the most inefficient air-suspension loudspeakers will play very loudly with this kind of amperage available. Into 4 ohms the ML-3 puts out 500 watts per channel; into 2 ohms, given a full 120-volt line and with any kind of complex load, it delivers a staggering 800 watts per channel! All this with extremely low distortion, with no crossover or notch distortion, and with such extensive heat-sinking that no fan is necessary. Even with sustained very low frequency organ pedals, the amplifier is just slightly warm to the touch. Part of the ML-3's tremendous power comes from its extremely "stiff," super-regulated power supply. Each channel has its own toroidal power transformer custom-made in England. Custom-made, computer-grade electrolytic capacitors are so big they look like 105-mm artillery shells, and they furnish a whopping 72,000 μ F per channel. The ML-3 uses twenty 250-watt bipolar power transistors per channel, plus two driver and two predriver transistors per channel. This driver/predriver setup affords at least several amperes of high drive current to avoid phase shift. The entire amplifier is push-pull, input to output. There are no single-ended stages anywhere. Here is a stunt with the ML-3 that certainly has professional implications: Line up four 8-ohm JBL or Altec studio monitor type speakers *in parallel per channel*, fire up this low-impedance nightmare, and the ML-3 will deliver a *kilowatt to each channel!!*

The ML-5 is the Studer/Levinson tape recorder, a standard Studer A-80 quarter-inch two-channel (half inch two channel may soon be an option) tape recorder modified by replacing five plug-in cards of electronics. One power-supply, two play, and two record cards are furnished with proprietary low-noise, low-distortion Levinson electronics. Equalization is NAB and CCIR at 15 ips, and AES at 30 ips. Tweaked to the nth degree for

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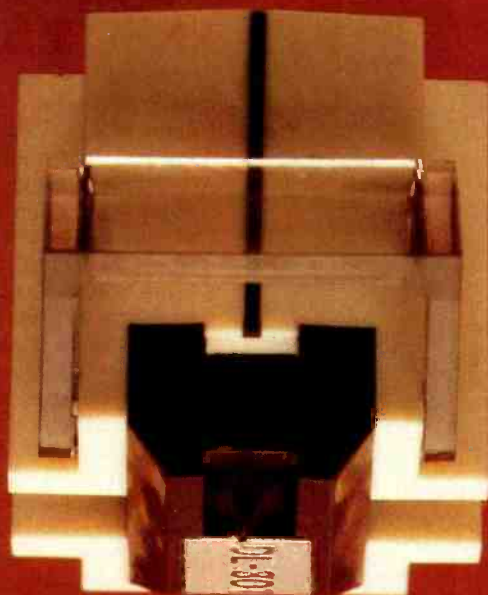
The year is 1951. Harry Truman is President. An amazing new device called television entertains millions. And in Japan the leading manufacturer of professional sound equipment—Denon—develops the first high-performance moving-coil cartridge.

Denon's engineers discover that an extremely lightweight stylus assembly, made without a heavy magnet attached to its stem, gives this new kind of phono cartridge the ability to reproduce music with a subtlety of detail that escapes conventional cartridges.

Denon offers the cartridge first to professional broadcasting organizations, and then later to small numbers of sophisticated home listeners. Among this discerning few, the moving-coil legend is born: there is no finer way to play a record.

In recent years, the moving-coil legend has grown to the point that many manufacturers build their entire product lines around the moving-coil principle. But only one company has had 29 years to refine and improve the moving-coil concept. The same company that developed direct-drive turntables 41 years ago. The same company that invented the world's first commercial digital recorder eight years ago.

Denon.



1980...DENON DL-300 SERIES PHONO CARTRIDGES.

The Denon DL-300 Series, the latest in the long line of superior Denon moving-coil designs. With the lowest stylus tip mass of any stereo cartridges in history, achieved through the use of Denon's patented dual-section cantilever and cross-shaped coil, they depict nuance and a sense of depth in music with unsurpassed sonic accuracy. The Denon DL-301 and DL-303 with long-area-contact stylus profiles and dual-section aluminum alloy cantilevers. Or the ultimate in record-playback performance, the Denon DL-305, with an ultra-low-mass Amorphous Boron cantilever.

Denon's DL-300 Series cartridges for 1980: three new musical instruments from the company where innovation is a tradition.

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 do next.*

Denon America, Inc.
 27 Law Drive, Fairfield, N.J. 07006

Ampex 456 tape, the Studer/Levinson affords a dynamic range of 83 dB at 15 ips, and 85 dB at 30 ips. The current price of this unit is \$14,000, and Mark has sold over 100 of them — with one client having ordered more than 30.

The ML-6 is a super-purist version of the ML-1, consisting of separate mono preamps and separate power supplies. Internally wired with pure silver wire, with virtually no controls, this is a specialized unit for the phonograph record enthusiast.

The ML-7 is the new preamp I reported on in my CES roundup. It is an entirely new generation of preamplifier, with totally new circuit topology that is the distillation of all of Tom Co-

langelo's and Mark Levinson's knowledge in this field. Nothing has been spared in the way of parts cost, fabrication technique, or test procedure. Intended as Mark Levinson's definitive statement on preamplifiers, the first production models should be available soon.


Assembly Line

The Levinson plant is an efficiently run place. All incoming parts are tested and graded for tolerances. Daniel Schaer, the manager of the engineering department, has set up an effective stream flow for production. In-house production of p.c. board artwork and specialized parts fabrication speed up

work considerably. But because the company is in a perennial back-order position and all units are literally handmade, speed is a relative matter. And nothing can really be rushed, what with the many quality-control checks. For example, the plant has a new wave soldering machine which solders all points on a p.c. board in one pass. Usually the machine is used to speed up production, but in this case it is prized for its even solder-flow temperature and uniformity of results. Once all the modules of a given component have been fabricated, they are sent to the testing laboratory where batteries of instruments check all pertinent parameters. Then it's back to the line for assembly, to the lab for testing, again to the line for final touches (cosmetic and otherwise), and on to racks where the equipment is "burned in" for several days. Then back to the lab for final quality assurance, and, at long last, on to the packing and shipping department.

Oddly enough, when I first met Mark in 1973, his firm and many others in the audio industry were suffering from an acute parts shortage. The same is true now, but with the added problem of the ravages of inflation. Lead time on some parts may be many months, but Mark absolutely refuses to use cheaper parts which may be more readily available. He just grits his teeth and waits. Similarly, he showed me two parts: One had cost \$2.00 six months ago and now costs \$6.00, and the other cost \$3.00 a year ago and was now \$10.00. Mark absorbs what he can, but inevitably all this must be reflected in higher prices.

Other strange things happen in Mark's area of business. In the middle '70s he had as many as 40 dealers in this country. He later found some simply did not understand the philosophy behind his equipment. Primarily, they were too awed and intimidated by the prices! Now Mark is down to 12 dealers, and his business has quadrupled. He does a substantial portion of his business abroad, principally in Japan, Hong Kong and Germany. Mark also gets special orders. Jazz/pop star Chick Corea ordered a \$100,000 sound-reinforcement and recording system, which included 10 LNP-2 preamps (several the special recording version), 10 ML-2 power amplifiers, numbers of B&K and Schoeps microphones, and specialized equipment to balance a 13-piece orchestra.

Mark Levinson's credo is professionalism, and his products and way of doing business reflect this attitude. Obviously, Mark's equipment is not for everyone, but then neither is Chateau Lafite Rothschild! However, it's nice to know such things exist. 

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The Cambridge 310 tweeter's moving mass of only 1/4 gram gives it flat response to a frequency well beyond human hearing, a sure guarantee that it will reproduce all the harmonics and overtones on your newest digital and direct-to-disk records.

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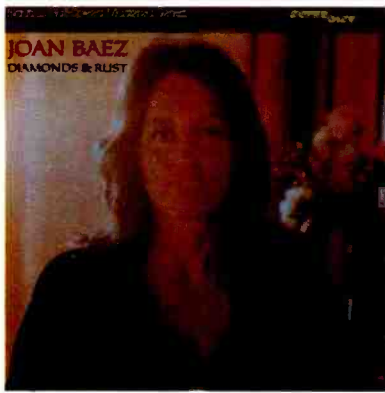
To hear the Cambridge sound that's good enough for digital, take your favorite high technology demo disk to your Cambridge dealer and ask him to A-B the Cambridge 310 against any other speaker he has in the house regardless of price. For the name of your nearest demonstrating Cambridge dealer, circle reader service number or write to us.



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Record Care, Part 1:

Aqueous Cleaning vs. Organic Solvents

Electron microscopy (Figure 1) shows the principal cause of record wear: small particles of microdust, deposited from the air by gravity, are ground along the record groove by the stylus. Surface noise goes up. Sound quality goes down.



Figure 1

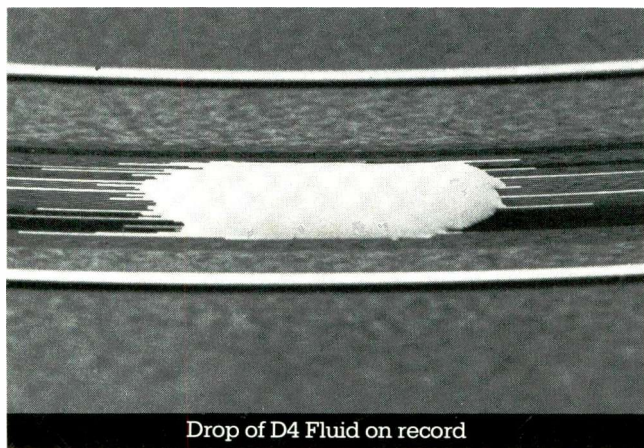


Figure 2

Figure 2 shows a drop of the aqueous Discwasher D4 Fluid, literally lifting dust and contamination out of record grooves. The extraordinarily complex D4 Fluid uses water pure enough for kidney dialysis, along with eleven chemically engineered additives that still results in lower dry-weight residue than most tap water. This formula is amazingly high in cleaning activity, uniquely safe for vinyl and vinyl additives, and preferentially "carries" contamination into the new Discwasher D4 pad.

In some record care products, organic solvents are used rather than water. Organic solvents such as ozone-gobbling chlorofluorocarbons, petroleum distillates (hexane, heptane) and alcohol concentrates are indeed speedy extractors and delivery solvents. They evaporate fast. Some organic solvents can dissolve vinyl stabilizers. Organic solvents may leave a "slick" looking record by treating the disc with other compounds carried in the solvent mix. In doing so, record contamination may also be dried back onto the disc in a nice even layer. Dust is often "held" to the record surface by "treatment."

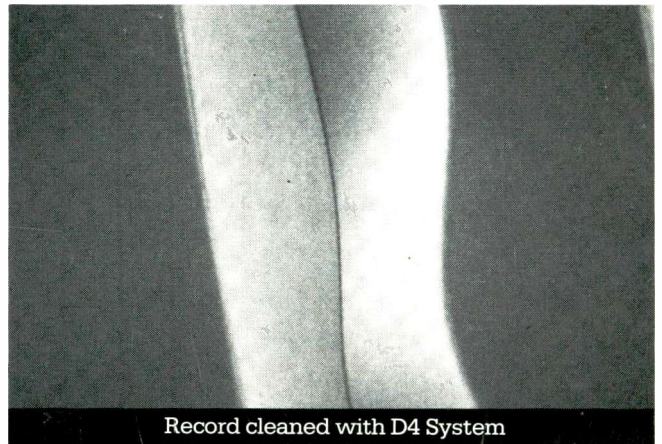
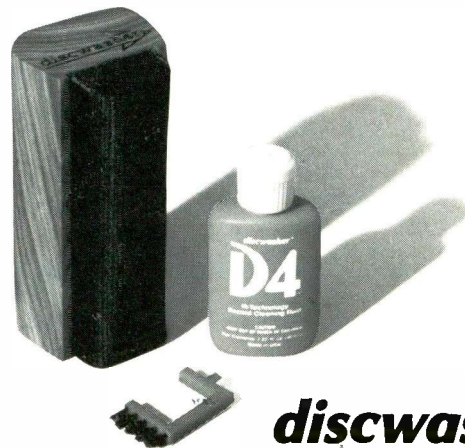


Figure 3

Electron micrograph (Figure 3) shows a record cleaned with the Discwasher D4 System. High technology record care leaves only a clean surface.



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