

The
Authoritative
Magazine
About
High Fidelity

Audio

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Special
Phono Cartridge
Issue

**PHONO
CARTRIDGE
OUTPUT
NETWORK**

**EXCLUSIVE
REVIEW:
McIntosh
MR-80 Tuner**

**MORE THAN
ONE VTA**



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has paper cone.

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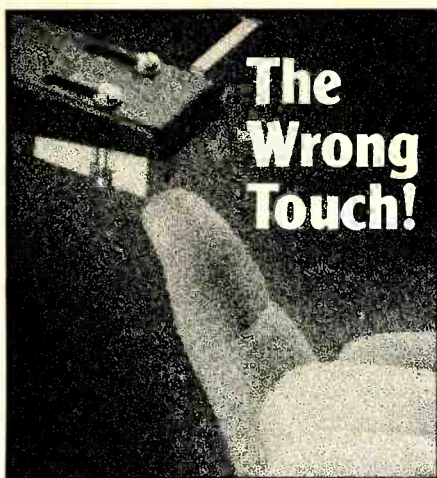
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VOL. 65, No. 3



FEATURE ARTICLES

MORE THAN ONE VERTICAL TRACKING ANGLE	Jon M. Risch and Bruce R. Maier	21
THE PHONO CARTRIDGE ELECTRICAL OUTPUT NETWORK	Arnold Schwartz	26

EQUIPMENT PROFILES

McINTOSH MR-80 TUNER	Leonard Feldman	34
APT CORP. APT 1 AMPLIFIER	Leonard Feldman	44
E-V CO15P/CS15P MICROPHONES	Jon R. Sank	50

RECORD REVIEWS

THE COLUMN	Michael Tearson & Jon Tiven	55
CLASSICAL REVIEWS	Edward Tatnall Canby	60
TOP OF THE PILE		64
FOLKBAG	Tom Bingham	70

AUDIO IN GENERAL

AUDIO ETC	Edward Tatnall Canby	6
TAPE GUIDE	Herman Burstein	14
AUDIOCLINIC	Joseph Giovanelli	16
DEAR EDITOR/ERRATA		18
CLASSIFIED ADVERTISING		71
BEHIND THE SCENES	Bert Whyte	87
VIDEO SCENES	Bert Whyte	91
READER SERVICE SYSTEM/ ADVERTISING INDEX		93
THAT'S THE WAY IT WAS	Walter I. Seigal	94



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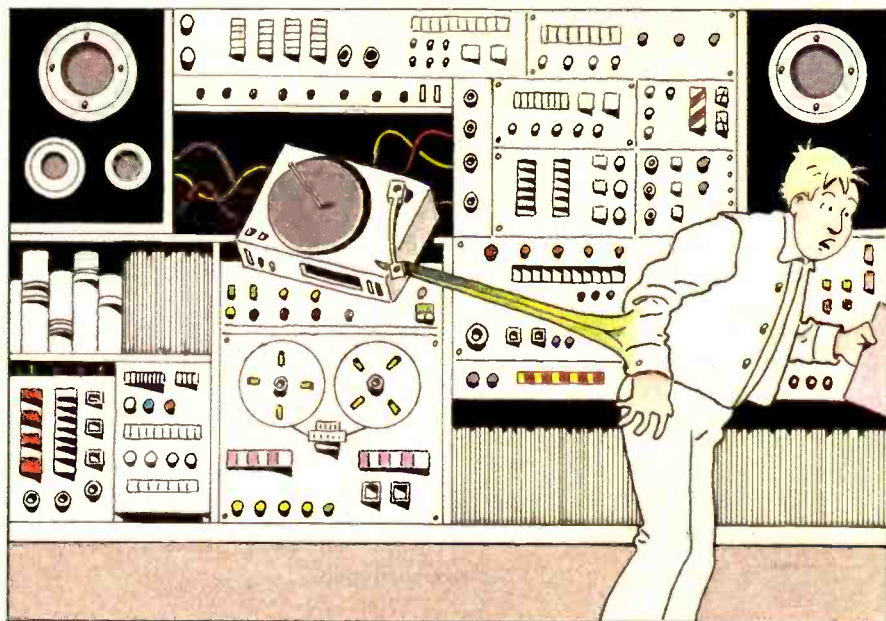
EDWARD TATNALL CANBY

Against a snag, no modern cartridge is proof One touch of knitted wool and the snag would be complete.

I've had my fingers into my hi-fi system again, to hook up and de-hook still more LP disc playback equipment — it's hard to keep up these days. Some people have objected that I condemn the LP by touting the day when a true all-digital disc, or several, will take over the field. Wrong! Wrong if they read me carefully. I have lived with LP for its whole life and I respect it, past, present and future — whatever this last may bring. That future has certainly NOT stopped unfolding, as anybody can plainly see and hear. So now for Installment Two, after a fashion, following my account in January of Sony's PS-X75 "biotracer" turntable.

Yes, human fingers are a lot better than remote control buttons when it comes to landing an LP stylus precisely on the quiet grooves between LP bands. But in other respects our thankless digitals are being asked to do a great deal in a negative way by the competing international manufacturers. Namely, to keep out of trouble. The damage that even a slightly unwary finger, or thumb, or even a human arm or sleeve can do today is appalling. I should know. Are your fingers bulkier and clumsier each year? That's the way it feels. I get the shaking palsy just looking at a new cartridge — me, I'm supposed to install THAT? And I can't even see the point, with 20-20 vision.

As far as I can tell, my professional colleagues on this magazine, bless them, seem never to make finger-faux-pas the way I do. Not if you read them, anyhow. I've figured out how they do it. Specially designed mechanical fingers, controlled by micro-circuits. What else? You put them on like surgical gloves. These fingers, I postulate, must be of spring steel, delicately tuned to a micrometer's breadth, tipped with iridium curved to a Shibata, with fingernails of nude diamond, the better to grasp. You don't make ANY mistakes with that kind of finger. Joints of sputtered silver, bab-bitted and lubed with silicon, powered by tendons of braided niobium sheathed in Teflon for precision movement. Some fingers! Maybe I'd do better if I had a



pair. As it is, if I ever wrote an Equipment Profile, it might go like this, in excerpt:

... On the left, the bias is controlled by a three-position toggle switch — oh-oh, there it goes. Fell right off in my hand. Must have tweaked it too hard."

Or: "The cartridge was lowered carefully to the record surface and EEEK — a one-inch scratch was seen to appear across the grooves at an angle of 93 degrees. This produced a peak reading of +87 dB at a frequency of 33.33 occurrences per minute, +1 percent, -½ percent."

Or even: "The phono stylus of stressed nubidium alloy was examined closely for tolerances. Oddly, two-thirds of the stylus bar was unaccounted for. However, the segment which proved visible easily exceeded manufacturer's specs."

No, only the people whose ordinary digits are no more precise than Neanderthal's could expect to run into that sort of testing trouble. Me.

So — to business, and all praise to my colleagues who do not write as per above. Today's account is of a quite fabulous new cartridge, as maybe you could begin to guess. I particularly had asked to try it because it is different in rather fundamental respects. The unit arrived just as I came down with digitalis (see February), followed, alas, by pericarditis, which is no fun at all. So I

tossed the little package quickly to my intelligent neighbor along with another brand-new table. I can't use more than one table at a time, after all, and these two would match, both of them state of today's art. Within a day, this guy called me back in distress. "Hey," said he, "why does this new cartridge skip grooves all over the place? My old one didn't." "WHAT," said I, "impossible! That thing should track anything, including a quarter-inch vertical warp."

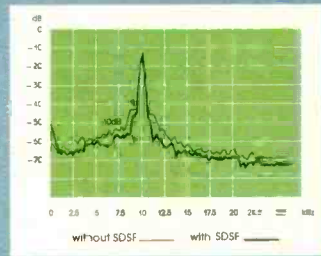
"Well," he said, "I put it right into my old table and —" "YOUR table! You mean that thing you've had for 22 years already?"

"It works," he said. "So why not? Your new cartridge is just lousy, that's all. It won't track. Even at 2½ grams."

"Good Lord, man," I shouted, as my fever went up two degrees. "Please," I said, "the NEW table. And two and a half grams — get that thing out of there and put it in the new table or I'm ruined! Repeat, the NEW table. And let's hope there's no damage. New cartridge, new table. They match. Get it? You CANNOT use a new high-quality cartridge in a table as old as that one, with its big, fat heavyweight arm and semi-rigid bearings. This thing is delicate, man! You've set up hideous strains on it, you've got horrible resonances. That is, as the cartridge sees them. If you want a cartridge for that table, I've got a batch of them in

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ALLISON:ONE® loudspeakers were used by Diversified Science Labs in reviewing nine "audiophile discs." The reviews were published in a special section of the Winter, 1980 issue of *Stereo* magazine. Here are some excerpts:

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These words are from record reviews. But the sounds described were not created by the records alone; they had to be reproduced by loudspeakers before the reviewers could hear them and judge their realism.

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my museum and any one will do a fine job, an optimum job. But lube things up a bit, first, will ya? That arm of yours sticks."

For once, this man was meek. Brains, yes, but no experience, like entirely too many of our consumers today. He'll learn. So the new cartridge and the new table were returned to me, each re-packed circumspectly in its own box. No apparent damage, and I breathed the well-known sigh of relief. I tend to be reckless on that score.

When I got back home from a rest cure, my friend came right over, all apologies.

Could he help me install the new cartridge? COULD he! I gave what passed for a faint whoop of joy. His fingers are big but he has patience. I just get exasperated. In short order, I was listening to the finest cartridge sound I have yet experienced. I was quite sure the sound was, indeed, in the cartridge, because with some foresight I had put away that other new table (later, later) and inserted the thing into my Sony, the PS-X75, already familiar to me. One variable at a time, please. No change in my entire set-up except the change of cartridge.

My state of bliss lasted several days, and you have been reading this for any number of pages. So I will now name names. The Micro-Acoustics System II is the cartridge and it is remarkable, perhaps unique, on a number of scores — most immediately, that it is *not* a magnetic. Neither moving coil, moving iron, variable R, or any other. It works by direct-coupled electrets, and it includes inside the ultra-light body of the cartridge a tiny micro-circuit adapter — no more extra black boxes, transformers, etc. — which automatically matches the unit to any combination of cable capacitance and preamp phono input, within one-half a percent. Moreover, it claims to be "the lightest, fastest cartridge ever," with the smallest stylus ever seen and a jewel point that is virtually invisible.

I went to the early press introduction for this cartridge last summer and was immediately impressed by these and a wealth of other quite astonishing innovations, even though at that point there wasn't much of anything in the way of sound. Some knowing readers will already surmise that this is the latest product of one of our most inventive minds, Arnold Schwartz, whose Micro-Point cutting styli are used everywhere in the business. "Arnie," as he is informally known, was once at CBS Labs, where I

met him way back. I still have a quadruple array of his loudspeakers, one of the earliest units to cope with the problems of forward-beaming highs and the cavity resonances set up by drivers mounted inside cutout boards, as the old ones mostly were. We have many innovators in our business but only a few, like Arnold Schwartz (like Edgar Villchur, like Ray Dolby, like S. Marantz), are the sort whose products work, reliably, predictably, uneccentrically, practically, for all their differences. My strong feeling was that any new cartridge from A. Schwartz should be worth a try, no matter how zany.

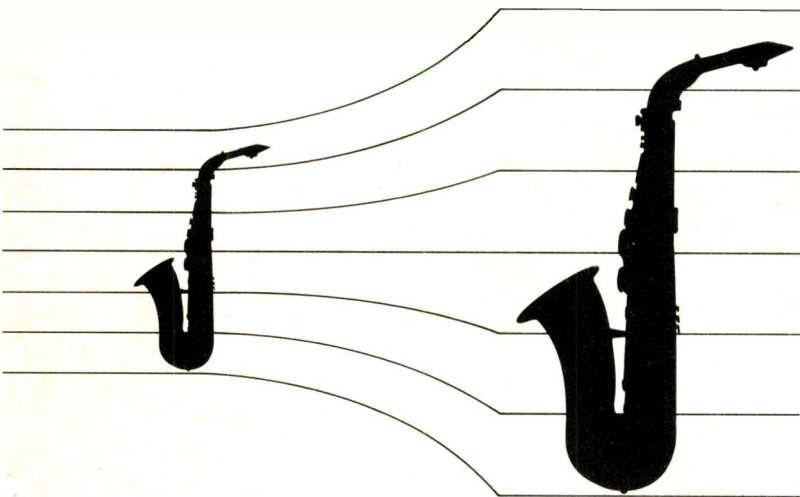
This System II from Micro-Acoustics (there are three in the line, from fancy to ultra-fancy) is no less than bewildering in the extent of its innovations. It has no business working at all, with so many "departures" from the delicately tuned experience of years in this touchy design art! And yet —. For instance, a lightweight body made of carbon — yes, carbon. Carbon fibre, to be exact. An entirely new coupling system, direct from stylus bar to the pair of electrets via a twin-pivot dual-bearing "resolver" — new word to me — and a whole galaxy of new dampers, iridium-platinum axial, dynamic feedback, and more. Not like anything you've seen, even if you know cartridges. And that stylus bar, made of rigid beryllium and said to be 60 percent lower in mass than "conventional aluminum stylus bars" — take your choice. I believe that. As I say, I have seen that stylus bar, though barely. You have to catch it with the light just right.

I'll stop with the quoted technicalities since this is not an engineering report. Frankly, I was a bit unsure whether I could plunge right back into my record reviewing with this unusual cartridge, just playing music as I had been doing with its worthy predecessors. Thanks, I do not want trouble. No eccentricities. I have work enough to do, just listening. I forget the cartridge — it's the sonic product that matters.

Unless you are an inveterate testing-testing type, whose life moves from one comparison to another, you would eventually feel the same way. Let's go! Let's play music.

And so I did. Not only was I instantly impressed by a kind of liquid, velvety smoothness of sound but it happened (it usually does with me) that the first record I put on the Sony table was warped. An

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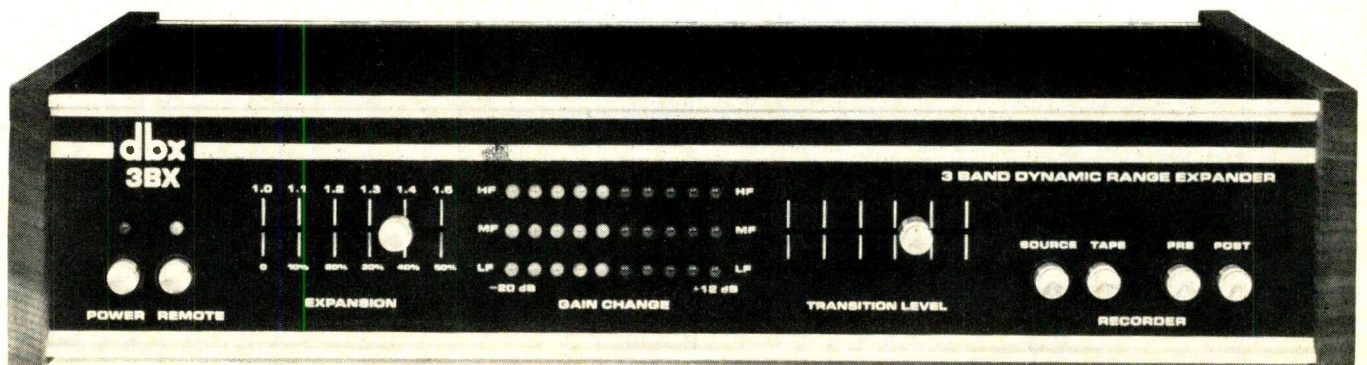
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up-bulge on one side, maybe a quarter inch off the rubber mat. At one-half gram the new cartridge, even so, played most of the music, skipping lightly into the air (the Sony is a good arm, definitely) for part of each turn. At one gram all but the outer inch of the record played without blemish. At 1 1/4 grams even the outer edge tracked, without distortion or skipping.

Now that is impressive! And a hasty trial of some other warped monstrosities (I have a few) only proved the point. The tiny beryllium stylus just gracefully bends up and down, the ultra-light cartridge body easily displaces itself and, you might say, the ultra-modern Sony arm

(you do need that) is happily surprised and cooperates perfectly.

Not only good sound but, to my growing surprise, a sort of background silence that had me baffled. The "surface noise" seemed lower, disc for disc, than I would ever have expected, knowing these records pretty well. In fact, after awhile, I put aside my usual surface-noise ratings until I could probe this welcome change. I really didn't know how to rate. When I later phoned Arnold Schwartz I mentioned this; silence from him. He may also have been surprised but more likely he meant, whaddya expect? Of course! Being modest, he let silence tell its own story.

The denouement was simple enough. I've set the background and you may guess what happened. On the third day, I finished up one last record review, playing the music as I wrote about it (my usual procedure) and then allowed the Sony to put the stylus to bed via its automatic shut off. Arm goes up, linear motor moves arm over to rest. Arm sinks to rest.

Next day I had other business, now being on the road to recovery, and on the fifth day got back to my typewriter, turned on my system and put another record under the plastic cover and onto the Sony table. After a few seconds a skittery noise came forth, shreds of faint music as the arm skated over the surface. Zero point pressure? Remember, this is adjustable in the new tables by an outside knob, even while the record is playing. I checked — it was set at one gram. With foreboding, I took the arm's headshell off and looked. Then just to be sure, I pulled out the removable stylus assembly.

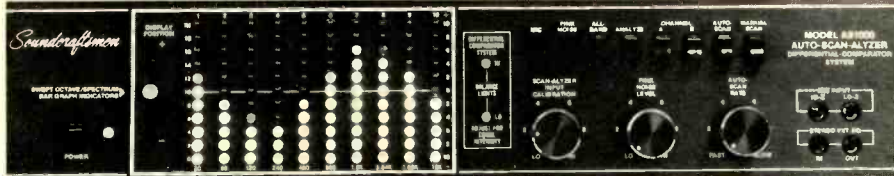
Yes, a segment of beryllium bar was left, about one-half. It had snapped cleanly, right in the middle. The half with the diamond had, of course, vanished.

Now that stylus system had been tested by a drop of several inches without damage. It simply bows, bends compliantly into the housing — as it had with the warped record. Did this one break off, then, of its own accord due to some internal defect or stress? Possible. Improbable.

MUCH more likely is what Arnold Schwartz calls a snag. Against a snag, no modern stylus is proof and especially this ultra-tiny one. Snag? Well, the Sony armrest is near its turntable and the arm sits on it like a feather. True, the Sony's mechanism ingeniously prevents the stylus from ever touching the rubber mat or the "floor" below. But what about a human arm, with a wool sweater and cuff, inserted under the dust cover to place a record on the table? One tiny touch of that knitted wool and the snag would be complete. I would never even feel it. That's my theory, anyhow, and I cannot blame Micro-Acoustics or Sony.

So it goes today. We must live with our new and perhaps delicate technology, not only fingers but human arms and even sleeves. One wrong move and disaster. And don't think your cartridge is immune, whatever the brand.

They're sending me a new stylus assembly and I have every intention of using the Micro-Acoustics System II once more, with absolutely enormous caution. Meanwhile, if you run into an equipment report on this cartridge, look to see whether the testing engineer ran into any snags. He might have, at that. Though he should know better.



Real-Time Spectrum Bar-Graph Auto-Scan-Alyzer, \$449.

You can *dramatically* improve your system through fast, accurate and continuous analysis with this new State-of-the-Art Real-Time Frequency Analyzer. The Auto-Scan-Analyzer also provides 0.1dB Read-Out patent-pending circuitry, a Bar-Graph of each individual octave or Full Bar-Graph Display, plus Variable-Rate octave-by-octave Automatic Sweep Scanning, both visually and aurally.

Your stereo component system can sound *even better* when you add-on a performance-engineered Equalizer, Analyzer, Pre-amplifier or Amplifier from Soundcraftsmen. Separate add-on components, made in the U.S., and designed specifically to improve and enhance your already fine stereo component system. Our slogan has always been, and remains, "guaranteed to *improve* and enhance *any* fine stereo component system."

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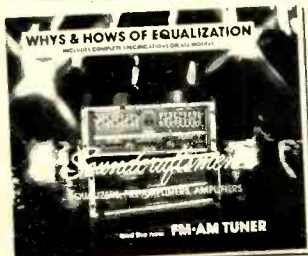
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- EQ defeat • ± 16/12dB octave gain
- S/N- 105dB • THD 0.01%
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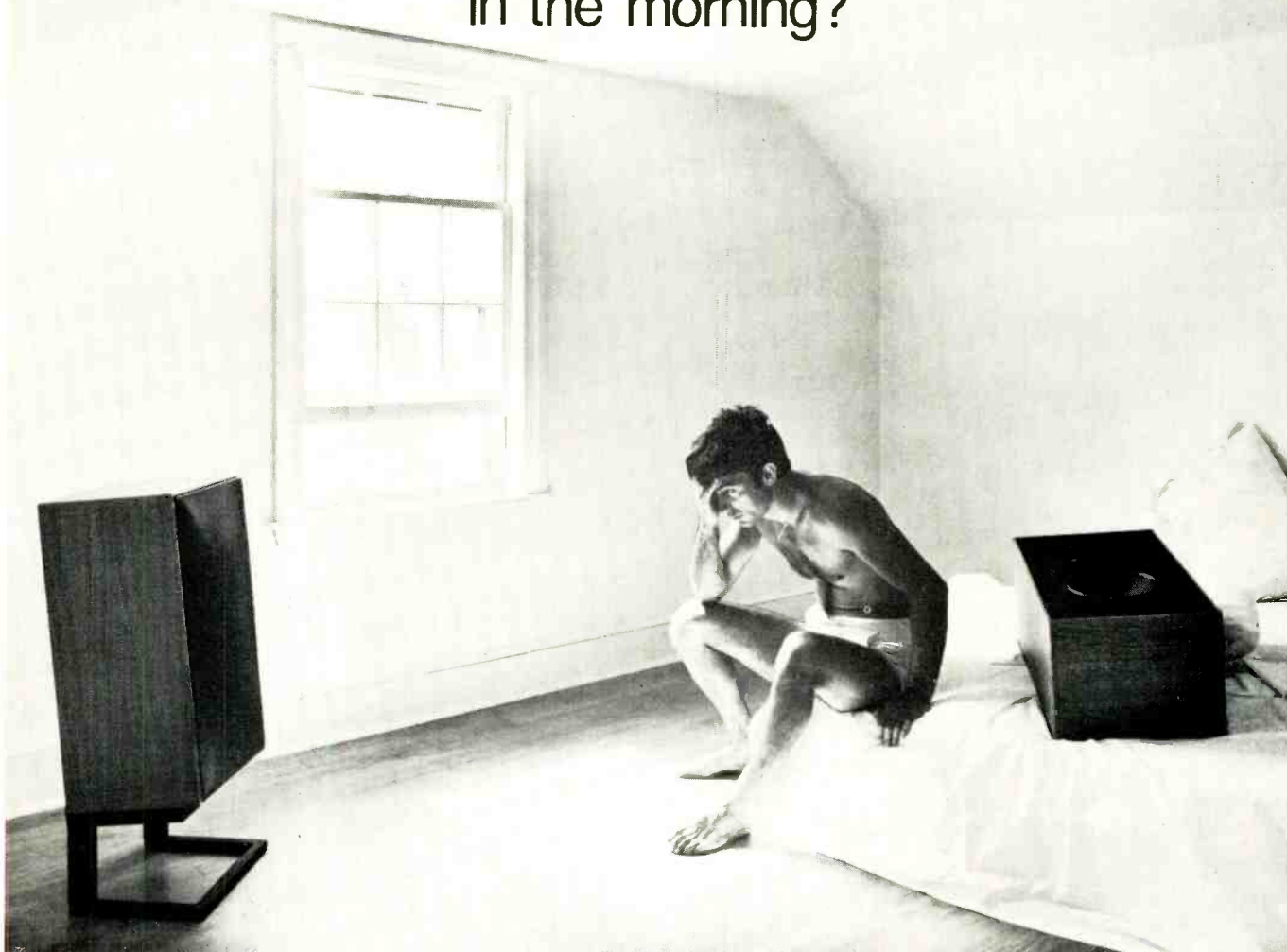


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Will you still respect your speakers in the morning?



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 only serve 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-

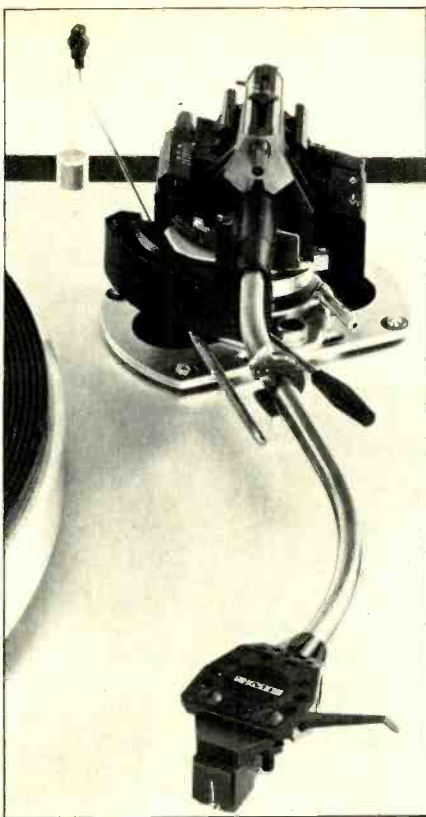
quency range, uncanny sonic accuracy, razor-sharp stereo imaging and true-to-life dynamic range, the L730 delivers untiring musical performance. Although the system is capable of shaking walls with clean, undistorted sound, you'll appreciate it most on those mornings when quality counts more than quantity.

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. AU24, or call 1-800-824-7888 (California 1-800-852-7777) toll free and ask for Operator 483.



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TAPE GUIDE

HERMAN BURSTEIN

Speed Traps

Q. I do a considerable amount of dubbing, using two Dolby-equipped tape recorders. I am concerned about converting a prerecorded tape from 3 3/4 ips to 7 1/2 ips. When transferring at different speeds, am I losing quality, and if so is there any way to compensate? — Dan Karsch, New York, N.Y.

A. If you are going upward in speed, there should be very little, if any, loss in quality when dubbing with good equipment and proper procedures. For playback of the tape to be dubbed, use the quieter of the two machines, because playback noise is usually more of a problem than recording noise.

If the tape to be dubbed is not Dolbyized, the input signal to the recording machine should go through the Dolby recording process but the playback signal should not. If the tape to be dubbed is Dolbyized, the Dolby mode should be used both for playback and recording.

Not-Talking Heads

Q. In the record mode, my deck intermittently ceases recording so that only previous material is played back. Are the erase and record heads at fault? — Jerry Farrar, Long Beach, Cal.

A. I doubt this. Rather, it seems that the oscillator may be intermittently cutting or shorting out. A component in the oscillator circuit may be responsible, or there may be a break or short in the leads from the oscillator to the record head. You probably need the help of a competent service technician to locate and cure the trouble.

What's Your EQ?

Q. Why do most cassette recorder manufacturers use record equalization and bias, while a few use playback equalization, and some use both record and playback equalization and bias? — Mel Muracka, Honolulu, Hawaii

A. All tape machines use record equalization and bias in recording, and playback equalization in playback. In playback they use the same equalization, conforming to an industry standard. However, machines may differ in their amount of recording equalization and bias, depending on the tape for which the machine is intended and the manufacturer's ideas on the optimum combination of low distortion, low noise, and extended treble response. Most cassette machines provide a switch which allows

the user to employ basically different kinds of tapes (such as ferric oxide versus chromium dioxide); this switch may change not only the bias but also the record equalization and even the amount of audio signal fed to the record head.

Roast Deck

Q. On a warm day the cassette well of my deck may heat up to 105 degrees. Is this harmful? — William Madlener, Chicago, Ill.

A. Electronic equipment is usually rated to work properly up to a temperature of about 140 degrees, so I don't think that 105 degrees is anything to worry about.

As Above, So Below

Q. I am going to buy an open-reel tape deck. The problem is that some decks have the drive capstan above the pinch roller, while others have the capstan below the roller. Which way is better? — Jerry Ubels, New Westminster, B.C., Canada

A. I doubt that it makes any significant difference whether the drive capstan is above or below the pinch roller. Ability of the deck to drive the tape with minimum wow and flutter and at steady speed depends on other factors, such as the guide system, use of a flywheel, tension arms, flutter wheel, nature and quality of the motor, etc.

Bottoms Up

Q. I have read that cassettes should be stacked end up rather than flat. If they are stored end up, then the weight of the tape will press on a single point, whereas if a cassette is stored flat, each turn of tape will rest on its edge so that the weight is distributed uniformly. Which method is correct? — G. Kornfilt, Istanbul, Turkey

A. The recommendation to stack tape end up is usually made by tape manufacturers. Flat storage tends to damage the edge of the tape, apparently leading to serious problems more easily than if the tape is stored on its end. If tape is fairly tightly wound, end-up storage is not likely to be harmful. **A**

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

AFTER 500 PLAYS OUR HIGH FIDELITY TAPE STILL DELIVERS HIGH FIDELITY.



If your old favorites don't sound as good as they used to, the problem could be your recording tape.

Some tapes show their age more than others. And when a tape ages prematurely, the music on it does too.

What can happen is, the oxide particles that are bound onto tape loosen and fall off, taking some of your music with them.

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So even after a Maxell recording is 500 plays old, you'll swear it's not a play over five.



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AUDIOCLINIC

JOSEPH GIOVANELLI



Digitally mastered and audiophile recordings have added an exciting new dimension to the state of the audio art. Sonus cartridges are exceptionally well-suited to realize the full sonic potential of these new recording techniques.

This is especially true of the new Sonus Dimension 5. Its unique phase-coherent, integrated, stylus construction enhances still further the exceptional purity and integrity of reproduction found throughout the Sonus range of high compliance cartridges.

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The finer your records the greater the difference a Sonus will make.



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Speakers Stacked Against Him

Q. I have a pair of stacked speakers, one for each channel, and the sound produced by this arrangement is always good. The sound is not as loud, however, with all speakers operating as when either the A or B set of speakers operates alone. Why is this? — Jerry H. Ervin, Flint, Mich.

A. I believe the reason for the loss of volume when both sets of speakers are operating is that the two speakers within each stack are out of phase.

To correct this, take one stack of speakers and reverse the common and hot leads of one of the speakers in the stack. Then go to the other stack and repeat. This process should produce the desired volume increase.

If the loss of volume is now even greater, and includes a loss of bass response, you'll have to replace all connections as they were initially. In this case, it's probable that a volume loss was intentionally designed into your amplifier to provide a means of safeguarding the unit from overloads.

Leaving Single Switches On

Q. I have a Heathkit Audio Control Center, and all of my components are plugged into it. When I turn the control center on, this automatically turns everything on. Is there any harm in leaving all the power switches in the "on" position? — Dan Tremaine, Sandusky, Ohio

A. If the power used by all the equipment does not exceed the ratings for the power switching in your control center, you can safely leave all equipment turned on and use that single switch in the control center to turn the system on and off.

In the case of a tape recorder which may not be frequently used, it may be better to keep it turned off, because many tape recorders are designed so that their motors turn all the time once power is applied — regardless of whether or not they are pulling tape. Since this adds wear to the motor, it should be avoided if possible.

Rock vs. Home Sound Equipment: Watts the Verdict?

Q. I recently got into a heated discussion with a sound technician working with a popular rock group. The group uses a dozen or more 200-watt amplifiers, along with expanders and equalizers, feeding into several speakers. The

technician told me that this \$50,000 worth of equipment is necessary to achieve the best sound available!

I flatly disagree. High-end home audio offers much cleaner, more transparent reproduction at a fraction of the price. There seems to be much more technology offered in this area, too.

Who is correct regarding accuracy in the reproduction of music? — Steve Grossman, Middletown, N.Y.

A. You and the sound technician are both right! Home entertainment equipment will reproduce sound about as accurately as anyone could measure. This is not necessarily the aim of the rock group that you were discussing, because the group is not reproducing anything; it is creating something. The fact that some of today's music is created electronically is not the issue. The group is creating something which you, with your home system, must be capable of later reproducing.

Each rock group wants a sound which gives its music a specific character. One means of achieving this is to use speakers which have rather severe coloration — even without other electronic coloring. This coloration, or distortion if you like, is enhanced by the use of equalizers and other devices. (One form of distortion is that of frequency response, as produced by an equalizer. Other kinds of distortion are perhaps more obvious, involving changes in the envelope of the waveforms, the fuzz guitar and the ring modulator being typical examples of this.)

Once rock groups have established their particular sound, they must perform their music in large spaces. Equipment used for home entertainment probably could not fill such large halls or carry well in open-air concerts. Achievement of good sound at concerts requires a large number of speakers with amplifiers to power them so that the audience will hear the music at the intensity the performers feel is correct.

Some additional equipment is needed just to enable the performers to hear themselves on stage. Problems involving the performers hearing themselves can be very significant and difficult to solve. **A**

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

Caring.

Owners of Crown audio components think of Crown as a "caring" company. Here are unsolicited comments discovered on returned warranty questionnaires from just ten such owners.

"I am very pleased with your interest in myself and my needs. Usually companies don't care after they have received their sales commission. Crown certainly has a fine product as well as unequalled business approach and attitude."

Norfolk, VA

"Your company is doing what very few people care to do anymore: make a quality product at a competitive price, and set up a line of communication."

Hatfield, PA

"I like your concept of not trying to put every possible function on a piece, but doing it so that you can gradually add on."

Phoenixville, PA

"Thank you for your concern."

Wichita, KS

"Crown International treats its customers with a professionalism found nowhere else in the industry. I simply can't be complimentary enough."

Rogers, AR

"I really enjoy being associated with Crown and its products."

Cleveland, OH

"Your concern for owner, as shown by letter communication is commendable."

Pacific Palisades, CA

"I am impressed with Crown International as a class operation with concern for its customers after the sale."

Garland, TX

"I'm pleased to be affiliated with Crown thru my purchase. The professionalism displayed by your company is overwhelming."

Toledo, OH

"I have called the Crown factory on several occasions and have always been more than satisfied with the courtesy and information given."

Atlanta, GA

We work hard to *be* a caring company, not just because it makes good business sense, but because it's much more fun to relate to our customers as whole human beings, not just as purchasers of our products.

Our customers apparently think so, too. If you'd like to find out what there is about Crown and our products to inspire such feelings, we'd like to send you the Crown Information Package. It's a collection of over 70 pages of specifications, technical papers on audio problems written by Crown engineers, brochures detailing the features

and operation of Crown components, reviews from leading audio publications, prices of Crown equipment and names of nearby dealers.

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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 VMRT™ 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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DEAR EDITOR

A Letter-Perfect System

Dear Editor:

Looking through the Annual Equipment Directory (Oct., 1980), I have come up with the following system: APT amplifier, AGI preamp, NAD tuner, STD turntable, ADC tonearm, AKG cartridge, ESS speakers, and an SAE cassette deck using DAK tape. Add a GLI equalizer, indoor antenna from BIC and an ADS signal delay.

The system will be marketed under the APTAGINADSTADADCAKGESSSAE-DAKGLIBICADS (Ap-tagi nad-stad cag-ess say-dak gli-bicads) label.

Sid Lee
Big Sur, Cal.

Change Platters and Dance

Dear Editor:

In November, *Audio* brought me something I've been waiting years to see: A beautiful write-up of the great Capehart record changer. I always wondered why no high-fidelity magazine had ever spotlighted this "mechanical marvel," as you justly call it.

I owned one of these Capeharts in the 1940s and later purchased another one built into an RCA Victor Model QU8 console, which was an improvement over the Capehart in that it used a magnetic cartridge and had a screw-type recorder surpassing the Presto professional systems of that era.

The Lincoln Series 50 record changer (which I owned up to 1956) was another "marvel." It was manufactured and marketed by Lincoln Engineering Co., of St. Louis, Mo., until they sold it to Fisher. After that it dropped out of sight. Although it wasn't as trustworthy as the Capehart, if well cared for it did its job nicely. Also, the Lincoln 50 played both sides of all modern records, including 45s, 78s and LPs.

I haven't been able to figure out why some enterprising manufacturer has never copied the Capehart and modernized it to handle LPs. I know it "would cost too much to make," as you state, but I know it would sell. How many turntables are there on the market now that cost \$700.00 on up — and their only specialty is that they will play in a preselected groove. In fact, I just read about a \$15,000 turntable that doesn't even do that!

I have never accepted the argument that a record changer is not desirable to-

day because of playing time per disc side. I long for a changer that will play both sides of a record so I can listen to a symphony or an opera without having to stand up at the end of the first few movements to turn the disc over.

Let's campaign for a modern, LP-capable Capehart. With the great advance in modern electronics it shouldn't be at all difficult to redesign it for long-playing records. This would be a "super marvel!" — and I would be the first in line to buy one.

Carlos Diaz-Granados, V
Miami, Florida

Nordine on the Air

Dear Editor:

I have always enjoyed your magazine for the good equipment reviews, history, new products, Prof. Lirpa, features and the like. However, I do have a little gripe concerning the time it takes before an album gets reviewed, be it good or bad. Specifically the Ken Nordine review (Nov. '80, pg. 78). I already had the album, *Stare with Your Ears*, for close to a year before I saw your review. Nordine-ites can be fanatics.

After mentioning the Word Jazz albums and his recent commercials, nothing was said about what he's been doing lately. He has his own half-hour show, Monday through Friday, on Public Radio (in this area, WBEZ, Chicago). The content of this program quite often transcends his latest album, and his audience is legion. Why else would Rita Jacobs Willens of the Midnight Special recommend his program on one of her rival stations (WBEZ vs. WFMT)? Why else would Studs Terkel have Ken for a guest?

Gripes excluded, *Audio* is one of the best magazines on the stands, one to which I shall always subscribe.

Bruce G. Goetzinger
Racine, Wisc.

Errata

The prices shown in our October issue on page 125 for *The Classic Trumpet Concerti of Haydn & Hummel* (Delos Digital Master Series DMS-3001) and *The Sound of Trumpets* (Delos DMS-3002) were incorrect. The price for each of these records is \$17.98.

In "Construct an Indoor/Outdoor FM Antenna" (January, 1981) Figs. 4 and 5 were transposed.

NEW HIGHS. The 500ID defines hard-to-get high frequencies because it comes with a cantilever that doesn't easily distort them.

It's boron-vapor hardened to track under "G"-forces that would buckle ordinary cantilevers.

NEW FIDELITY. In addition to hearing more highs you're going to hear less noise from a 500ID.

There's nothing complex about the benefits of Samarium-Cobalt magnets. They are simply less massive and higher in output than conventional ones.

So, if we had to give a reason for our signal-to-noise ratio being better than most, it's because the materials we use are better than most.

NEW TECHNOLOGY. Because the 500ID features Empire's inertially damped tuned stylus system, its performance is consistent—even when the capacitance varies from one system to the next.

Which means, the performance we monitor in our lab is the performance you're likely to hear at home.

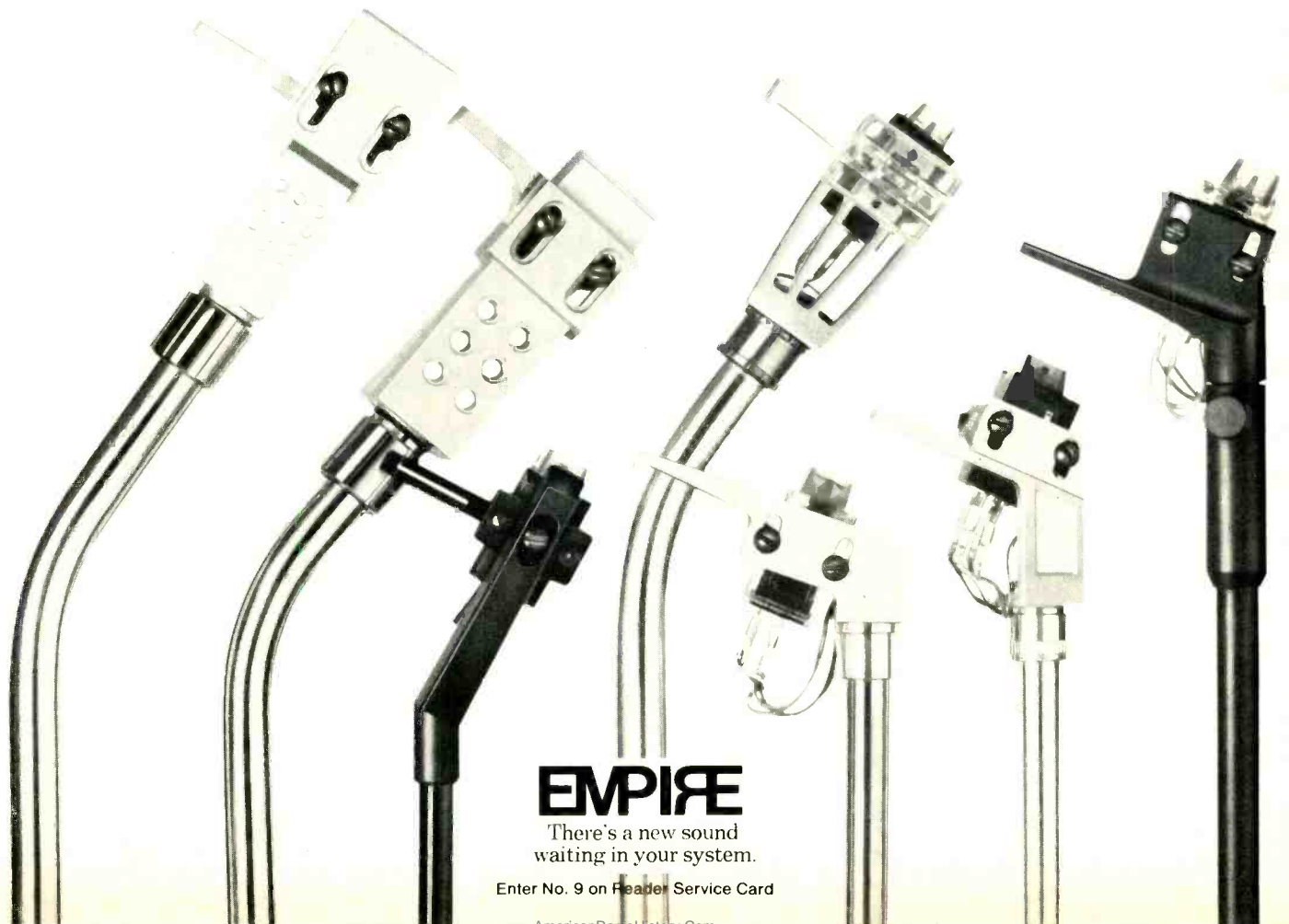


NEW SECURITY. Empire's two-year limited warranty is 365 days longer than the one-year limited warranty offered by many other manufacturers.

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NEW SOUND. The Empire 500ID. You're an arm's length away from a new listening experience.

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Single-play vs. multiplay: the argument is over.

BSR is proud to put an end to the seemingly endless debate over what style of turntable is the "correct" turntable—single-play or multiplay.

Introducing the BSR Pro III Series—the third generation of turntables.

The BSR Pro III Series combines the precision and accuracy of the finest single-play and the ease and versatility of a multiplay. At a price well within the range of both.

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This may be the finest tonearm ever offered on a multiplay turntable. It has an extremely low mass carbon fiber head shell, designed to be used with today's finest low-mass cartridges and measures an impressive 237mm from pivot to stylus. And, its sleek, rapier-straight line will give you unerring tracking performance.

Two motors are better than one.

The BSR Pro III Series 300 and 200 models feature a direct response FG Belt Drive turntable with a quartz-locked control system that references the speed of the motor to that of the turntable. Additionally, there is an independent servomotor that drives the tonearm only during cycle changes. This unique two-motor design eliminates complicated cams, trip switches, etc.—all of which can interfere with optimum turntable performance.

Independent tonearm and turntable suspension.

BSR Pro III Series turntables utilize a floating suspension system to isolate both the turntable and the tonearm. Mounted together on a separate subplate, independent of base, cover and controls, this eliminates most causes of vibration and acoustic feedback.

Three-record umbrella spindle—short and sweet.

Unlike traditional six-record multiplays, the BSR

Pro III Series turntables are designed to play up to three records. The decreased height and weight of the record stack allows for a much more precise vertical tracking angle and overall turntable performance.

Digital readouts.

BSR Pro III Series turntables have a multifunction digital display, allowing you to determine both quartz-locked and variable turntable speed, elapsed time, stylus time and exact turntable leveling.

Lateral cueing.

The BSR Pro III Series has the only lateral cue control on a multiplay turntable. It provides fast and slow cueing in both directions, allowing for precise location of any portion of a record.

Remote control.

For total convenience, the BSR Pro III Series 300 has infrared remote control, which handles all major turntable functions, including volume control, from as far away as 40 feet.

Look at the look.

The BSR Pro III Series has a handsome low-profile design, with all electronic pushbutton controls conveniently placed outside the closed dustcover.

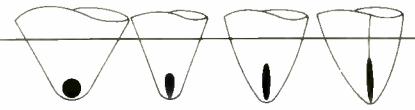
Add it up—both sides win.

Whether you're a believer in single-play or multiplay turntables, we believe that the BSR Pro III Series offers exactly what you demand. We invite you to examine it at your audio dealer.

BSR Pro III Series.
The Third Generation of Turntables.

BSR (USA) Ltd., Blauvelt, New York 10913. BSR (Canada) Ltd., Rexdale, Ontario.

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MORE THAN ONE VERTICAL TRACKING ANGLE

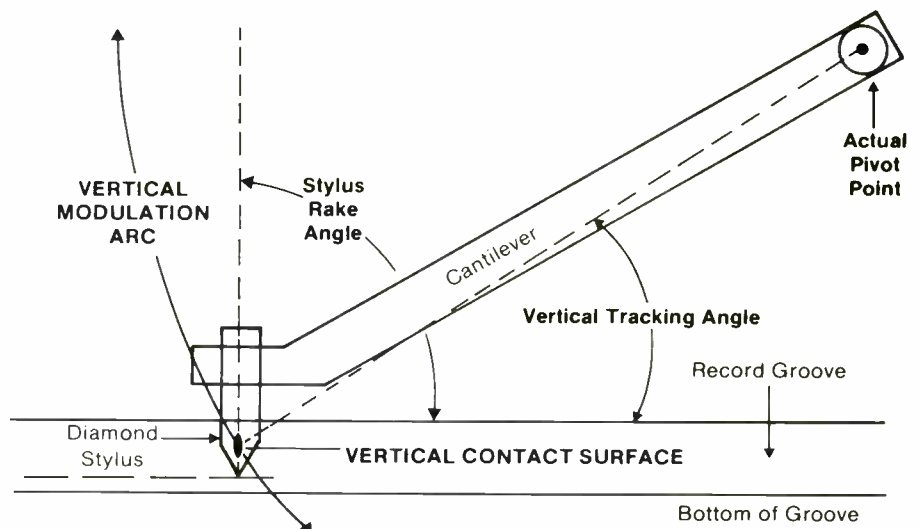
JON M. RISCH
and BRUCE R. MAIER*

Discwasher Laboratories has recently been investigating high-performance phonograph playback, and as a result of our investigations, we have become aware of several unusual aspects of the vinyl playback system (VPS). In one of our studies, we were concerned with the microscopically small dimensions involved where the record groove is being dragged past the playback stylus, as well as more visible aspects such as vertical tracking angle (VTA). In our tests, we wished to retrieve

as much undistorted information as possible, and among the VPS parameters we felt should be optimized was VTA. Correct VTA for the VPS, in classical theory, involves having the playback angle match the cutting angle (Fig. 1). Physically, VTA is the angle between the surface of the record and the line described by the contact point of the stylus in the groove and the pivot point of the cantilever. This relationship is analogous to and originates in the recording process. The theoretical importance of matching

VTAs between recording and playback has been widely expounded, and popular explanations of causes and effects are generally available, but they should be examined in some detail to fully understand their consequences. Mismatch of playback VTA to the recorded VTA is said to cause one minor effect: Frequency modulation of the highs present in program material in response to any significant level of low-frequency vertical groove motion. Referring to Fig. 1 again, notice that the vertical-modulation arc

Fig. 1 — The playback system, showing the relationships of vertical tracking angle (VTA), stylus rake angle (SRA), and vertical modulation arc; side view through groove.



*Members, Research Staff, Discwasher Laboratories, Columbia, Missouri

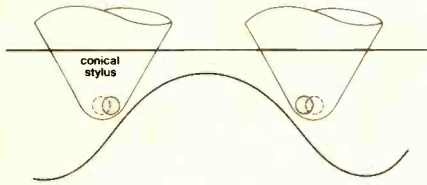
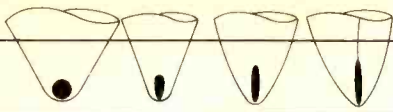
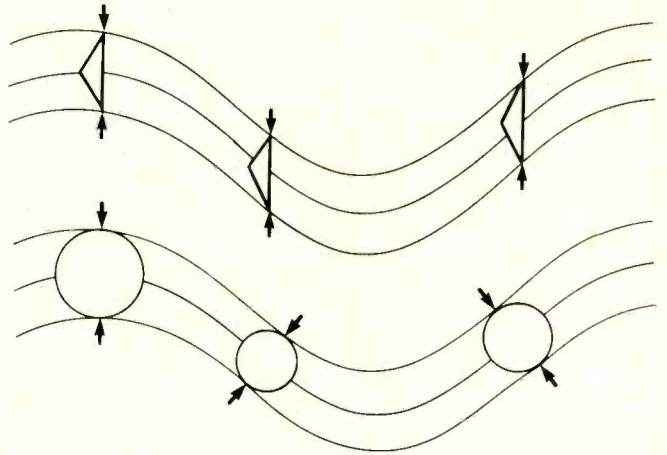


Fig. 2 — Conical stylus tracing error with vertical groove modulation, showing contact patch or footprint shift from reference position; side view through groove.

Fig. 3 — Conical stylus tracing error with lateral groove modulation, showing contact point (center of contact patch) skew relative to cutting stylus; top view.



shown is characteristic of any vertical (out-of-phase) modulation in the groove. Because of this arc and the resultant forward and backward motion along the groove, the momentary linear cutting speed would be varied proportionally to the amount of horizontal displacement this vertical motion causes. Any time this occurs, any frequencies higher than the dominant vertical-displacement low frequency will be modulated by that low-frequency displacement. Of course, all this is not a problem if the recorded VTA is replicated in playback, whereby the frequency modulation (FM) is cancelled due to the vertical-modulation arc being the same. The sonic effects of a VTA error are similar to flutter, heard as wavering of the high frequencies. There is an important difference between typical flutter and frequency modulation due to VTA error, and this is that the FM causes wavering in relation to the low-frequency content of the program material whereas flutter is generally a repetitive, continuing variance affecting the entire range of program material. It is this time-dispersive FM distortion that arises from VTA error and causes the theoretical furor of concern over cartridges with higher than optimal VTAs.

The literature indicates that if one had a cartridge with an inherent VTA higher than recorded angle, it could be tilted back (cartridge body allowing, some won't) and minimum distortion would be obtained. This isn't quite true, since stylus shape, in addition to VTA, also influences FM distortion.

Conical (or spherical) styli have a certain built-in amount of FM distortion with either a lateral or vertical modulation

(Figs. 2 and 3). As shown in Fig. 2, due to the ultimate rounded tip shape of the conical stylus, a significant vertical modulation will cause the contact patch to shift. From the center or reference position, a stylus drift or lateral thrust ahead and then behind will cause exactly the same type of distortion as VTA error. Both are slope related and can augment or tend to cancel depending on the sign (polarity) of the VTA error. The amount of FM due to the stylus shape will vary in relation to the stylus radius and the amplitude of the vertical modulation.

With lateral modulation (Fig. 3), the FM inherent to conical styli occurs on both channels in opposite directions, so the mono (sum) signal would show little or no FM effect (depending on the accuracy of lateral tracking angle). In stereo playback, however, the two channels illustrated would have high frequencies recorded along with the lows. The low-frequency modulations cause the stylus contact areas to skew or twist, thus causing a degradation of high-frequency phasing and stereo imaging. The net result of these and other factors is that correct VTA for conical styli will only minimize, not eliminate, the FM distortions.

Other stylus shapes reduce these problems because of their smaller contact scanning radii. Typically, today's genre of elliptical or modified-Shibata styli have a scanning radius no smaller than 0.2 mil, while conical styli range from 0.5 mil to 0.8 mil. This smaller radius allows a more consistently defined contact with the groove, reducing these types of FM distortion.

Our tests indicated elliptical and Shibata-type styli have another parameter of dramatic importance not present with conical styli. This overlooked factor is called stylus rake angle or SRA, which is the angle that the vertical center line of the stylus contact patches make with the groove modulation ridges. Stylus contact areas for different types of styli are shown as black vertical patches at the bottom of Fig. 4. As seen in this figure, the Shibata-type stylus shows the longest, narrowest contact, while the conical stylus predictably has a circular contact patch or footprint. The elliptical and modified elliptical stylus shapes fall in between these extremes. Due to its long, narrow footprint, the Shibata-type stylus is theoretically very sensitive to positional changes in SRA. Any misalignment of the footprint relative to the groove modulation ridges will cause its vertical footprint span to increase, resulting in possible losses of very high frequency modulation (scanning loss).

Our detailed models showed that this increase in the effective scanning radius does not result in a simple, smooth, effective broadening of the stylus footprint. Due to the nature of the tilted, narrow contact edge, the manner in which this edge contacts the groove modulations is somewhat nonlinear and more complex as compared to a simple conical stylus shape of comparable radii. Physical modeling showed the tracing errors which arise with a misaligned Shibata-type stylus are similar to, but greater in distortion level than those of a conical stylus, and similarly result in some low-frequency-dependent FM of the decoded high frequencies.

We therefore hypothesized serious geometric potential for improper SRA of Shibata-type styli. The groove modulations can grab at the scanning edges of the stylus, torquing or attempting to twist the stylus which can send vibrational shocks up the cantilever.

From the modeling of these factors, it would seem both VTA and SRA should be corrected for optimal playback. Yet the physical connection of cantilever and stylus causes both of these parameters to vary simultaneously. There is a fixed relationship between the inherent VTA of the cartridge, when set up as recommended, and the SRA which results from the fixed stylus chip vs. cantilever attachment.

When considering the proper vertical alignment of our test system, we had to decide whether we should align for correct VTA, proper SRA, or some optimal compromise position so as to maximize undistorted information retrieval. Before we could make that decision, we decided to assess the effect of varying VTA. Our test system consists of a Denon direct-drive DP-80 turntable with a modified DA-401 tonearm with the ability of in-play rear-pivot-height adjustment via a precision micrometer. Several different moving-coil cartridges were used in tests with an HA-1000 pre-preamp running into a modified lab reference preamp. The output of this preamp was observed via a Tektronix 466A Storage Oscilloscope and/or with a GenRad 2512 Spectrum Analyzer. Test data could be plotted on an Easterline-Angus 575 X-Y plotter for reference plots, etc.

Some initial tests were conducted consisting of spectrum analysis of vertical modulation IM bands (CBS STR-112 test record) where the vertical angle was varied using a moving-coil cartridge having a modified elliptical stylus. The results of these were somewhat inconclusive as there seemed to be no clear-cut indication of a minimum level of distortion at the various angles of playback. There were some subtle and generally inconsistent shifts in the distortion spectra with changes in VTA, although their significance was not determined until some time later.

In order to control the variables in our test system, cartridge tests were performed using the DIN 45-542 VTA test record [1], which has bands with varying

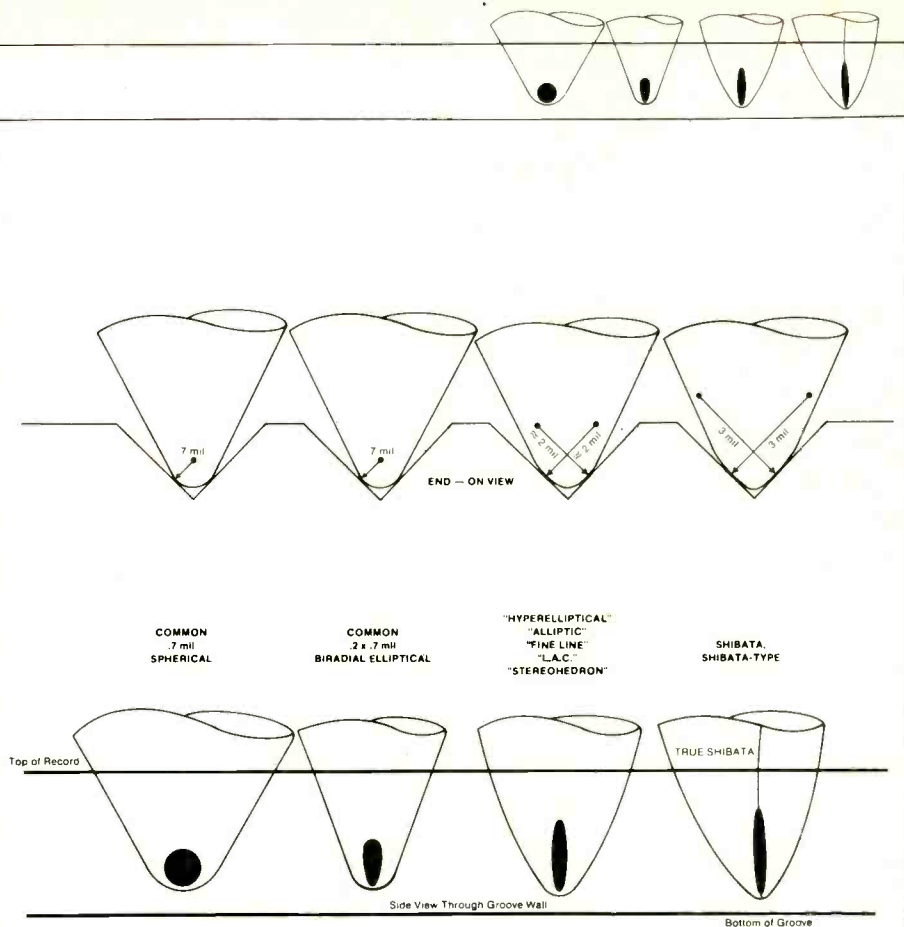
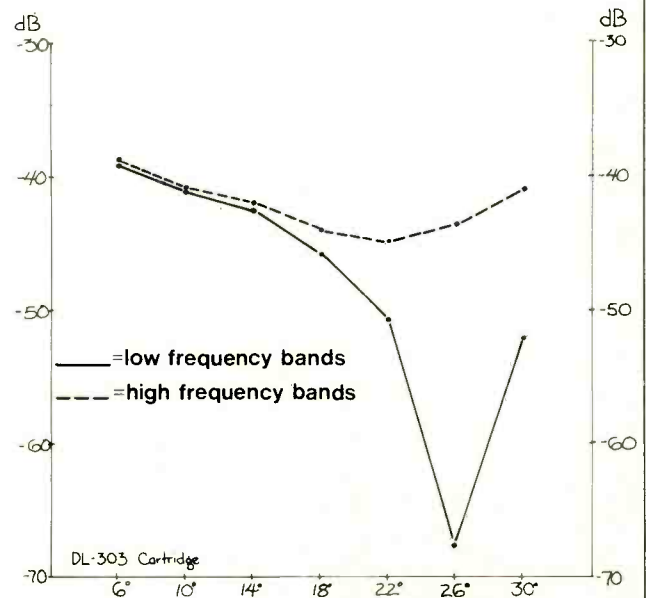


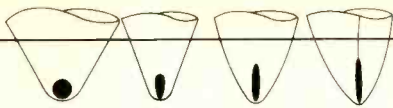
Fig. 4 — Groove contact geometry of four common stylus shapes.

Top: End-on view or profile as stylus rests in groove with no sink-in shown.

Bottom: Side view through groove with black patches showing stylus footprint or contact area.

Fig. 5 — An IM distortion vs. VTA variation comparison, showing null points in the high and low frequency sections.





VTA. Two groups of bands are involved with VTA determination: One is a high-frequency IM tone consisting of 1.85 kHz and 3.15 kHz with a high-side IM product of 5 kHz, whereas the other section is a low-frequency IM tone consisting of 370 Hz and 630 Hz giving a high IM product of 1 kHz. Neither IM product is harmonically related to the base frequencies, and thus no masking confusion occurs.

Figure 5 is the data plot from this DIN record using the cartridge with the modified elliptical stylus. Notice the shallowness of the high-frequency bands null (point of minimum distortion) compared to the low-frequency bands null. There is also a difference in the angle at which the null occurs, which tends to hold true for any stylus shape with an SRA potential. If VTA were the only effect being measured, the IM distortion nulls for the two bands should be very close in slope, shape, and location. We theorized that the observed difference in the nulls (Fig. 5) was due to SRA interaction with the shorter wavelengths involved in the high-frequency section of the tests. The shallowness of the high-frequency null is most likely a result of the different SRA-to-VTA relationships between the cutting system and playback cartridge (about 25 degrees difference in this cartridge). We feel it was a similar effect in the initial VTA tests that caused the spectral plot of distortion products to show little overall change on the CBS test record.

Tests with a cartridge having a conical stylus always gave a much closer correlation between the nulls for the two different frequency sections and tended to give a deeper null for the high-frequency bands than for other (elliptical, Shibata) types of styli. The reason that null points for the two frequency sections do not give exactly the same angle and depth was hypothesized to be due to some of the tracing distortion mechanisms inherent in the conical stylus shape, as discussed earlier.

One means of isolating VTA parameters is to use a cartridge with a conical stylus, which has no SRA because of its circular contact footprint. Figure 6 is a spectral plot of a vertically modulated IM test band (400 Hz and 4 kHz) made using a moving-coil cartridge with a conical stylus. The vertical tick marks are 10 dB apart, with the top of the graph starting at -25 dB down from the 400-Hz com-

Fig. 6 — Distortion variation with VTA change, showing the increase of distortion components with a 4-degree misalignment in VTA.

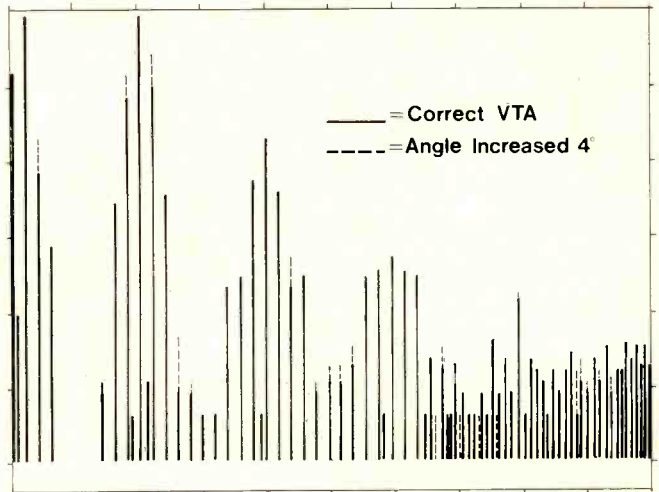
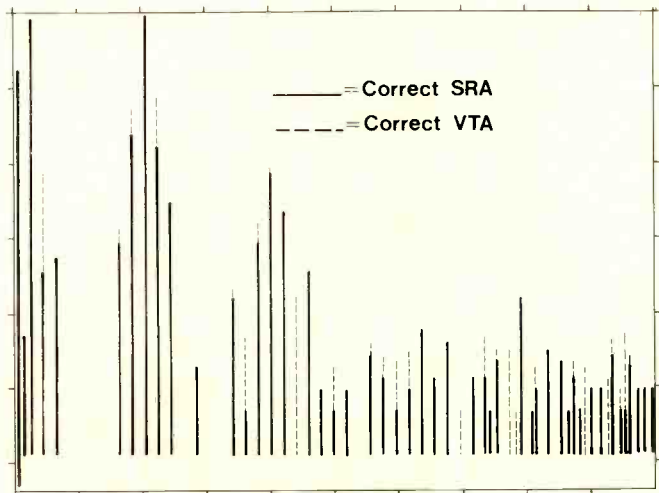


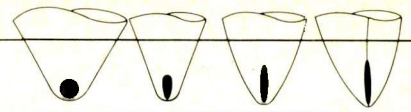
Fig. 7 — SRA vs. VTA (or record/playback angle match), showing the increase in distortion with misaligned SRA, even though the record/playback VTA is matched.



ponent; the horizontal ticks are 2 kHz apart on a linear frequency scale from d.c. to 20 kHz. The dark lines shown are the original distortion components (plus some noise components as the frequency goes up) at a VTA of 16½ degrees, which is the angle cut into the record [2]. The dotted lines rising up at some points represent the increase of those distortion components with an increase in the VTA by 4 degrees to 20½ degrees. Notice the increases in the second-order components of about 5 dB, consistent with data reported by others [3] who have performed tests with conical styli. There are a few other locations where the levels come up a bit, but no major trends

are indicated. The major increases that result from the 4-degree VTA error are roughly those predicted by theory and past experimentation. Since the conical stylus used has essentially no SRA, the differences in distortion spectra are due entirely to playback angle not matching the recorded angle.

This experiment points out very clearly that if SRA is not a playback variable, proper matching of record and playback VTA results in lowest playback distortion. It must be kept in mind that the increase in the second harmonic of 400 Hz is due to slope-related waveform distortion, while the increase of the 4-kHz component sideband is due primarily to



increased frequency modulation of 4 kHz — a more objectionable form of distortion than harmonic distortion.

The next step was to test for distortion differences between the optimization of VTA for proper SRA alignment or for vertical-modulation arc matching. At this stage of our experimentation, we attempted some tests using a Shibata-type stylus with a bent cantilever tube to give odd combinations of SRA-to-vertical modulation arc alignment. We were never able to make a satisfactorily "clean" bend due to the Shibata-type configuration and its need for critical vertical (head-on) alignment, but the data produced were intriguing.

We were, however, fortunate to have in our stock of cartridges a unit deemed defective due to a stylus misalignment. This cartridge had a modified-Shibata stylus which was slanted more than a typical unit. When properly aligned for SRA, this cartridge was slightly more than 4 degrees "low" in proper VTA match. Figure 7 illustrates the results of the correct SRA versus correct VTA experiment, with the same basic data display as Fig. 6. A distinct distortion increase is shown when SRA is misaligned and the correct VTA match is also made. Compare Figs. 6 and 7, and it will be seen that for an equal degree of misalignment, the SRA parameter is most significant in causing a rise in distortion, especially higher order distortion products. Notice, too, that when the modified Shibata stylus is correctly aligned for SRA, distortion products are at lower levels than when VTA is correctly aligned for the conical stylus. These data are fairly conclusive regarding which parameter is of importance for different styli.

Reported listening tests concerning VTA alignment have said that as little as 1/30 of a degree can make an audible difference in the clarity of the music, with a higher than optimal misalignment causing excess brightness. These reports typically do not distinguish between VTA and SRA even when the report mentions the existence of SRA. The results of our tests indicate that the parameter being optimized in these reports was almost undoubtedly SRA. Our own informal listening tests bear this out as well. When SRA is correctly aligned the sound quality "locks-in" and the retrieval of minute details is enhanced.

Table I — Frequency modulation data for different conditions.

VTA ($\pm \frac{1}{2}^\circ$)	Freq. Deviation at 4 kHz	Stylus Type	Sum of 2nd-Order Sideband (Major Distortion Level)	
Modulation				
14°	2.1%	Vertical	Conical	12.0%
16½°	1.8%	Vertical	Conical	11.1%
19°	2.2%	Vertical	Conical	12.8%
21½°	2.5%	Vertical	Conical	16.4%
≈14°	1.4%	Vertical ¹	Shibata	—
14°	L 1%, R 0.6%	Lateral	Shibata	—
16½°	L 1.3%, R 0.8%	Lateral	Conical	—
	Mono 0.0% for both			

¹CBS STR 112 test record, Band 7, Side B (400 Hz and 4 kHz).

These conclusions were further confirmed by some tests utilizing a laterally modulated 500-Hz asymmetrical square wave cut from Denon test record XG-7003. This recorded signal has a series of finely detailed harmonics extending above 40 kHz. We postulated that a misalignment of the stylus would alter or lose the harmonics. When a 4-degree tilt to the optimal SRA was introduced, alteration of the harmonics as low as 5 kHz and 7 kHz occurred and losses of harmonics above 30 kHz were evident! These changes are subtle, but at the same time consistent and repeatable.

We studied the frequency deviation for the 4-kHz component of the IM tone used throughout these tests. An experimental comparator based on a PLL IC was used for these tests. While absolute accuracy may not hold, the relative rankings remain accurate. Table I lists the results of these measurements taken under various conditions of VTA. It can be seen from these figures that there is an alarming amount of distortion present, although in practice vertical modulation tends to be rare in recording. In fact, the thickness of the recording lacquer, commercial considerations, and engineering expertise generally keep vertical cutting low, and thus phase information coherent.

Our calculations indicate that maximum cantilever vertical-arc travel is typically 1 degree due to these limitations. Another theoretical aspect of VTA match often overlooked is cantilever length, which should be matched between cutting and playback systems. There is no

standard for these lengths, and cartridges we have examined show gross differences in cantilever length and do not correlate to cutting systems.

Thus, our investigations clearly show SRA to be a more important controllable variable than VTA. Our dialogue with cutting engineers indicates that VTA currently varies between 16 and 22 degrees, depending on the lathe system. SRA, however, is generally 91 to 95 degrees relative to the record surface in order to facilitate lacquer "chip" (cutaway strand) removal.

Proper hi-fi set-up should therefore concentrate on cartridge adjustment that has the tip of the stylus pointed "back" toward the tonearm pivot, and the top of the stylus tipped "forward" so that the contact SRA face is 92 degrees between the stylus and the record surface. Such alignment will at least approximate correct SRA. (One cautionary note: True Shibata styli do not have their stylus contact area or footprint lined up with the bulk of the stylus chip, and this should be taken into account when adjusting for proper SRA.) The effects are clearly audible on a fine audio system. **A**

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THE PHONO CARTRIDGE ELECTRICAL OUTPUT NETWORK

With the exception of the cartridge designer, the effects of the cartridge's electrical network are most often totally overlooked.

ARNOLD SCHWARTZ

The characteristics of the phono cartridge electrical output network have been almost totally neglected and have become something of a skeleton in the audio technology closet. Hi-fi equipment is often described as "the audio chain." This is a very appropriate description because it reminds us that the performance of each component depends on the components preceding and following it, and my purpose here is to describe the electrical network coupling the cartridge to the preamplifier, an important, if somewhat neglected, link in the chain. The function of the cartridge can best be understood if we examine the phonograph record under, let's say, 1000 times magnification. If we did this, we would see a continuous undulating groove. These undulations are musical waveforms, a mechanical replica of the musical performance. The job of the cartridge is to retrieve the musical information from the record, where the musical data exists in mechanical form, and deliver an electrical signal which is a replica of the mechanical information to the phono preamplifier stage. In doing this, the cartridge performs three distinct but related functions. First, the stylus tip scans the mechani-

cal waveforms. Second, the transducer mechanism converts the mechanical vibrations of the stylus to an electrical signal. Third, the cartridge is part of an *electrical network* which transmits this electrical signal to the preamplifier input stage. This network consists of the electrical element internal to the cartridge, in series with the signal; the sum of tone-arm cable capacitance, interconnecting cable capacitance and preamplifier input capacitance, in shunt with the signal; and the input resistance of the preamplifier, also in shunt with the signal.

With the exception of the cartridge designer — who carefully attempts to use the characteristics of this electrical network in his overall design — the effects of this circuit on cartridge performance are most often overlooked. In fact, the performance of this electrical network can be as important as, and sometimes even overshadow, the high frequency and transient performance of the scanning and transduction systems of the phono cartridge.

Recognizing the importance of this network, we have used a unique approach in our System II cartridge which has a passive network incorporated in the body of the cartridge in the form of a thick film hybrid micro circuit. It serves to match the electrical characteristics of the electret transducing element to the external circuit. The electret, the electrostatic counterpart of the magnet, functions as a transducer by directly converting mechanical vibrations to an analog elec-

trical signal. This internal matching network presents a purely resistive 4,000-ohm impedance to the capacitive-resistive external circuit. The circuit itself and the method of measuring the frequency response of the System II cartridge electrical output network is shown in Fig. 1. The transducer signal is simulated by an oscillator with an output impedance of less than 10 ohms; the sum of the tone-arm cable, connecting cable, and preamplifier shunt capacitances is shown as a single capacitor, and the typical preamplifier input resistance of 47,000 ohms is included. The cartridge itself is used as the series impedance in this test circuit so the conditions are almost precisely those in actual operation. Although the range of capacitance in user playback systems may vary from as much as 250 pF to 1000 pF, the circuit response is measured for capacities of 300 pF and 500 pF, the more usual values for better quality playback systems. The frequency response of the System II electrical network (see Fig. 2) is essentially flat from 20 Hz to 20 kHz (down less than 0.25 dB at 20 kHz with a 500-pF load). The circuit time constant with 500 pF is approximately 2 microseconds so that we know the response is -3 dB at 80 kHz. The flat frequency response in the audible range means that the signal will be delivered to the preamplifier exactly as it appears at the System II cartridge output terminals, and, just as important, it will not be significantly affected by the wide variations

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in capacitive load found in user playback systems.

The internal electrical element of the magnetic cartridge is an inductance. Magnetic cartridges convert mechanical vibrations to an electrical signal by inducing a signal in a coil of wire located in a magnetic field. The electrical network of the moving magnet, moving iron, and induced magnet (all three types have essentially the same general circuit configuration) is shown in Fig. 3. This circuit is a low-pass filter with a cut-off frequency somewhere below 20 kHz, and, depending on the value of the circuit elements external to the cartridge, will exhibit something approximating a 12 dB/octave roll-off beyond its cut-off frequency. Variations in cable capacity affect the cut-off frequency and will have a pronounced effect on the frequency response.

The circuit of the moving-magnet cartridge is shown in Fig. 3. The cartridge itself is used as the series inductance to reproduce the actual playing conditions as closely as possible. Figure 4 shows the frequency response of a high-quality moving-magnet cartridge connected into the circuit as the cartridge impedance; with a 300-pF load the response is -3 dB at 15 kHz and falls rapidly to -6 dB at 20 kHz. At 500-pF load the response changes — ± 1 dB at 7 kHz, -3 dB at 13 kHz, and -8.5 dB at 20 kHz. The signal from this moving-magnet cartridge is altered considerably by the time it arrives at the preamplifier, and it will change as the capacitive load varies from one playback system to another playback system.

The electrical output network of a moving-coil cartridge, a form of magnetic cartridge, is shown in Fig. 5 (upper circuit). Because the moving-coil cartridge has a low output, a step-up transformer is often used to boost the voltage fed to the preamplifier.

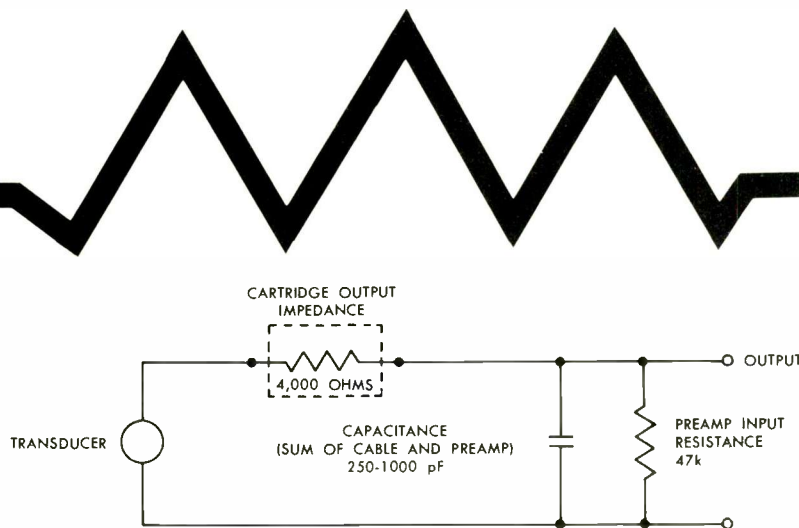


Fig. 1—Output network of System II cartridge.

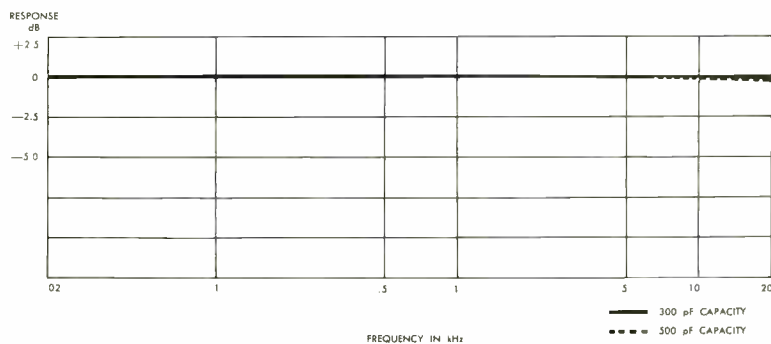


Fig. 2—Frequency response of System II cartridge's electrical output network, showing effects of different capacitances.

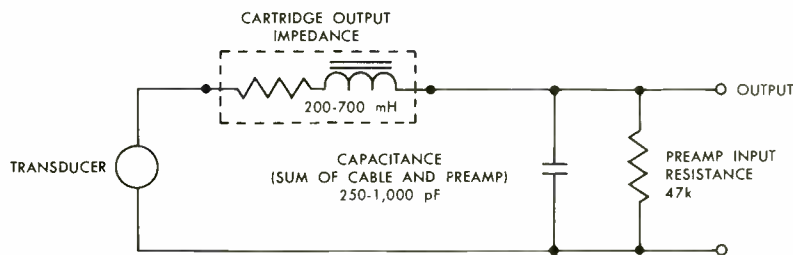


Fig. 3—Output network of moving-magnet, moving-iron or induced-magnet cartridge.

Capacitance in ordinary playback systems may vary from 250 to 1000 pF, while 300 to 500 pF is usually found in better quality systems.

Transformers have leakage reactance which appears as a series inductance in the equivalent circuit, as well as a shunt conductance which appears as a shunt inductance in the equivalent circuit (lower circuit of Fig. 5). We have taken one channel of a high-quality moving-coil cartridge feeding a transformer, which was designed by the manufacturer to work with the cartridge, and connected it as shown in Fig. 5. The frequency response of the circuit is shown in Fig. 6 for capacities of 300 pF and 500 pF. At 300 pF the electrical response falls to -3 dB at 12 kHz and -5 dB at 20 kHz. With a 500-pF load, the response falls to -3 dB at 11 kHz and -6.25 dB at 20 kHz. At low frequencies, due to the shunt conductance of the transformer, the output falls about -0.5 dB at 100 Hz and -3 dB at 30 Hz. Here again, we see that the quality of the sound is altered when it arrives at the preamplifier, and it will change as the capacitive load varies from playback system to playback system.

If we compare the System II electrical system to the electrical systems of magnetic cartridges, we note two important differences:

A) While the System II frequency response is flat within the audible range, the moving-magnet and moving-coil cartridge circuits are not, and

B) System II circuit response remains flat with changes in playback systems, while changes in the playback system capacitance do affect the response of magnetic cartridges.

A major significance of the 80-kHz pass band of the System II cartridge electrical network lies in the speed of its response — how fast it reacts to instantaneous changes of the music. Response speed is generally referred to as transient time, and transient time is the figure of merit for comparing the ability of the cartridge to reproduce the transient characteristics of music. Musical sounds are, actually, a series of transients. Transient response or rise time is determined by using a square-wave test signal (see Fig. 7) in our test circuits; in this case the simulated transducer feeds a square wave to the cartridge circuit. The transient rise time is the time elapsed from the point of the leading edge of the signal when the waveform is at 10 percent of maximum height to the point when the waveform leading edge is

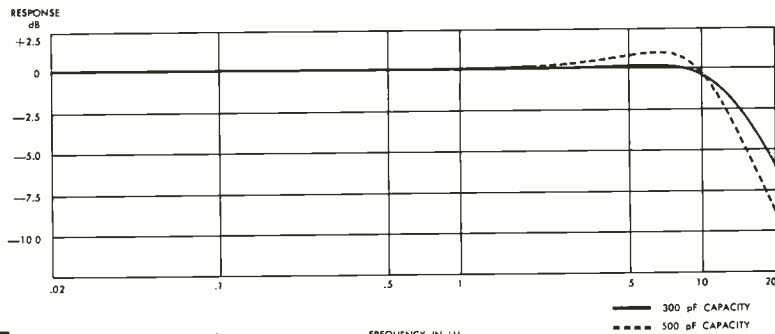


Fig. 4—Frequency response of a moving-magnet cartridge's output network, showing effects of different capacitances.

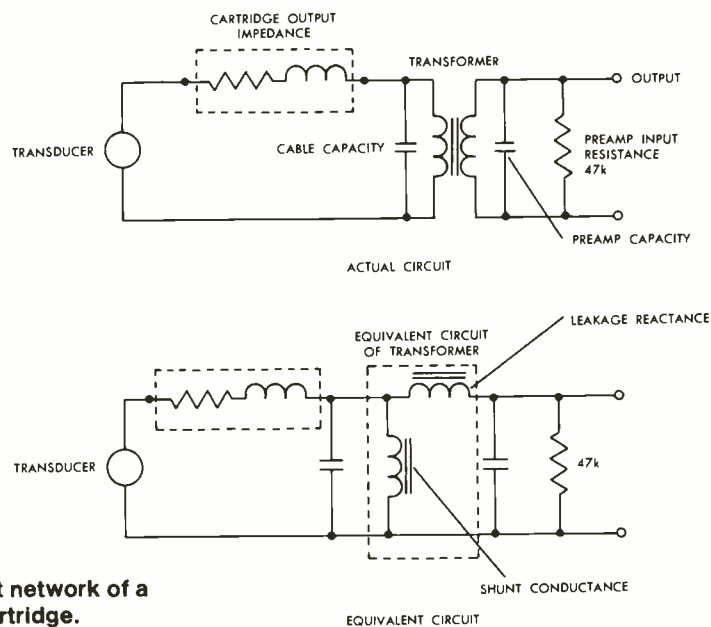


Fig. 5—Output network of a moving-coil cartridge.

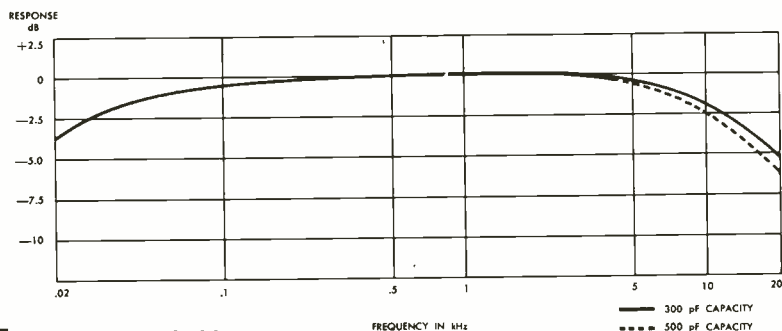


Fig. 6—Frequency response of a moving-coil cartridge's output network, showing effects of different capacitances (includes transformer).

The rise time of a phono cartridge's circuit also influences how quickly it can respond to instantaneous changes in the musical signal.

at 90 percent of the maximum height. This widely accepted engineering measurement method uses the most uniform segment of the leading edge to measure the transient rise time. If a transient is slow to pass through an electrical network, only the slow-moving low-frequency components pass through unaffected, while the high frequencies, which contribute to the attack and brilliance of the music, are eliminated or delayed. To actually measure the rise times, the output of the cartridge networks (see Figs. 1, 3 and 5) are displayed on an oscilloscope with the simulated transducer generating a 1,000-Hz square wave. The time it takes from a point on the wave front that is 10 percent up from the bottom of the wave to a point 90 percent of the maximum height of the waveform is the transient rise time.

Figure 8 shows the oscillogram of the output of the System II electrical network. The waveform at the left is the conventional representation of square-wave response. However, if we expand the time scale by 20 times and then look at the leading edge, we improve our resolution. The transient rise time is 2 microseconds. The time constant of the System II circuit is 2 microseconds, reflecting the 80-kHz bandwidth. The very fast rise time contributes to the ability of the System II cartridge to reproduce the attack of sharp musical sounds that are so important to the dramatic quality of the original musical performance. The comparable rise time for the moving-magnet cartridge (Fig. 9) is 25 microseconds, while the moving-coil cartridge (Fig. 10) has a rise time of 30 microseconds. The significantly slower rise time of magnetic cartridge circuits, less than one-tenth the speed of the System II, reflects the limited bandwidth of their low-pass filter circuits. The slow rise time reduces the ability of the playback system to faithfully reproduce the attack times of the musical performance.

These measurements of cartridge circuit are of great significance to the user and illustrate why the cartridge's electrical output network has such a profound effect on the overall performance of the playback and why the cartridge designer must take the characteristics of this network into account in the most thorough way possible in his design. We think we've done that in our System II cartridges. **A**

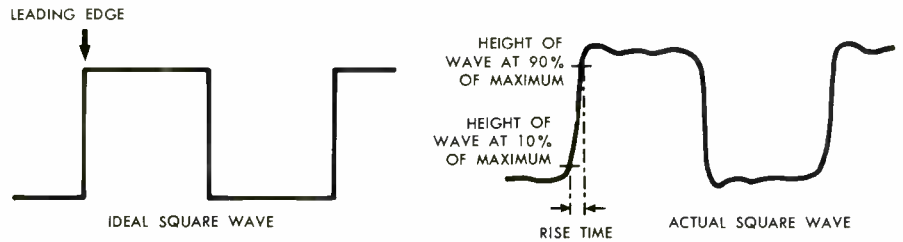


Fig. 7—Rise time measurement.

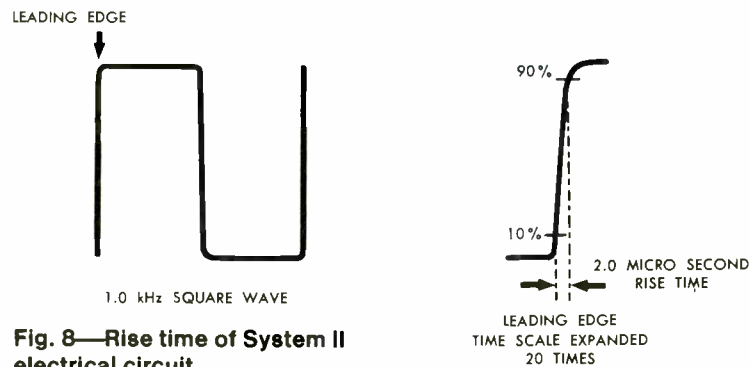


Fig. 8—Rise time of System II electrical circuit.

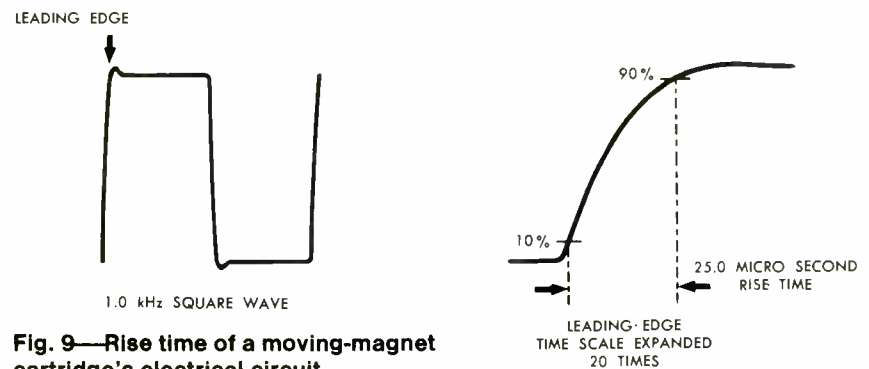


Fig. 9—Rise time of a moving-magnet cartridge's electrical circuit.

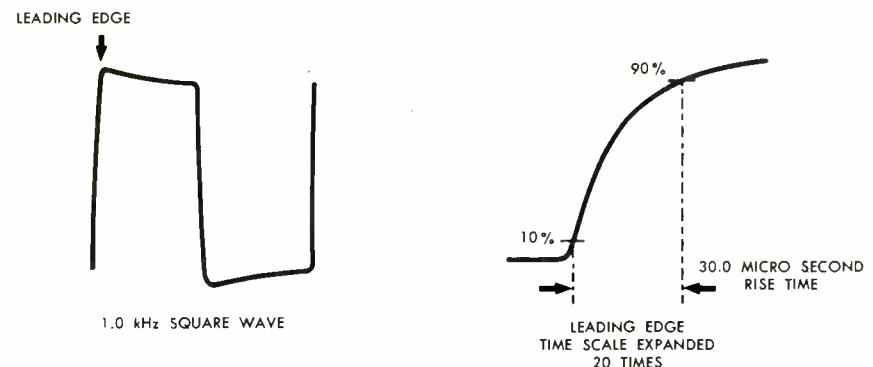


Fig. 10—Rise time of a moving-coil cartridge's electrical circuit.

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To further assure their quality, the Franklin Mint records are pressed in a special "clean room," similar to the facility in which the mint produces its flawless proof-quality coins. In this atmosphere-controlled clean room, technicians wear vinyl gloves and every precaution is taken to ensure protection for every record. Here, the most



(left) You normally can't tell if the record you buy was the first or last to come from a record stamper, or if the stamper was made from a defective metal mold. But (right) The Franklin Mint Record Society aurally auditions a greater number of pressings than most other producers. And every metal mold is actually played, from start to finish, before it is used to produce stampers.

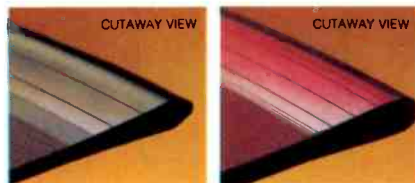
meticulous attention is paid to the pressing of the records—in order to greatly minimize noise, to assure a quieter, clearer record and to make certain that the full quality of each original recording is faithfully preserved.

Together, these important features enable The Franklin Mint Record Society to create a collection of *proof-quality* records—records that offer greater clarity of sound and are quieter and clearer. To attest to this high standard of proof quality, each record bears the distinctive mintmark of The Franklin Mint.

Most of the recordings in the collection are in full stereophonic sound. But naturally, the very early recordings are monaural. However, all of the records throughout the series reflect the highest fidelity possible—and all are playable on any stereo phonograph or system. No special equipment is needed.

In addition, the recordings of legendary greats such as Enrico Caruso, Rosa Ponselle, Feodor Chaliapin and Giovanni Martinelli have been remarkably improved by electronically removing imperfections that were present in the earlier recordings, thus enabling you to now hear these glorious voices more nearly as they sounded in the actual performances.

Rarely if ever have records of such distinction been produced. Rarely if ever has so much time and attention been devoted to their creation. And these are the superior records which you will receive when you become a subscriber to *The 100 Greatest Recordings of All Time*—the ultimate private library of recorded music.



Ordinary records (left) may warp, causing "skipping" and distortions in sound. But Franklin Mint proof-quality records (right) are 36% thicker and heavier than ordinary records and are, therefore, less likely to warp.



Ordinary records (top), have static charges that attract dust, causing surface noise when the record is played. But the special vinyl used in Franklin Mint records (bottom) has a built-in anti-static element that assures clearer sound. Electrostatic meter tests show that the Franklin Mint record has only one-fifth the static charge of an ordinary record.



For the first time in history, the world's greatest works of music—and the greatest recorded performances of those works—have been brought together in one unique collection of distinctively high-quality records. Truly the ultimate private collection of fine recorded music.

These are the supreme masterpieces of man's musical genius, performed by the most outstanding artists of the century. Together, they form a record library unprecedented—and unsurpassed—in the entire history of music. *The 100 Greatest Recordings of All Time.*

The greatest music —and the greatest performances

An international panel of renowned music authorities was appointed to participate in the selection of these great recordings. This distinguished panel considered countless recordings of each of the greatest works of music—a momentous task.

For instance, members of the panel reviewed 24 different recordings of Beethoven's 7th Symphony and chose the *one* recording they considered superior to all others: Toscanini with the New York Philharmonic.

From 30 great recordings of Tchaikovsky's Nutcracker Suite, the panel selected the *one* greatest performance: Arthur Fiedler and the Boston Pops.

Similarly, the recordings of other great symphonies, concertos, sonatas, rhapsodies, ballet and vocal music were reviewed and the most



The Franklin Mint Record Society presents the ultimate private library of recorded music.

The 100 Greatest Recordings of all time

A unique collection of the greatest performances ever recorded, selected by an international panel of music authorities and presented on 100 records of superb proof quality.

outstanding performance in each instance was recommended.

The creation of this definitive collection has been made possible through the cooperation of leading record companies both here and abroad. And now, *The 100 Greatest Recordings of All Time* is being issued exclusively by The Franklin Mint Record Society.

Among the works chosen for this collection are immortal masterpieces by Beethoven, Brahms, Mozart, Tchaikovsky, Schubert, Rachmaninoff, Debussy, Verdi—performed by such superb artists as Vladimir Horowitz, Jascha Heifetz, Enrico Caruso, Van Cliburn, Isaac Stern, Artur Schnabel, Leontyne Price—with the world's finest orchestras under the direction of such great conductors as Toscanini, Ormandy, Bernstein, Stokowski, von Karajan, among others.

In every sense, the ultimate private library of recorded music—to be cherished for a lifetime, and presented as a legacy to future generations of your family.

Handsome library cases provided

To house these magnificent proof-quality records, special library cases are provided for all

100 records. Each hardbound library case holds two long-playing 12" records and is attractively designed. Displayed in a bookshelf or cabinet, these handsome library cases will be an impressive addition to any home.

The fifty library cases also include specially written and illustrated commentaries discussing the great masterpieces and their composers, and providing fascinating background on the orchestras, conductors and soloists.

Thus, you will enrich your understanding of great music—and introduce your family to a world of pleasure and cultural satisfaction.

Created solely for subscribers to this series

The 100 Greatest Recordings of All Time is produced solely and exclusively for those who enter subscriptions to this series. The collection may be acquired *only* by subscription from The Franklin Mint Record Society. It will not be sold in any record stores.

To begin building your private library of the world's greatest performances on *proof-quality* records, mail the attached postpaid application directly to The Franklin Mint Record Society, Franklin Center, Pennsylvania 19091, by March 31, 1981.

The Advisory Panel

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ANDRÉ PREVIN, Music Director of the Pittsburgh Symphony Orchestra; composer, pianist

WILLIAM SCHUMAN, composer, first winner of Pulitzer Prize for music

H. H. STUCKENSCHMIDT, member of the Akademie der Kuenste, West Berlin

EQUIPMENT PROFILE

1

McINTOSH MODEL MR-80 FM TUNER

Manufacturer's Specifications

Sensitivity: 9.3 dBf (1.6 μ V) for 35 dB of quieting; 14.7 dBf (3 μ V) for 50 dB of quieting; 13.2 dBf (2.5 μ V) for 3 percent total noise and harmonic distortion (IHF Usable Sensitivity).

Signal-to-Noise Ratio: 75 dB (mono).

Harmonic Distortion: 0.2 percent, 20 Hz to 15 kHz, mono or stereo; typically 0.08 percent at 1 kHz.

IM Distortion: 0.15 percent mono or stereo, any combination of frequencies, from 20 Hz to 15 kHz, with peak modulation equal to 100 percent or less; typically 0.1 percent.

Frequency Response: Mono and stereo ± 1 dB 20 Hz to 15 kHz, with 75, 50 or 25 microsecond de-emphasis.

Capture Ratio: 1.5 dB.

Selectivity: Alternate channel 90 dB narrow, 110 dB super-narrow; adjacent channel 8 dB narrow, 60 dB super-narrow.

Spurious Rejection: 110 dB.

Image Rejection: 90 dB.

Maximum Signal Input: 8 volts across 75-ohm antenna input.

Audio Hum: 75 dB down from 100 percent modulation.

Muting: 70 dB noise reduction between stations.

Muting Threshold: 2 μ V to 1000 μ V, variable.

SCA Rejection: 60 dB or more.

Stereo Separation: 50 dB at 1 kHz.

Stereo Filter: 10 dB noise reduction.

Audio Output: Variable, 2.5 V into 47 kilohm; fixed, 1 V into 47 kilohm.

General Specifications

Power Requirements: 120 volts, 50/60 Hz, 25 watts.

Dimensions: Front panel, 16 in. (40.64 cm) W x 5-7/16 in. (13.81 cm) H; chassis, 14 3/4 in. (37.47 cm) W x 4-13/16 in. (12.22 cm) H x 13 in. (33.02 cm) D.

Weight: 28 lbs. (12.73 kg).

Price: \$1,995.00.



In all the years that I have been evaluating FM tuners, I have concluded that there are two basic approaches to the design of an FM tuner or the FM tuner section of a receiver. There are those engineers who design these products for other engineers, almost as if the users of their products will do nothing but measure them in shielded laboratory rooms. Then there are those engineers who design tuners to be used for listening to music broadcast by near and remote FM transmitters in the "real world." Seldom have I encountered a tuner that has been optimized both for the laboratory and for the nontechnical music lover. The recently introduced McIntosh MR-80 FM tuner is such an optimized tuner. You will understand why if you follow my description and the results of my tests of this product.

In terms of outward appearance there's no mistaking the MR-80 for anything but a McIntosh Laboratory product, with its familiar black front panel and its back-lighted nomenclature. But there is much that is new and up-to-date about this product's cosmetics, as well as its internal circuitry. Instead of a printed frequency dial scale, the upper section of the front panel is dominated by a large digital display which reads out the frequency of the tuned-to signal in Megahertz, to the nearest 100 kHz. This tuner does not employ frequency synthesis nor does the manufacturer claim that it does. One could argue about the use of the word "digital" in connection with this tuner, since that has come to mean a frequency-synthesized tuning system to a great many audiophiles, but that is largely a semantic argument these days, since many manufacturers of tuners who employ digital readout of frequency have begun to refer to such products as "digital" FM tuners.

To the left of the digital frequency display are four "touch pad" switches which are used to select one of four preset station frequencies. When one of these pads is touched, a small rectangle of light appears above the pad to indicate that the tuning command has been executed. To the left of these preset selector pads are three indicator lights. The red stereo light comes on when a stereo transmission is received. The second, an amber-colored indicator light, is identified by the word "lock" and indicates when the tuner is locked to an incoming station signal. The third, a green-colored light, indicates when the stereo multiplex filter is active.

To the right of the digital frequency display is a column of tiny LEDs arranged vertically; they indicate signal strength. No center-of-channel indicator is necessary since, as we shall see, the unique locking circuitry of this tuner insures proper tuning. Two more touch pads to the right of the signal-strength column are labelled "Auto Scan" and are used to make the tuner tune up and down the FM dial, stopping at received station signals. Finally, to the right of the auto-scan pads, we find a conventional tuning knob for manual tuning. There is a fourth method of tuning the MR-80 which we will discuss when we examine the rear panel.

The lower section of the front panel of the MR-80 is equipped with six rotary controls and a centrally located stereo headphone jack which is driven by its own audio amplifier circuitry and can deliver 2.5 volts of signal into 600-ohm loads; more than enough to drive low impedance phones, incidentally. Starting at the left, there is a two-position selectivity switch, with settings identified as "Narrow" and "Super Narrow." Normally, the "Narrow" position is used, and in our tests we found that it provided excellent alternate-channel selectivity and the ability to separate closely spaced signals in our listening area. We have

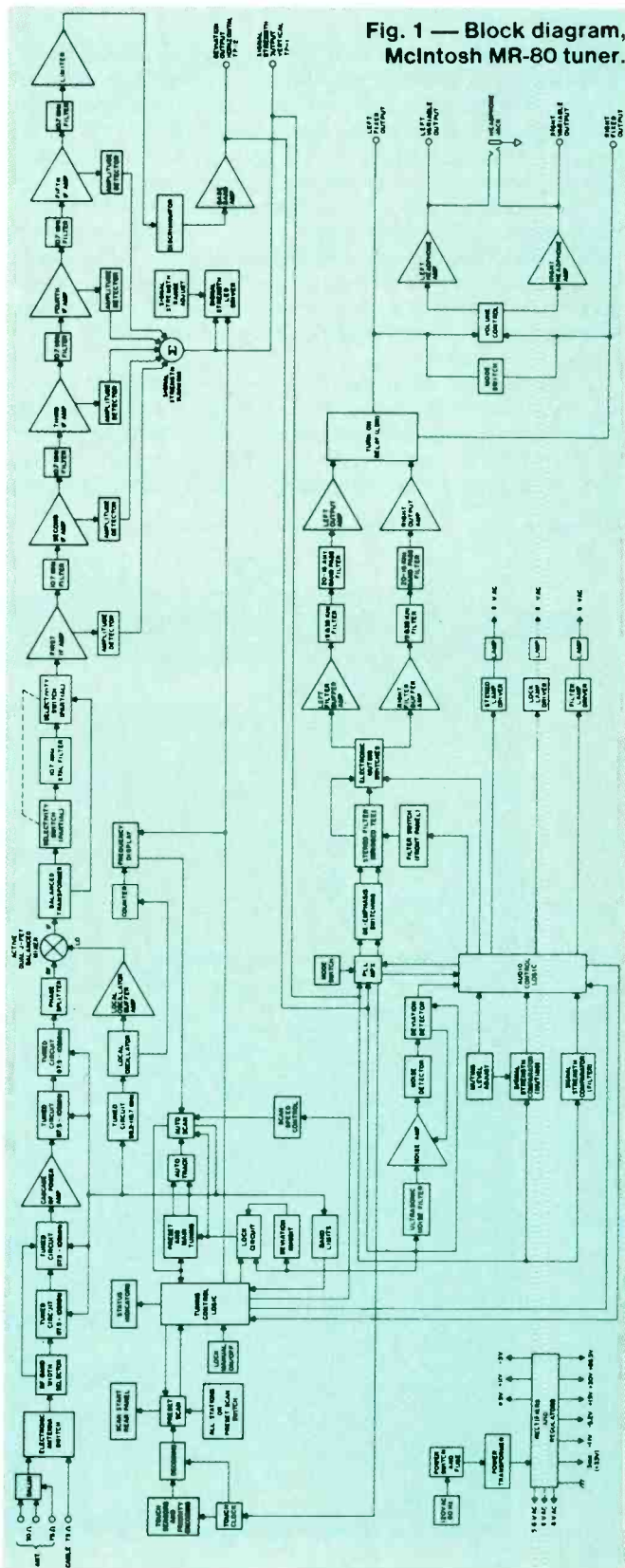


Fig. 1 — Block diagram, McIntosh MR-80 tuner.

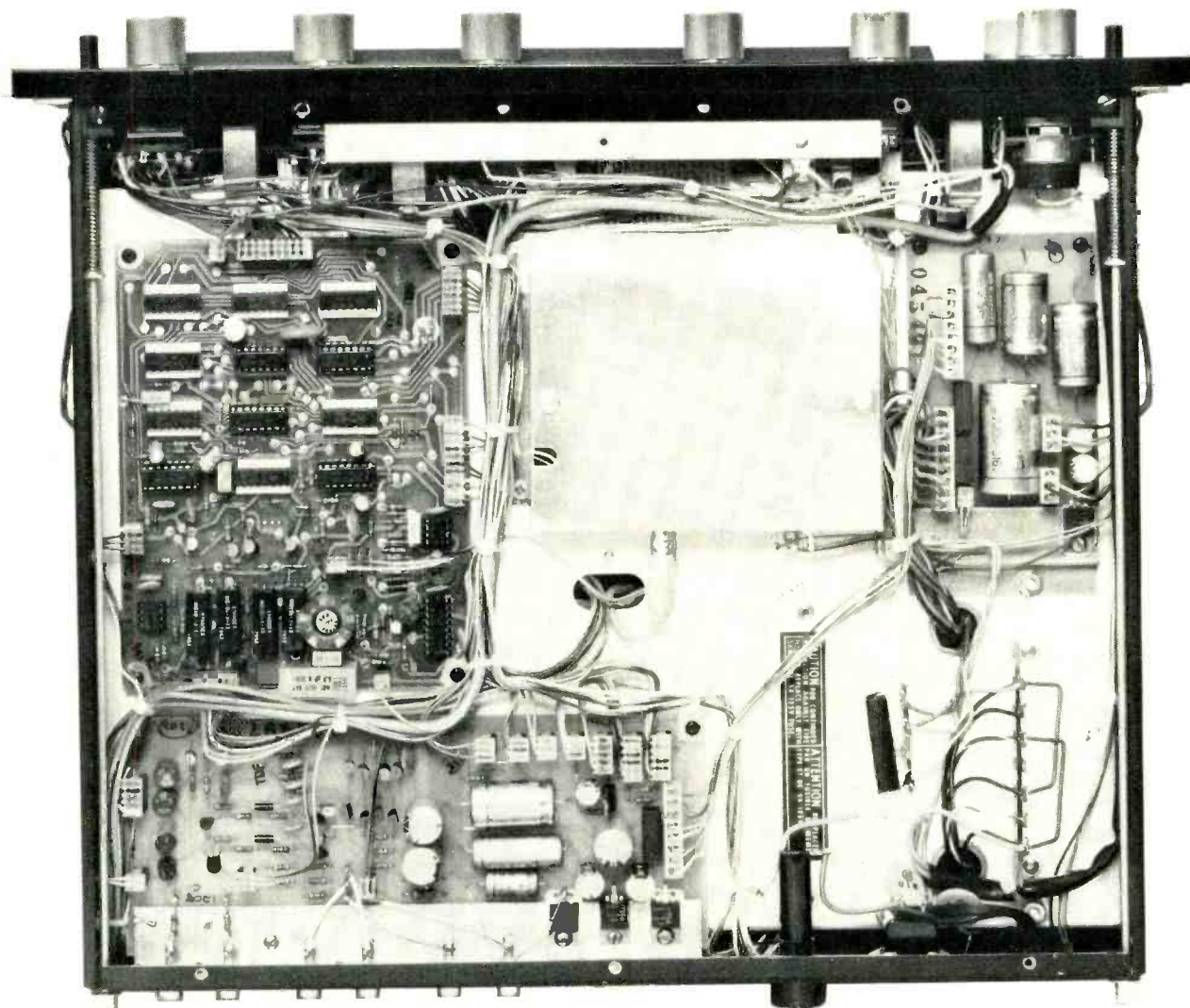
been told by some of our friends and colleagues, however, that there are some areas of the country in which high adjacent-channel selectivity is a must if listeners are to be able to tune to distant, weak signals without being swamped by strong local-station signals separated in frequency from the remote desired signal by only one channel bandwidth, or 200 kHz.

The next rotary switch activates the stereo multiplex filter circuitry, either permanently when set to "in" or, when set to "auto," automatically whenever stereo signal strength falls below 100 microvolts or so. Since activation of the filter is always accompanied by an indicator light mentioned earlier, the listener is always aware of the filter being turned on, even if turn-on occurs automatically.

A stereo/mono mode switch follows, and to its right, beyond the headphone jack, is a continuously variable control called "scan," which determines the speed of tuning when in the scan mode. A variable-muting control comes next, which is used to set muting threshold and also determines scanning sen-

sitivity, that is to say how strong an incoming signal must be in order for the auto-scan tuning system to stop on that signal. Finally, the right-most control, located just below the tuning knob, is a master output level control which determines audio level at the variable output jacks on the rear panel and which, when rotated fully counterclockwise, disconnects power to the tuner.

The rear panel of the MR-80 is equipped with two 75-ohm coaxial antenna connectors (one of which is intended for commercial cable input), 300-ohm antenna terminals, and a ground terminal. A jack nearby accepts a plug on the end of a supplied long cable that allows the user to either scan or call up the preset stations, one by one, from a remote location, depending upon the setting of a nearby slide switch. Variable and fixed level output jack pairs are at the lower right of the rear panel, while nearby are a pair of scope jacks (horizontal and vertical) intended for connection to an oscilloscope for observation of multipath (reflection) problems. A line fuseholder and an



LUX AMPLIFIERS ARE WHAT MAKES LUX CASSETTE DECKS BETTER.

Lux decks start with half a century of amplifier expertise because while the record and playback heads are the senses of a deck, the recording amplifier is the heart.

Only DC amplification provides low inherent distortion, wide dynamic bandwidth and the headroom to take advantage of metal tape. Then Lux adds the features essential for total performance.

Look at Lux's K-8 and K-15. Wherever possible, mechanical operations are replaced by electronics. Both decks have full IC logic controlled solenoid operation so any function, in any order, is a finger-stroke away.

Meters have been replaced by instant-response fluorescent peak level indicators with a special, 3dB added scale for metal tape. The electronic digital tape counter is precise, easy to read, and shows tape motion as well.

Bias and equalization settings are provided for all tapes, and variable bias control lets you add the final adjustment for your ears only. Other features include automatic play/rewind/repeat functions complete with memory. And Dolby® NR, of course.

Both units are exquisite examples of mechanical, electronic and human engineering in sleek, contemporary rosewood cabinets.

Sophistication ... and then some

Lux's K-15 goes even further, with DC playback amplification as well for even lower distortion. And, Dolby®HX, a new circuit

offering at least 10dB additional headroom in the record mode.

Dolby HX works with the Dolby NR circuitry, monitoring the signal being recorded. The HX system is automatic, continuous variation of bias and equalization in response to signal content, particularly at the high frequencies.

Tape saturation is reduced, and while Dolby NR gives you less noise, Dolby HX gives you more signal. The improvement is significant and very noticeable when played back on any machine with Dolby NR. Dolby HX works with any tape ... and makes it better.

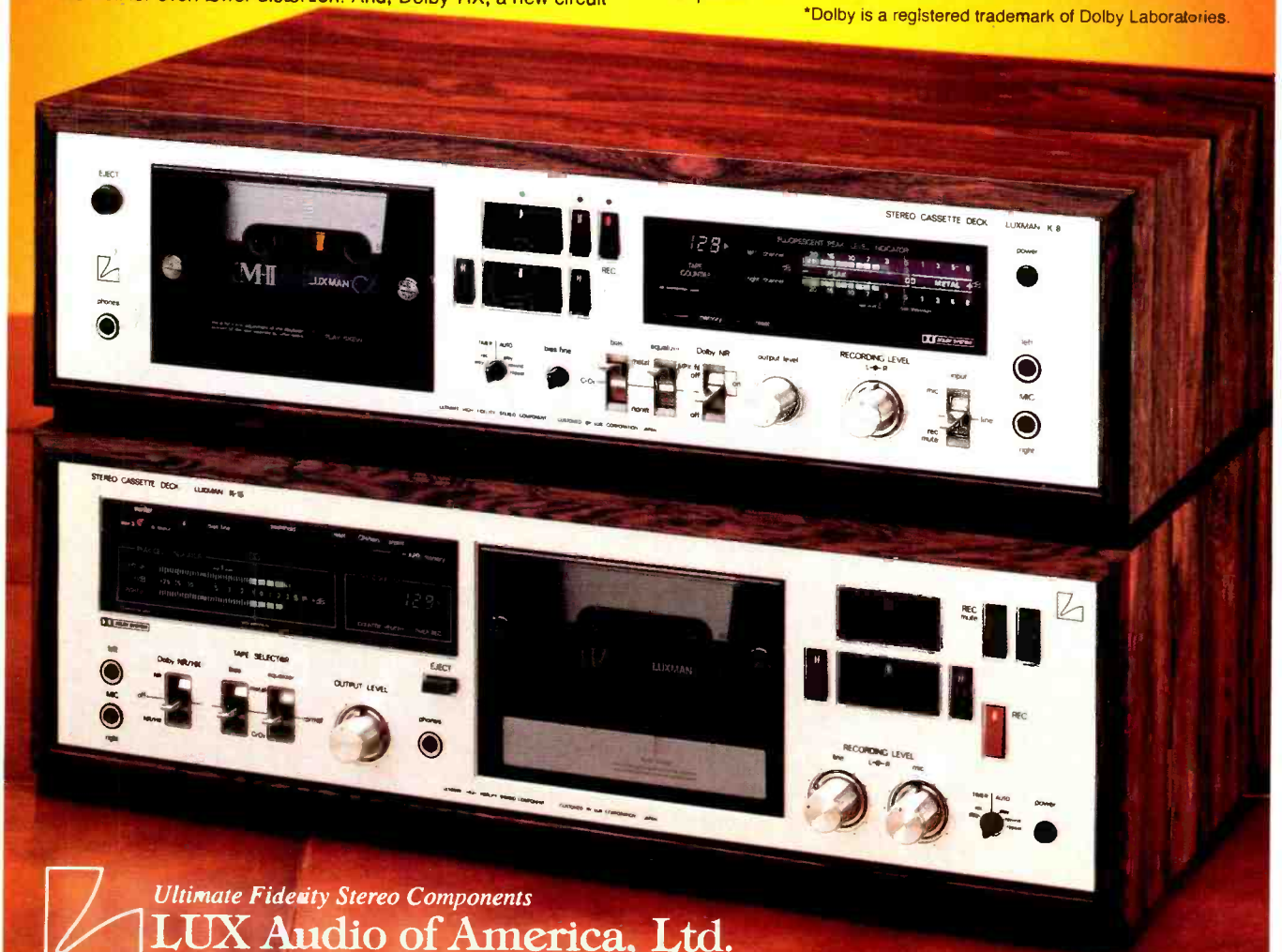
Lux K-8: 2-heads; DC servo motor drive. Frequency response 20-20,000 Hz, metal tape. S/N ratio 65dB, metal tape, Dolby on. Wow & Flutter 0.055% WRMS.

Lux K-15: 3-heads; 2 DC servo motors; dual-capstan closed loop system. Frequency response 30-20,000 Hz (±3dB), metal tape; S/N ratio 69dB, metal tape, Dolby on. Wow & Flutter 0.04% WRMS.

Other exceptional decks in the Lux line range in price from \$299 to \$1995 and include the 5K50 professional deck with 3 heads, 3 motors and dual DC amplification; K-12, 2-head, 2-motor deck with dual DC amps; K-5A with 2 heads and Lux bridge motor drive; K-1, 2-head, servo motor drive. All are metal compatible and have Dolby NR.

The Lux cassette deck ... better because it's built with the Lux Amplifier.

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LUX Audio of America, Ltd.

Reflecting Tomorrow's Technology in Today's System

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unswitched convenience a.c. power receptacle complete the rear panel layout.

Additional adjustments and controls are located along the top surface of the tuner. These include four continuously variable rotary controls which are used to set up the frequencies of the four desired preset stations, a rotary control which adjusts the sensitivity of the signal-strength LED column display (you can set it so that the strongest station in your area will cause full-scale readings), and five small push-button switches. An r.f. preselect circuit is activated by the first of these buttons and adds a tuned circuit between the antenna and the first r.f. stage to immunize against strong signal overload. The next button selects the cable or your own antenna input. The third button can be used to disable the locking circuit. The last two buttons provide selection of either 25, 50 or 75 microsecond de-emphasis characteristics.

Circuit Highlights

A block diagram of the circuitry of the McIntosh MR-80 is reproduced in Fig. 1. An electronic antenna switch selects signal inputs either from the cable input or from one of the direct antenna inputs and feeds the signal to the first r.f. amplifier which consists of a low-noise junction FET and a high-power bipolar transistor arranged in cascode configuration. Two PIN diodes are used to insert a second preselector stage during strong-signal reception. Tuned circuits are tuned by a series-parallel connection of four matched varactor diodes which are tuned by relatively high voltage (5 to 26 volts) to eliminate diode nonlinearities and possible IM distortion. Two parallel tuned circuits follow the r.f. amplifier to improve image rejection and increase r.f. selectivity.

The balanced mixer stage is a matched-dual-FET and bipolar transistor circuit. A low-loss, toroidal, phase-splitting transformer is used as an impedance matching network in the gate circuit of the mixer. A bipolar transistor is used as an oscillator buffer to prevent oscillator pulling on strong signals and as the constant-current source for the dual J-FET mixer.

Four differential amplifiers, coupled with linear-phase monolithic filters, comprise the narrow selectivity and signal-strength sections of the i.f. amplifier. A four-pole, four-zero crystal filter is inserted in the signal path as well when the "Super Narrow" selectivity setting is selected. A solid-state signal-strength meter is used as a front panel indicator of incoming r.f. signal strength. This meter can be user-set to give a full scale indication on a signal as low as 2 microvolts or as high as 100,000 microvolts. Signal-strength voltage is also used to control mono-stereo switching, automatic stereo filter insertion, muting, and automatic scan stop. The control voltage also adjusts stereo separation at low r.f. signals so that, unlike many other tuners, there is no abrupt change from mono to stereo in the presence of marginally weak signals; reduced separation also produces the best possible signal-to-noise ratio at weaker signal strength levels.

The limiter following the selectivity section of the i.f. amplifier has a total gain of 80 dB for extremely hard limiting with good impulse-noise rejection. A broadband Foster-Seeley discriminator is used as the FM demodulator, and output of the detector is fed to a buffer stage for isolation from variations in load impedance.

The phase-locked loop stereo-decoder IC incorporates two special new systems, the automatic variable-separation control

circuit mentioned earlier and tri-level digital waveform generation which helps to eliminate interference from SCA signals and from the sidebands of adjacent-channel FM signals. Following the de-emphasis switches, an electronically switched filter circuit is used to reduce out-of-phase noise when receiving weak signal stereo. The filter is actually a twin-T bandpass that blends high and low frequencies, but leaves separation unaffected at mid-frequencies for improved stereo imaging when the filter is required. LC notch filters further reject any residual 19-kHz or 38-kHz sub-carrier output products. A separate headphone amplifier, capable of driving low impedance phones, also serves as the main output amplifier.

Tuning, Scanning and Control Circuitry

A detailed explanation of the touch sensor, preset scanning, control logic, scan circuit and lock circuit, as well as of the frequency counter and power supply circuitry is provided in the excellently written owner's manual supplied with the MR-80, and

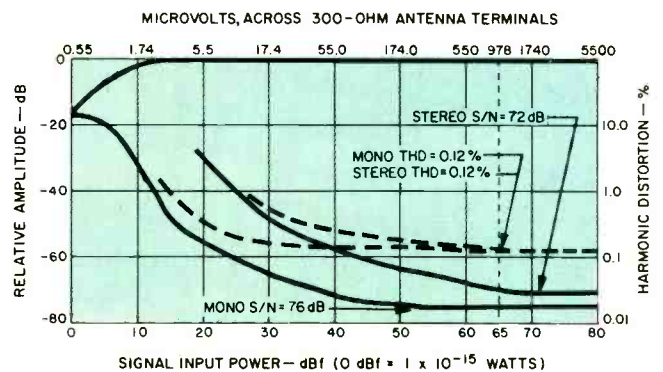


Fig. 2 — Mono and stereo quieting and distortion characteristics.

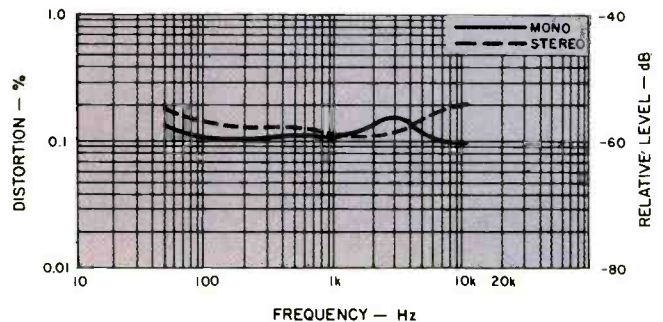


Fig. 3 — Harmonic distortion vs. frequency at 100 percent modulation.

The continuing story of TDK sound achievement.

Parts Eight and Nine.



Parts Eight and Nine, the two sides of the TDK shell, are not merely well matched. They are mirror images. TDK engineers knew that unless every part of the TDK cassette mechanism was encased in a perfect, unchanging world, the total effort to create perfect sound would be lost.

To achieve the perfect mirror image, a test cassette was cast in solid metal. With it, TDK engineers determined the delicate interrelationships between parts.

They found eight key points of contact between tape and shell. Whenever the sides were not



TDK cassette
tape-to-head interface area.

perfectly parallel, to a micron, there was phase shift and sensitivity loss. A difference of more than a few microns could affect the sound as well as damage the tape.

To avoid structural problems, TDK engineers chose a very special plastic. High impact styrene. It performs impressively in tem-

perature extremes and holds its shape under stress. Then a metal die was designed to cast the shell. The die alone has 428 separate parts for superb quality control.

Before a TDK shell design is approved for mass production, it's checked in thermostatic chambers to an accuracy of $\pm 1^\circ\text{C}$. Its image magnified 5 to 20 times on a 600 millimeter screen.

Surface roughness is checked on a graph enlarged 100 to 1,000 times. To be sure there's no variance, the two shell halves are precision molded from

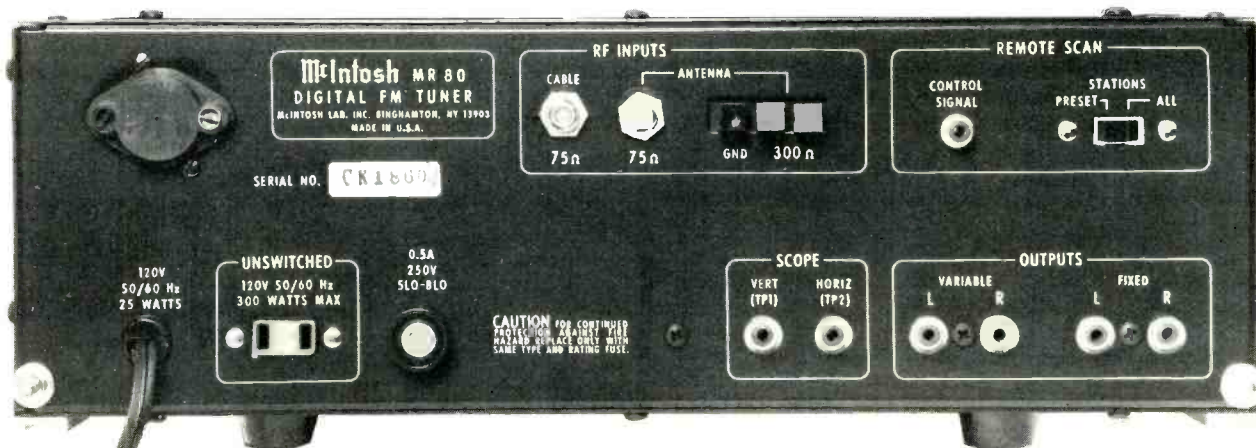
matching dies and kept side by side until they are precisely mated by five computer-torqued screws. There is no room for error in a TDK cassette. Even the TDK label is made of a special paper.

Looking through today's

larger TDK window, you'll have a perfect view of tape movement and direction. It's the direction TDK has set for cassettes. Total performance depending not merely on the tape but the design and interplay of every component part. With TDK, music will continue to be the sum of its parts. And that's quite an achievement.



 **TDK**
The Amazing Music Machine.



full schematic diagrams are also included for the benefit of the technically oriented user or for possible servicing needs. The descriptions of the remaining non-r.f./i.f. related circuits are too lengthy for even an abbreviated treatment here, but we cannot leave this subject without providing a brief explanation of the unusual "lock" circuitry designed into this unusual tuner. This new circuit will be correctly tuned even if the station (or, more likely, the cable company) is not on its correct frequency. Two operational amplifiers are used. A deviation signal from the detector is fed to the first amplifier, which produces an output voltage proportional to the logarithm of the d.c. component in the detector output. A second amplifier, connected as a switched-gain low-pass filter, removes any audio signals present. The filter output, which is a correction voltage, is fed into a scaling circuit that compensates for the tuning diodes' nonlinear frequency-to-voltage response. Both amplifiers operate with more than 50 dB of gain at d.c. So, with a closed-loop gain of more than 100 dB, tuning error (when locked) is less than 1 kHz at 100 MHz. This error is less than that obtained with most frequency-synthesized circuits and provides the additional benefit of correct tuning even if the station or cable signal is not on proper frequency.

Since this circuit will "track" a station even if it drifts by more than 1 MHz in either direction, the user must be able to defeat the lock easily. The touch sensor switching arrangement on the manual tuning knob takes care of this and, to prevent the tuner from locking onto a strong signal next to a weak signal, a circuit is used to sense strong adjacent channel signals and to inhibit the lock circuit in such circumstances. The lock on/off switch on the top surface of the unit, incidentally, will cancel the lock only insofar as the manual tuning knob is concerned. The lock circuit continues to work for all the preset signals and for the scan circuits.

Laboratory Measurements

The multi-purpose graph of Fig. 2 shows the mono and stereo quieting and distortion (at 1 kHz) characteristics of the MR-80 tuner with the selector switch set for "Narrow" (normal) selectivity. Usable sensitivity in mono measured 12.0 dBf (2.2 μ V), while for stereo, the usable sensitivity was a very low 20 dBf (5.5 μ V). The 50-dB quieting point was reached with input signals of 3.5 μ V (16 dBf) in mono and 30 dBf (17.4 μ V) in stereo, the stereo result being about the lowest we have ever measured for any

stereo FM tuner. At 65 dBf of input signal strength, signal-to-noise ratio measured 76 dB in mono (as opposed to 75 dB claimed by McIntosh) and 71 dB in stereo. Distortion at that strong signal level was the same in mono and stereo, a low 0.12 percent for a 1-kHz signal.

Figure 3 is a plot of distortion (harmonic) versus modulating frequencies, for both mono and stereo operation of the tuner, again with selectivity set to the normal or "Narrow" position. We measured specific values of 0.12 percent at 100 Hz for mono, and 0.15 percent for that frequency in stereo. At 3 kHz, mono distortion was a bit higher than that measured in stereo, 0.18 percent as against 0.13 percent, but at the highest required test frequency of 6 kHz, stereo THD came close to the 0.2 percent limit while mono distortion was again a low 0.1 percent.

We should point out that when the "Super Narrow" selectivity setting is used, distortion does rise rather significantly, approaching the 1.0 percent mark, but this is a trade-off that was most deliberately chosen by McIntosh Laboratory's designers. There is just no other way to achieve adjacent-channel selectivity of 60 dB without increasing distortion in the stereo mode where sidebands of high frequency modulating signals extend well beyond the single channel width of 100 kHz to either side of center carrier frequency. What is remarkable, in fact, is that McIntosh was able to achieve this sort of adjacent-channel selectivity and still keep the distortion level in stereo under 1.0 percent! It should be noted, incidentally, that noise performance or signal-to-noise ratios remain essentially the same in the "Super Narrow" setting as they were in the "Narrow" or normal selectivity mode.

The spectrum analyzer plots of Fig. 4 illustrate frequency response and separation characteristics of the tuner measured with selectivity set to the "Narrow" or normal position. We measured a separation of 50.5 dB at 1 kHz, 48 dB at 100 Hz, and 35 dB at 10 kHz. The lower trace in the scope photo shows the crosstalk in the unmodulated channel. The center trace shows what happens when the multiplex filter circuit is introduced. While separation at the frequency extremes diminishes, notice that at mid-frequencies it is actually greater than it was without the filter over a narrow region of frequencies around the 500-Hz mark.

As might be expected, when selectivity is switched to the "Super Narrow" mode, separation suffers somewhat, as illustrated in the scope photo of Fig. 5. In addition, we note the

WHY ONLY SONY WINDS UP WITH FULL COLOR SOUND.

Strangely enough, some of the things that make Sony Full Color Sound sound so terrific are things you can't hear.

Such as Sony's unique experience and technical achievement. Sony makes both tape *and* the equipment that plays it. So Sony's experience with tape recording is unique among major tape manufacturers. After all, you'd better know all there is to know about tape decks before you make a tape. Sony does.

Then there's unique Sony *balance*. The fine-tuning of all the elements that go into making a tape, so that each synergistically complements the other and delivers the finest recording humanly and technically possible to achieve.

You also can't hear Sony's unique SP mechanism, one of the carefully balanced elements in every Sony tape. It's a perfect example of Sony's technical achievement. The SP mechanism is what makes the tape run so smoothly inside the cassette. And smoothly running tape is critical for total, perfect tape performance.

Smooth running means less friction. So some of the most popular tape makers give the tape as much clearance inside the cassette as possible. (We used to do the same thing.) But this method results in uneven or too tight winding and actually increases friction as you wind and rewind the tape. Jamming and even a stopping of the tape in its tracks can result.

It was clear to Sony that even, uniform winding was the key. So Sony reversed the basic thinking about friction completely and invented the SP mechanism, the first positive guidance system on the market. Instead of giving the tape lots of room, it gently guides the tape smoothly and precisely through the cassette, and onto the reels, with a maximum of positive precision support, yet with an absolute minimum of friction. This is a perfect example of Sony

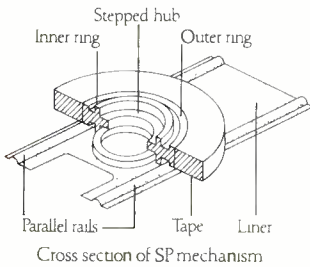
pioneering and how the Sony balance system works.

Some of the unique patented Sony innovations are the stepped hub wheel, which suppresses wobble, parallel "rails" of the liner which guide the tape and hub and keep the tape winding flat and even. Even the surface which touches the tape is special graphite-coated polyester, for the least possible friction.

Our Sony SP mechanism is actually 10 times more trouble-free in lab tests than our old conventional mechanism. And the increase of friction after 200 "torture-test" windings and rewindings has been reduced by nearly 2/3!

The fact is, the more sophisticated your equipment, the more you'll appreciate Full Color Sound. Listen to Sony SHF (our best normal bias tape), EHF (high bias), FeCr or Metallic tape. Listen to the perfect balance of its perfect components. It's the secret of Full Color Sound. **SONY**.

Enter No. 22 on Reader Service Card



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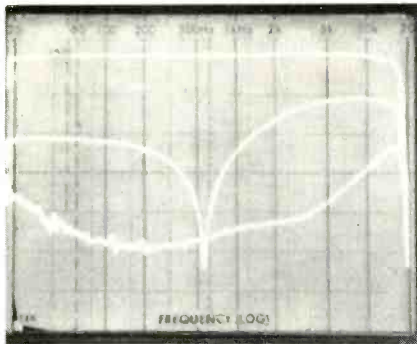


Fig. 4 — Frequency response and separation with selectivity circuitry in "Narrow" mode.

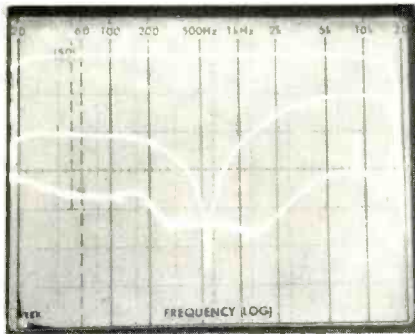


Fig. 5 — Frequency response and separation with selectivity circuitry in "Super Narrow" mode.

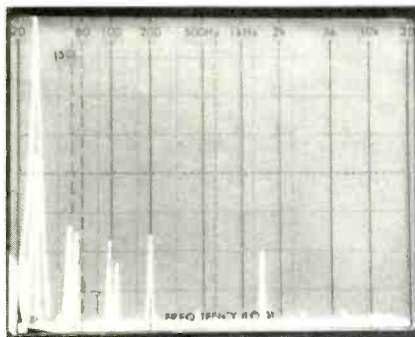


Fig 6 — Crosstalk components for a 5-kHz input signal.

appearance of some beats at around 9 kHz and at 19 kHz in the unmodulated channel output. Again, these are some of the trade-offs that must be made to obtain the kind of adjacent channel selectivity of which the MR-80 is capable. And that kind of selectivity can only be appreciated by the listener who, having been unable to receive a preferred station because of strong local station interference, suddenly hears the desired signal with absolutely no interference.

In Fig. 6 we have changed the sweep mode of our spectrum analyzer so that it is linear (in previous scope photos it was

logarithmic as indicated by the frequency notations at the top of the display), and printed frequency notations should now be ignored. The sweep is from 0 Hz to 50 kHz, at 5 kHz per division. The tall spike at the left is the 5-kHz output from the modulated channel. Contained within that spike is the opposite (unmodulated) output from the other channel, while to the right of these are the crosstalk products at harmonics of 5 kHz as well as any residual 19-kHz and 38-kHz subcarrier output products, all of which are about 60 dB or more below the level of 100-percent modulation.

Capture ratio measured exactly 1.5 dB as claimed, while image rejection was in excess of the 90 dB claimed as a limit specification. We were unable to measure alternate channel selectivity in the "Super Narrow" mode (our equipment can only read reliably to 100 dB) but were able to confirm all other selectivity readings claimed by McIntosh in both the "Narrow" and "Super Narrow" modes of the i.f. system.

Use and Listening Tests

Since our own local distribution of FM stations was such that we did not run into adjacent channel problems if we used a good directional antenna in our listening tests, these tests were divided into two separate parts. First, we did some off-air testing and found that the MR-80 picked up more usable signals than any tuner we have tested over the last three years. The automatic blend filter action and the variable separation (which occurs automatically) resulted in stereo reception of weak signals that was completely acceptable from a noise point of view but that would have been too noisy for pleasurable listening with other tuners we have tested in recent months. The "lock" circuit always yielded optimum tuning point, as evidenced by a complete absence of audible distortion. In short, as we said at the outset, the MR-80 is designed to cope with the real world of broadcasting.

As proof that it could respond well to the world of the laboratory (and because we wanted to see just how sharp that "Super Narrow" selectivity position was) we conducted additional tests which amounted to a "closed circuit" experiment. Using our Sound Technology Model 1100A "Signal Conditioner" (which accepts program modulation from tape or discs and applies required pre-emphasis) to modulate our primary FM stereo signal generator, we "transmitted" some of our favorite discs and master tapes both by direct cable connection and by low-power radiation from one room to the next. These experiments were conducted at a variety of signal strength levels, ranging from around 50 microvolts to 100,000 microvolts. The dynamic range capability of the tuner was awesome, better than any of the program material we used in these experiments.

All of which brings us to the same conclusion we have reached when testing other excellent tuners in the past. Before investing in a tuner of this excellent quality and performance capability, ascertain whether or not there is any station in your area that is meticulous enough in its broadcast practices and caring enough in its selection of program sources to justify the relatively high price of the Mac MR-80. If you are fortunate enough to have one or more such stations in your area and are also sufficiently affluent (or possessed of a good enough credit rating) to afford the MR-80, I could not recommend any product more highly. The McIntosh MR-80 is what FM and stereo FM is really all about — or should be.

Leonard Feldman

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There are 300 voices
in the Mormon Tabernacle Choir.
This tiny diamond tipped sapphire
enables you to hear every one.



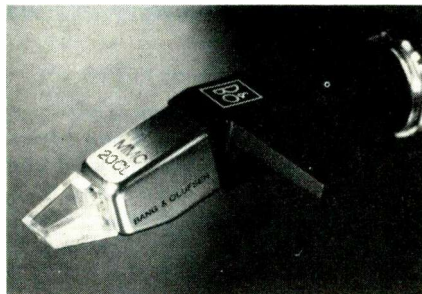
Shown actual size

What you see above is the diamond stylus/sapphire crystal cantilever of the Bang & Olufsen[®] MMC 20 CL Phono Cartridge.

We chose sapphire because it is one of the most rigid materials on Earth. So there is no audible tip resonance. No distortion of the music. Even when subjected to the 10 G forces which cantilevers encounter when tracking today's records.

And while sapphire may seem like overkill, the fact is that your cartridge, though dwarfed by the rest of your system, has an overwhelming influence on the reproduction quality you achieve. Which is why we go to great lengths to achieve optimum performance where it counts in our cartridges.

Another place the MMC 20 CL excels is its stylus. A Contact Line nude diamond. Super-polished to shun contaminants and reduce record wear. It



tracks the groove like a train on a rail.

Then there is the Moving Micro Cross, heart of the patented B&O[®] cartridge for years. Now highly refined, it maximizes stereo separation and minimizes effective tip mass (ETM). For extended record life, and unsurpassed trackability.

Since inductance is low, induced noise is negligible. And output is constant, regardless of cable or preamp capacitance.

Bang & Olufsen's other three cartridge models are the MMC 20 EN, MMC 20 E, and MMC 10 E. They are produced to the same exacting stan-

dards as the MMC 20 CL. And offer almost equivalent performance.

The top three models each come with their own computer-generated test report showing output voltage, channel balance, channel separation, and tracking ability. The MMC 20 CL is also supplied with its own individually plotted frequency response graph.

While you might wonder just how much difference all of this makes, you can hear it for yourself at your local Bang & Olufsen Dealer.

Or write to us, and we'll send you reprints of what reviewers the world over have been reporting. Which is that Bang & Olufsen Stereo Phono Cartridges are great places for your music to begin.

Bang & Olufsen

Bang & Olufsen of America, Inc.
515 Busse Road
Elk Grove Village, Illinois 60007
Attention: Sandy Reinquist

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EQUIPMENT PROFILE

2

APT CORP. APT 1 AMPLIFIER

Manufacturer's Specifications

Power Output: 100 watts/channel into 8- or 4-ohm loads, 175 watts/channel into 2-ohm loads, 75 watts/channel into 16-ohm loads; in mono bridged mode, 200 watts/channel into 4- or 8-ohm loads.

THD: Less than 0.03 percent, 4 and 8 ohms; less than 0.05 percent, 2 ohms.

Dynamic Headroom: 3 dB at 8 ohms, 2 dB at 2 ohms.

Reactive Load Rating: 3 dB

Capacitive Load Rating: To 0.8 μ F

Frequency Response: 10 Hz to 30 kHz, +0, -0.25 dB.

Input Sensitivity: 90 mV for 1-watt output.

Input Impedance: 50 kilohms in parallel with 300 pF.

SMPTE-IM: Less than 0.01 percent.

IHF-IM: Less than 0.01 percent.

TIM: Less than residual in test equipment of 0.006 percent.

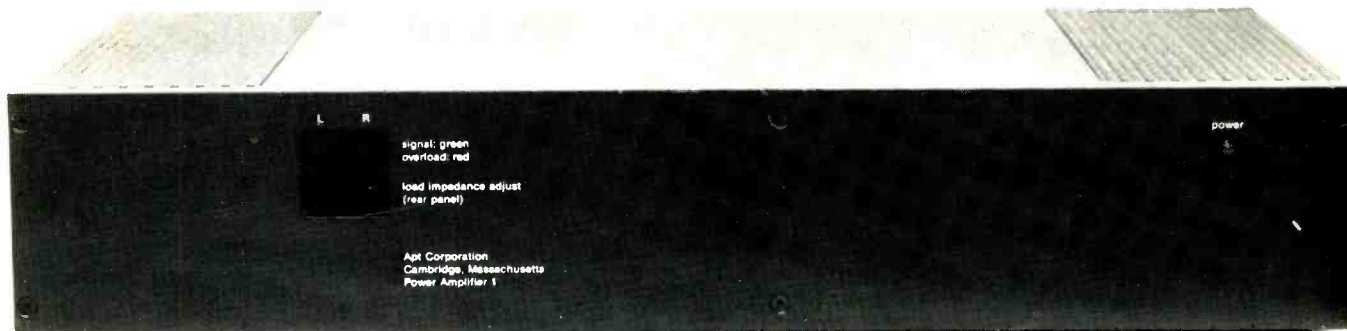
Slew Factor: Greater than 10.

S/N: 80 dB below 1 watt (110 dB below rated output).

Dimensions: 3.12 in. (79.25 mm) H x 16.9 in. (429.26 mm) W x 10.19 in. (258.82 mm) D.

Weight: 22 lbs. (10 kg).

Price: \$641.00 East, \$656.00 West.



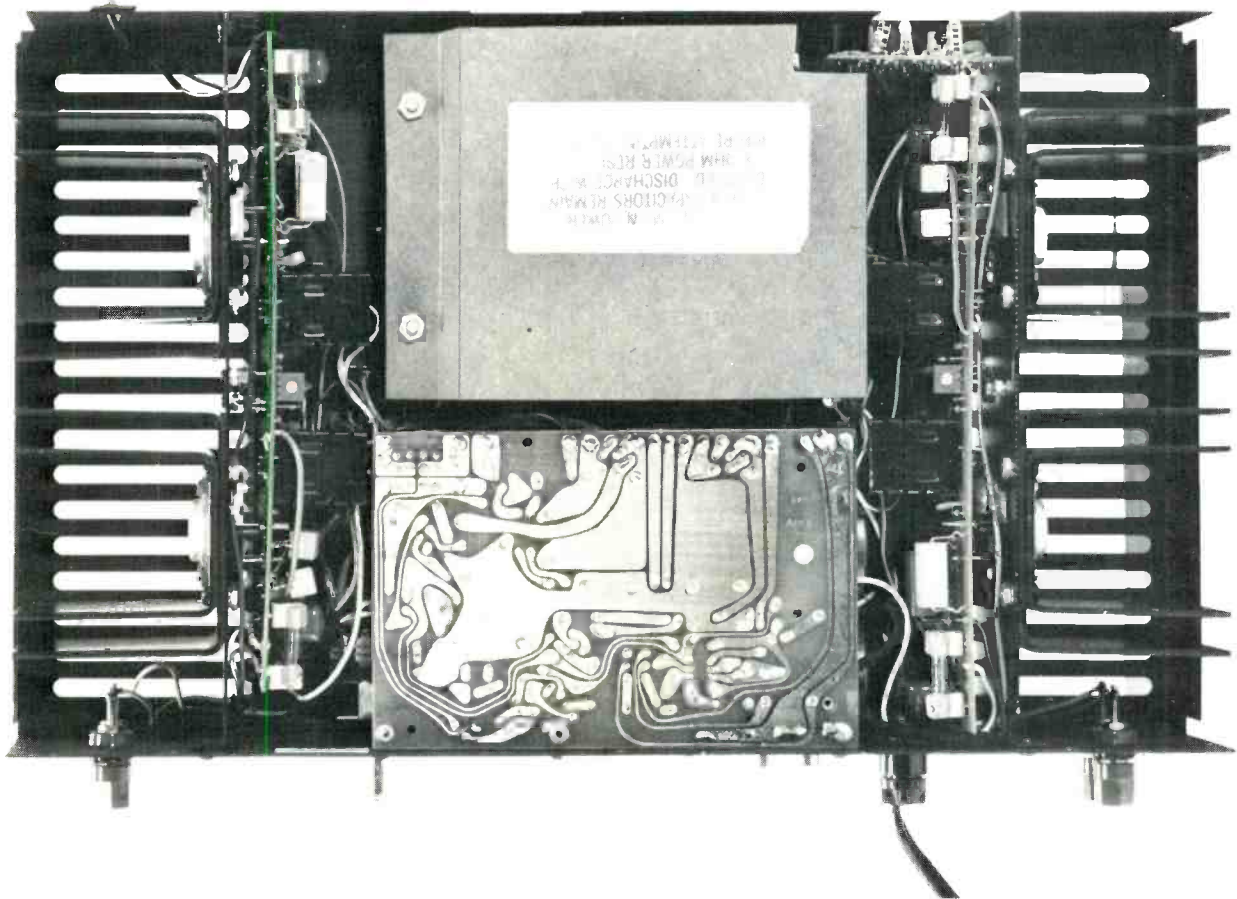
The arguments over whether or not one can hear differences between similarly rated and similarly measuring amplifiers will probably be with us for many years to come. As far as this reviewer is concerned, however, the Apt 1 Amplifier, the second product to be introduced by Tom Holman in the past couple of years, settles the argument in my mind. It sounds better than most amplifiers in its price and power class and, I might add, these judgments are not only my own but those of my listening panel of associates and friends who, as in all recent tests, had no idea what was being compared with what and whether the switch was really being thrown from A to B or from A to A or, as was true in some cases, from B to B!

As well as providing superlative sound, the Apt 1 is also one of the most conservatively designed amplifiers we have encountered in some time. And in addition and unlike some amplifiers which perform well on the lab bench with idealized loads but fail to measure up sonically when delivering power into real-world loads, the Apt 1 can easily deliver its rated power, and then some, into the most complex and unusual of speaker loads yet devised by man.

For all its design innovation, the Apt 1 is a compact unit and fairly lightweight at 22 pounds (or, an even 10 kilograms, if you prefer to be metric about it). Its grey metallic front panel has no

controls on its surface. The only visible items on the front panel are a tiny power-on indicator light and a small viewing area housing LED indicators. The upper pair of LEDs illuminates in green whenever a signal is being amplified by the Apt 1, switching to red when an instantaneous overload condition occurs. The other LED illuminates when the load is mismatched to the amplifier's output, at which time the user is expected to remedy the situation with an impedance switch on the rear panel.

That rear panel is equipped with color-coded, five-way binding posts for speaker cable connection, with one pair located at each end of the panel. A small switch at panel-center can be released from its normally depressed setting for bridged mono-phonetic operation of the amplifier. In such a mono mode, only the L input is active. A fuseholder housing a 4-ampere line fuse is located on the rear panel, as is the aforementioned impedance switch. The switch has two settings: 8-16 ohms stereo/16-32 ohms mono or 2-4 ohms stereo/4-8 ohms mono. As previously noted, an improper setting may be indicated by illumination of the front-panel LED indicators. Such indications may take place even if the "nominal" impedance of the speakers being used corresponds to the switch setting, since nominal speaker impedance does not always correspond to actual impedance under a given set of drive conditions for an amplifier.



Circuit Highlights

A complete schematic (one channel only) of the Apt 1 is shown in Fig. 1. The power amplifier stage employs some newly developed circuits which were conceived by Tom Holman and designer Mark Dinsmore. The first stage is a Darlington-connected differential-pair with emitter current source and gain degeneration. This configuration was apparently selected because of its relatively high stage current and attendant high slew rate combined with high input impedance and good thermal stability.

One side of the differential pair drives a current mirror, which reflects the output of half of the differential pair downwards. The second stage is driven in both directions, up and down. Each half of this stage consists of a two-transistor cascode circuit.

The output stage consists of two triple-Darlington, complementary-symmetry, common-collector stages (emitter-followers). This configuration provides high current gain, so that load variations in impedance are reflected back to the gain stages at a very low level, with little overall effect upon the specifications of the amplifier.

The safe-area detector circuitry works much like the portion of safe area limit circuitry which detects unsafe conditions in output transistors. The detector, however, is not used to interrupt the drive to the output as it sometimes is in conventional circuits.

Instead, the detector output is used to signal the output protection relay to disconnect the load. This action is postponed for as long as possible thanks to the conservative design approach in the output-stage "safe area." Common-mode conduction from one output half through the other half is prevented from reaching destructive levels by fuses in the B+ and B- supplies to each amplifier.

Additional inputs to the relays are a turn-on delay and d.c. detectors for each channel. Since the amplifier is direct coupled internally, any input offset will appear as a larger d.c. offset at the output. To prevent such input offsets from appearing at the output, a separate servo amplifier maintains d.c. conditions at zero at the output.

A voltage/current comparator measures the V/I relationship in the left channel and drives the load impedance indicator in the event that the load impedance drops below 4 3/4 ohms in stereo or 9 1/2 ohms in mono bridging.

The power supply of the Apt 1 is unusual in that it has the ability to alter voltage and current relationships depending upon load impedance. It uses all of the power transformer regardless of the setting of the impedance switch so that windings are not wasted in either mode of operation. B++ and B-- voltages are developed separately from the B+ and B- voltages so as to

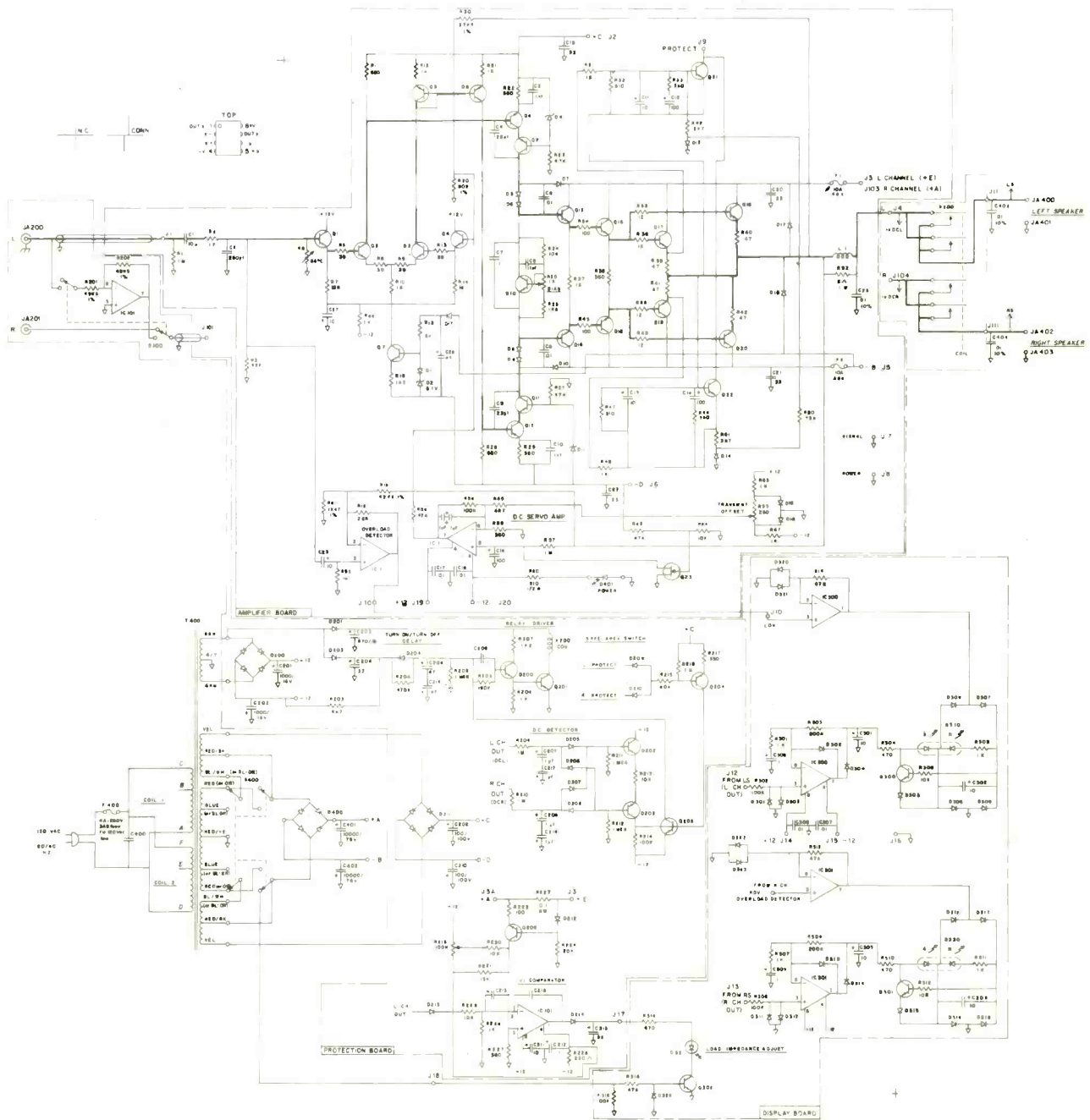


Fig. 1 — Complete schematic, including power supply and signal/overload indicator, of one channel.

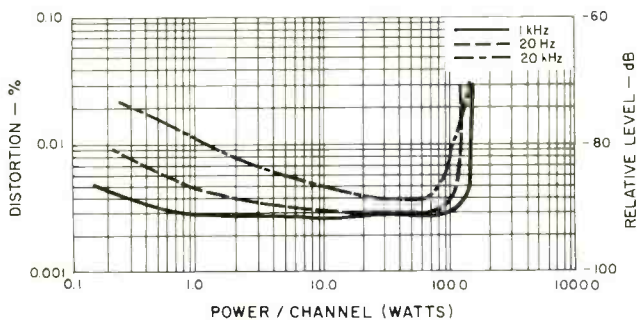


Fig. 2 — Power output vs. THD, 8-ohm loads.

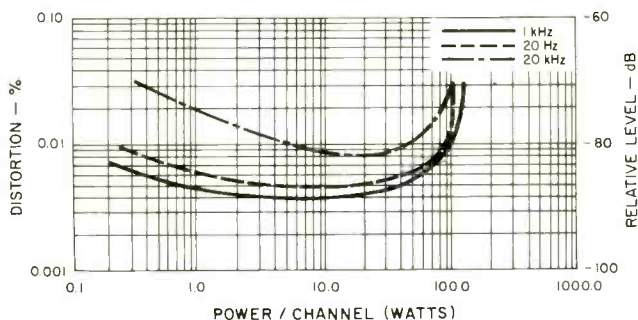


Fig. 3 — Power output vs. THD, 4-ohm loads.

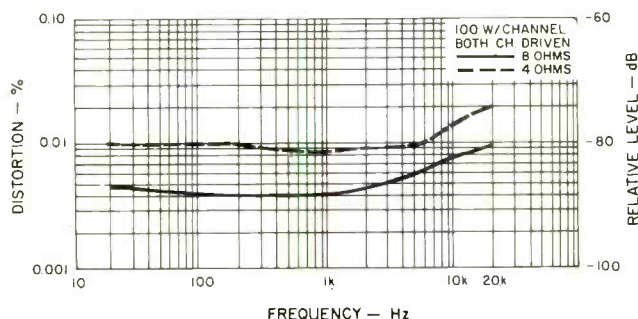


Fig. 4 — Distortion vs. frequency at rated output.

operate the low-level stages of the power amplifier with minimal interaction with the power supply. The important driving stages are well isolated from the power output demands on the amplifier.

The dual-color LED display circuitry tests the output for small signals and lights a green LED for signal present at the output jacks. An overload detector differential amplifier triggers whenever the input and output of the amplifier do not "track" each other. This amplifier then suppresses the green LED and changes it to red to indicate overload.

Laboratory Measurements

With 8-ohm resistive loads connected, the amplifier delivered 123 watts per channel at mid-frequencies before harmonic dis-

tortion reached its rated value of 0.03 percent. With a 4-ohm load, power output for 0.03 percent THD was 115 watts. Returning to 8-ohm loads, we measured a maximum continuous output of 114 watts per channel at 20 Hz and 118 watts per channel at 20 kHz. Under 4-ohm load conditions, the amplifier delivered 101 watts at 20 Hz and 102 watts per channel at 20 kHz for the same level of distortion. On the basis of the 8-ohm measurements, we would rate the amplifier as being a 114 watt per channel unit, abiding by FTC criteria, but that hardly begins to tell the whole story. This amplifier exhibited a dynamic headroom of 3.2 dB at 8 ohms. That means that under music signal conditions, the amplifier can deliver short-term power peaks as high as 209 watts per channel without clipping! A plot of power output versus harmonic distortion for the 8-ohm load condition is shown in Fig. 2, while in Fig. 3 we have plotted the power output versus harmonic distortion for 4-ohm loads. Figure 4 shows a pair of plots (8 ohms and 4 ohms) of distortion versus frequency at rated output (100 watts per channel, continuous).

Power bandwidth (the frequency extremes at which full power could be delivered for rated THD, 8 ohm loads) extended from 11 Hz to 35 kHz. Frequency response at nominal power levels was flat from 3.5 Hz to 75 kHz for -1.0 dB, extending further to 200 kHz for the -3 dB roll-off point. Damping factor was around 200 for a 50-Hz test signal referred to 8-ohm loads.

SMPT-E-IM distortion measured a low 0.015 percent for rated output as against the published or rated value of 0.03 percent. IHF-IM was so low as to be unmeasurable using our test equipment, which normally can read down to 0.01 percent. Slew factor (the highest frequency divided by 20 kHz at which full-rated input produces an output having 1.0 percent THD) could not be measured beyond 6 on our test equipment, but we can verify that it was probably in excess of 10, as claimed, just by extrapolation. Input sensitivity corresponded exactly to the published claims, with 90 millivolts required for 1-watt output and ten times that amount needed for the rated 100 watts output into 8-ohm loads. The A-weighted signal-to-noise ratio was 88 dB below 1-watt output reference, or fully 8 dB quieter than claimed by the manufacturer.

Summary and Listening Tests

We hooked this amplifier up to a variety of speaker systems; everything from our reference KEF 105-II to some recently acquired mini-sized speakers that lack an octave or so at the bottom but are otherwise well balanced and accurate. There are those who maintain that some amplifiers do good things for certain speakers while messing up the sound of others. The Apt 1 is *not* such an amplifier. Each of the speaker types we tried with it seemed to benefit audibly from being driven by this superbly designed unit. Bass reproduction was extremely tight and un-muddled, and the amplifier somehow never seemed even close to running out of steam, even when coupled to relatively inefficient speaker systems. Mid-frequencies and highs were well defined and transparent, with not the slightest hint of high-end fuzziness or raspiness under any drive conditions.

Having checked out the Apt preamplifier more than a year ago, I rather suspected that the matching amplifier would be a winner too. It is!

Leonard Feldman

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We could save money by making one driver do in many systems. Some companies do. But at AR we design each driver for the individual operating level of each speaker.



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While there's nothing inherently wrong with putting a Frammas woofer and Tekamaki tweeter with a Schenklocker driver, the quality of the parts is out of your hands.

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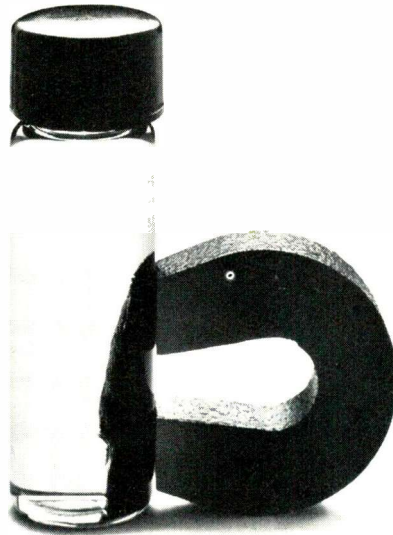
That's why we can confidently say that the end product will do exactly what it's designed to:

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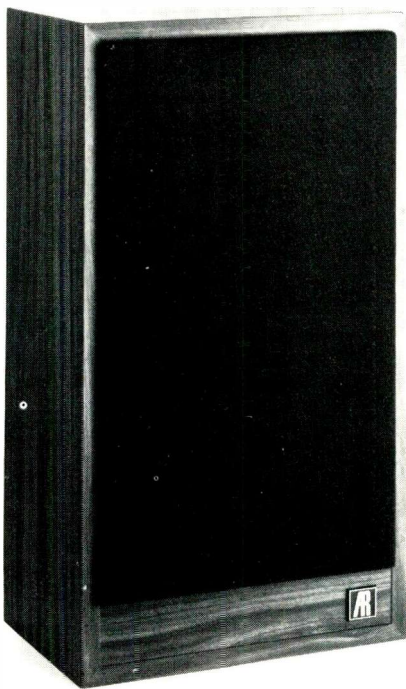
thing done right, yourself.



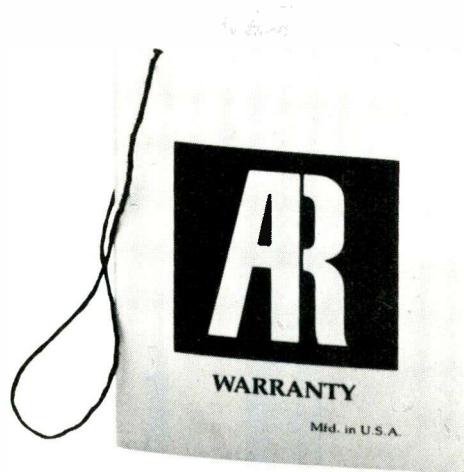
This coil of wire (it's called a choke) is part of an AR crossover. Winding it on a ferrite core would save copper and money. We use only air-core chokes for better performance.



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AR gives you a full (not limited) 5-year Warranty on parts, labor and performance to within 1 dB of design specs.

Produce pure accurate sound that will enthrall you in the showroom. And forever more. (Which is not an idle promise. The AR warranty promises, among other things, that your speakers will perform within 1 dB of design specifications for 5 years. Check the warranty for details.)

So next time you're shopping for speakers, look for the ones with the AR nameplate.



It stands for a lot.
A lot more speaker for your money.

"Truth in Listening"

EQUIPMENT PROFILE

3

E-V CO15P/ CS15P ELECTRET CONDENSER MICROPHONES

Manufacturer's Specifications

Model Identification: CO15P comprises CO15E head plus PE15 preamp; CS15P comprises CS15E head plus PE15 preamp.

Directional Pattern: CO15P, omnidirectional; CS15P, "single-D" cardioid.

Frequency Response: CO15P, 20 Hz to 20 kHz; CS15P, 40 Hz to 18 kHz.

Impedance: 150 ohms, nominal.

Element: Electret condenser, interchangeable heads.

Maximum SPL for 1% THD: CO15P, 145 dB; CS15P, 141 dB (0 dB = 20 micropascals, $f = 1,000$ Hz, load $Z > 1,200$ ohms).

Equivalent Noise Level, Max. Values, A Weighted: CO15P, 26 dB; CS15P, 22 dB.

External Powering: Phantom system,

8 to 50 V d.c. at 3 to 12 mA (current depends on voltage).

Case: Machined steel with fawn beige micomatte finish.

Dimensions: 27 mm (1-1/16 in.) head diameter, 19 mm (3/4 in.) handle diameter, 176 mm (6-15/16 in.) long.

Connector: 3-pin male, Switchcraft A3M type.

Supplied Cable: 4.6 m (15 ft.) with Switchcraft A3F connector.

Supplied Accessories: Wind screen, 315A; clamp (swivel mounting), 312A, and metal storage case.

Prices: CO15P, \$264.75; CS15P, \$246.00; CA10 10-dB pad for condenser heads, \$31.85; AC24M power supply, a.c. operated, for two microphones, \$102.00; AC24S expander module, attaches to AC24M to power four more microphones, \$86.50.



Models CO15P and CS15P were selected for review from Electro-Voice's recent "C" series of electret condenser microphones. I received one pair of everything in this series, and the hardware occupied half of the studio floor when it was unpacked. Because the functions of some components were not obvious, it was necessary to read the catalog and instruction literature. To test all pieces in all possible ways and write a proper review would be a monumental undertaking, and I have therefore chosen only those components of the "C" system that would be of greatest interest to audiophiles. The hardware that was not tested includes a hypercardioid head, a preamp with rolled off low-frequency response, and a line-type (shotgun) condenser head. These are intended primarily for television and motion picture use on booms and for sound reinforcement in the performing arts. Clear descriptions of the entire "C" series may be found in the E-V Professional Microphone Catalog.

The two models evaluated, the CO15P and the CS15P, consist of a preamplifier and two interchangeable heads. One head is omnidirectional; the other is a "single-D" cardioid. This latter term is used by E-V to distinguish between the two types of pressure-gradient (such as cardioid) mikes they produce. "Single-D" refers to those microphones with one or more rear sound ports located a short distance behind the diaphragm. All of the pressure-gradient microphones we've tested from other manufacturers are of this variety. They exhibit proximity effect, a bass boost which occurs when the sound source is closer than three feet. This boost can be compensated for by a 6 dB/octave roll-off with turnover frequency selected to match the particular source distance. (A complete series of proximity effect frequency response curves is found in my article, "The Compleat Microphone Evaluation," in the April, 1977, issue of *Audio*.) The other class of pressure-gradient mikes patented and manufactured by Electro-Voice is the "variable-D." These microphones feature a series of rear sound ports. The ports for high frequencies (short wavelengths) are nearest to the front, while those for low frequencies (long wavelengths) are far from the front. In an old model, the low-frequency port was a small hole in the handle which could be covered if you held it incorrectly. Current models have ports distributed along a distinctive rib. The "variable-D" scheme is said to eliminate proximity effect. E-V now makes several "single-D" microphones and claims the proximity effect is an advantage in close-miking pop music where extra bass response is desired.

The head for the CO15P is rather unusual — the diameter of the electret element is only 9.5 mm (0.375 in.), but the diameter of the housing is 27 mm (1.0625 in.). Since the housing is a solid metal obstacle behind the element, I initially concluded that the high-frequency performance would be that of a 27-mm microphone, and the advantages of the tiny element would be lost. (In the September, 1978, issue of *Audio* we reviewed a 16-mm diameter microphone which had excellent high-frequency characteristics.) E-V claims that this is not so because some special damping material surrounding the element "absorbs all of the badness." (My translation of E-V's letter.) Our test proved that neither we nor they were entirely correct. E-V did allow that a 9.5-mm head diameter "concert version" may be forthcoming. Naturally, the company would have to trade off ruggedness for acoustical performance in such a version.

The element of the CS15P cardioid head is, according to the drawings supplied by E-V, much larger in size than the omni-

element. It seems to fill up the bore of the housing which has a 27-mm (1.0625-in.) outside diameter, similar to the CO15P head. Accordingly, the high-frequency characteristics cannot be expected to be as linear with frequency as the CO15P but should be comparable to many other current condenser microphones which are about 25 mm (1 in.) in diameter.

The PE15 preamplifier, which is common to both microphones, is plain and simple, at least on the outside. It is specified to have linear frequency response from 20 to 20,000 Hz and a voltage gain (loss) of -1.5 dB. No low-cut switch is provided, so the user must employ external equalizers to compensate for proximity effect or to reduce room-noise pickup. Also, no integral head attenuator is provided; this is available as an accessory 10-dB pad that screws in between head and preamp. Since the microphones are specified to accept greater than 140 dB SPL without clipping, we would think sales of the pad would be rather limited. The pad, incidentally, should not be used simply to reduce microphone output level because the equivalent noise SPL is effectively increased by 10 dB, and this would be 36 dBA for the CO15P. Microphone noise would then be audible in quiet auditoriums where typical ambient levels are 30 dBA. Reduction of microphone audio level for input SPLs of 140 dB or less is properly accomplished with a pad after the preamp; E-V sells plug-in attenuators for this purpose.

The phantom powering scheme, which has been explained in previous reviews, applies to both of these microphones. Essentially, the scheme permits ordinary two-wire shielded microphone cable to be used between microphone and power supply. A power supply is available from E-V and listed in the accessories, though any mixer, console or recorder that provides up to 50 V d.c. phantom power may be used. We used the AC24M supply for all tests and did not try the AC24S which mounts piggyback on the AC24M to expand the powering capability from two to six microphones.

Measurements

I would like to remind the reader that the details of our microphone testing procedures may be found in the April, 1977, and September, 1978, issues of *Audio*.

I noted from the instructions for the AC24M power supply that

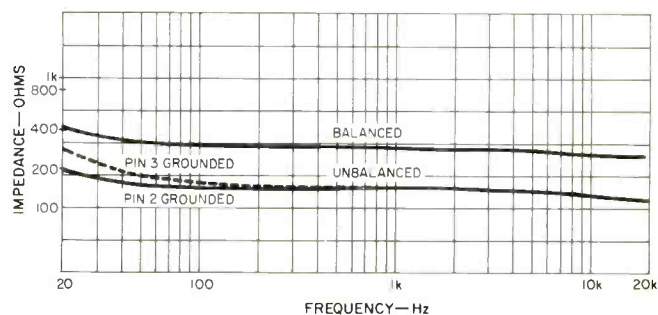


Fig. 1 — Impedance vs. frequency, Electro-Voice CO15P/CS15P microphones.

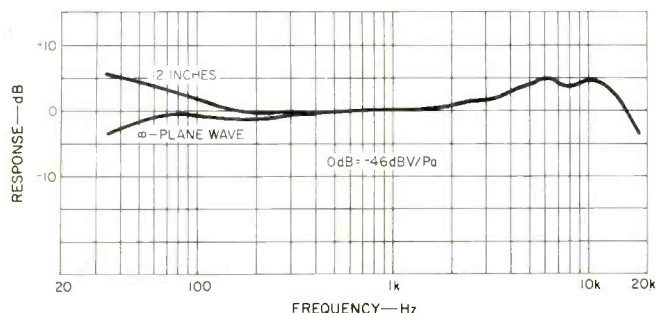


Fig. 2 — Frequency response, CS15P microphone.

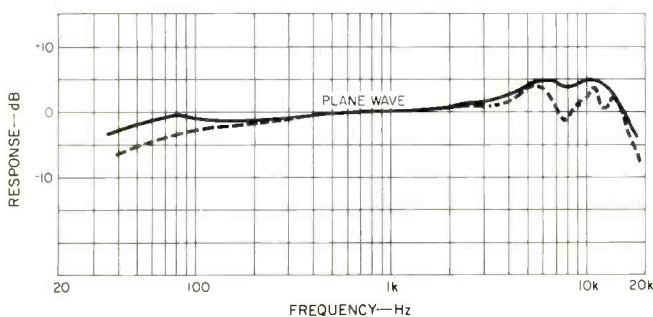


Fig. 3 — Frequency response variation between two production models of the CS15P; solid line is unit used for review. Only the heads were interchanged; the same PE15 electronics were used for each test. Sensitivity variation was 2 dB.

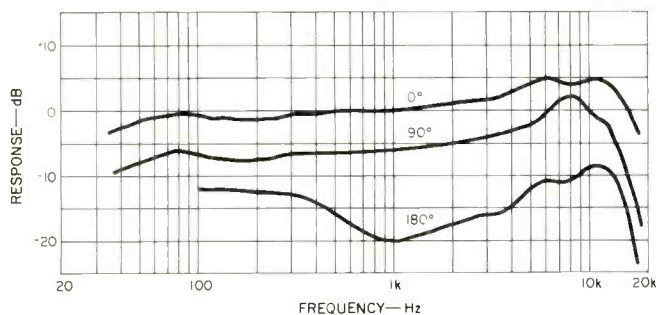


Fig. 4 — Frequency response vs. angle, CS15P microphone.

its audio output is not to be connected to unbalanced loads (i.e. one audio line grounded). Electro-Voice recommends a 1:1 isolation transformer between the AC24M and an unbalanced load. Balanced loads with center point floating or grounded are permitted.

With the above caveat in mind, we measured impedance with and without a 200:200 ohm transformer (UTC HA108X) between the AC24M and our unbalanced test setup. Figure 1 shows that the impedance changes from about 300 to 150 ohms when the transformer is removed. In addition, grounding pin #3 produces a rise in Z below 100 Hz. Since unbalanced operation is forbidden, one must compare the measured 300-ohm value to the nominal 150 ohms specified. Most 150/200/250 ohm inputs are "unloaded" and typically run well above the 1,200-ohm value stated in the distortion specification. (Matched loads are detrimental to certain types of electrodynamic directional microphones as the frequency response may be affected.) The clipping level of condenser microphones may be reduced by a load impedance which is less than the recommended minimum value.

We tested frequency response with three types of input circuit: Balanced-floating, balanced-CT grounded, and unbalanced. Both types of balanced loads produced normal response and output level. The unbalanced load did not change the frequency response, but the output was 3 dB less than with the balanced connection. Although this brief test showed no problem with unbalanced loads, the rest of our tests were conducted with a balanced, CT-grounded load.

Figure 2 shows the frequency response of the CS15P. The distant response shows the beginning of the claimed roll-off below 40 Hz. For practical purposes, the response is uniform to 35 Hz at distances of about three feet or greater. Considerable bass boost is evident at 12 inches. The smoothly rising high-frequency response and the output level agree closely with E-V's data. Figure 3 shows frequency response variations between the two condenser heads supplied. If the 1,000-Hz levels were adjusted, the responses would fall within a 4-dB wide envelope save for a slight departure at the 8,000-Hz dip. The "Q" of this dip seems to be the most significant variable in the CS15P response.

Note in Fig. 4 that the 90-degree response exhibits a peak at 8,000 Hz which coincides with the dip in the 0-degree response. Below 8,000 Hz, the 90-degree response is 6 dB below the 0-degree curve, following the cardioid characteristic perfectly. Above 8,000 Hz, the 90-degree response falls off, probably due to diffraction. From 500 to 8,000 Hz, the 180-degree response is 15 dB or more below the 0-degree response, and the CS15P has good cardioid properties. Our indoor measurements show that front-to-back ratio reduces to 11 dB at 100 Hz. E-V's curves show a similar reduction, but a ratio greater than 15 dB is maintained at 100 Hz. Our indoor test setup does not yield very high front-to-back ratios below 500 Hz, and we would expect to measure 15 dB or more outdoors. Above 8,000 Hz, unidirectional characteristics are maintained fairly well, noting that diffraction effects are probably in control in this frequency region, requiring careful design of head geometry. To summarize, the CS15P has very uniform directional properties for a microphone of this size.

Figure 5 shows that the frequency response and directional characteristics of the CO15P are fairly close to those of a 16-mm microphone (see *Audio*, September, 1978) except for the

higher peak at 5,000 to 7,000 Hz. The off-axis response of the 9.5-mm element has not been greatly attenuated by diffraction effects of the large housing. Figure 6 shows excellent production uniformity between two CO15Ps.

We measured noise only with the CS15P. The A-weighted level is 3 dB higher than specified for the CS15P but 1 dB lower than the specified value for the CO15P. We consider this to be in good agreement, noting that noise measurements are subject to many variables. The spectra (Fig. 7) show peaks at 30 and 50 Hz. These may be due to ambient acoustical noise but probably do not contribute to excessive overall level, as the A-weighting curve is greatly rolled off at low frequencies.

The 60-Hz hum pickup of the CS15P was 15 to 20 dB less than the reference microphone. (A previous review explains the reasons for using the Nakamichi CM-700 microphone system as reference for comparison.) Clipping level was greater than 140 dB SPL for the CS15P. Phasing was pin #3 positive, which does not follow the proposed revision to the EIA standard. Phasing of CO15P/CS15Ps purchased as complete microphones should conform to the proposed revision to the EIA standard (pin #2 positive). The combination of certain early production elements and later production preamps (and vice versa) could result in pin #3 positive.

Use and Listening Tests

Like most condenser microphones, the CO15P/CS15P has no integral windscreen and is very "pop" sensitive without the accessory foam screen. The CS15P with screen had somewhat more pop sensitivity than the reference microphone (with cardioid capsule and perforated plastic screen). The CO15P with screen had no pop noise, same as the comparable reference microphone configuration. The CO15P and CS15P had very low vibration sensitivity, the same as the reference microphone's.

On axis, the CS15P sounded more crisp than the reference mike with voice, while at 90 degrees it sounded the same. The CO15P sounded identical to the reference microphone with voice at 0 or 90 degrees. Interestingly, the CO15P picked up less ambient room noise (from an air conditioner) than the reference microphone, yet both have flat response to very low frequencies.

Alas, I did not have an opportunity to record a concert with either the CO15P or CS15P microphone. However, the differences between these mikes and the reference are in the region above 1,000 Hz, so an acoustic guitar was a good sound source for comparison. The CS15P on axis reproduced all of the very high overtones that the reference did, but the mid-highs or "presence region" was more emphasized in the CS15P. I thought this produced a very dramatic guitar sound, and this hints that strings, brass, and woodwinds may sound good with the CS15P. I was amazed that the "high highs" were not attenuated, compared to the (16-mm diameter) reference at 90 degrees off axis, and it is difficult to understand why a 27-mm microphone sounds as good off axis as a 16-mm microphone. Of course, the carefully tailored axial peaking helps to preserve a linear response off axis, and the total sound variation, 0 to 90 degrees, is definitely greater with the larger E-V microphone.

The CO15P picked up all of the high string overtones at 0 or 90 degrees that the reference did, but it sounded crisper on axis in the mid-high or presence region. This extra crispness, in my

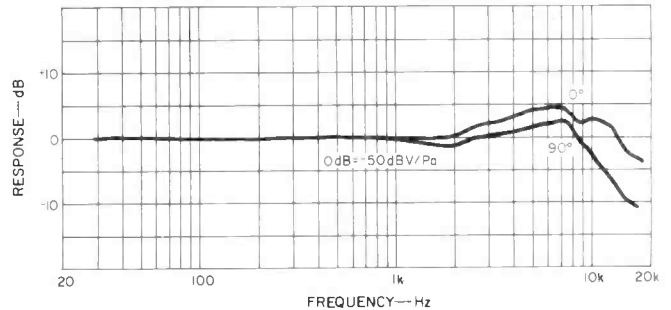


Fig. 5 — Frequency response vs. angle, CO15P microphone.

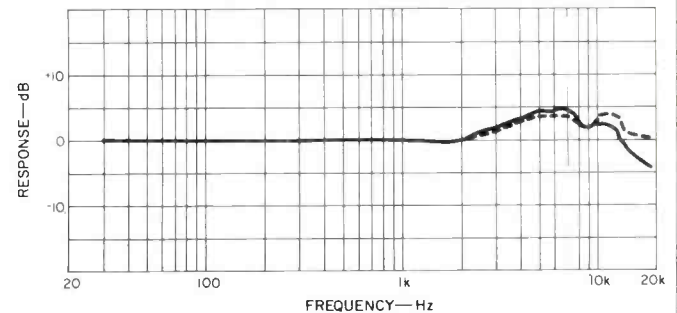


Fig. 6 — Frequency response variation between two production models of the CO15P; solid line is unit used for review. Only the capsule was changed; the same PE15 electronics were used for each test. There was no variation in sensitivity.

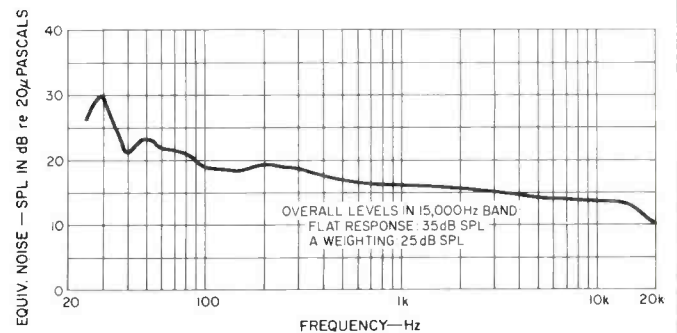


Fig. 7 — One-third octave band spectrum of noise from the CS15P mike.

opinion, did not make the guitar sound better, as anticipated. In contrast, the reference microphone (with omni head) sounded more "full" and "warm."

Summary

The Electro-Voice Models CO15P and CS15P electret condenser microphones possess an excellent combination of electroacoustic performance and traditional E-V ruggedness. The CS15P performance is much better than expected from a 27-mm microphone, and with the single caveat of lacking actual concert recording experience, I have no criticisms to offer.

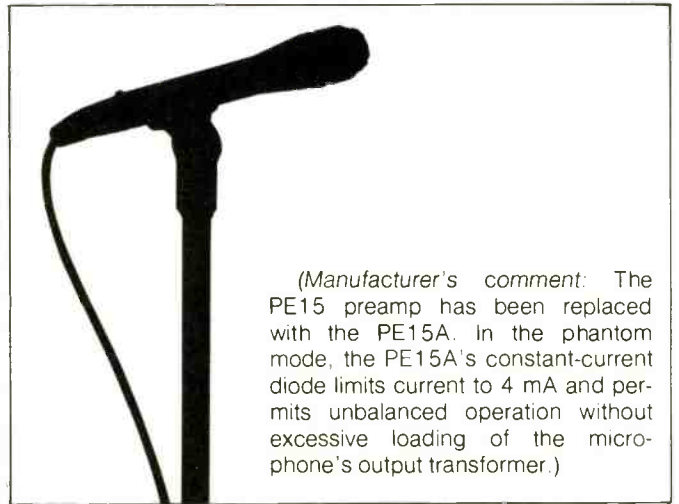
The CO15P measurements showed that putting a 9.5-mm element in a 27-mm housing did not spoil the performance as anticipated. I don't know why the listening test with guitar did not produce as strongly pleasing a sound as anticipated from the test data, but it did do well and I can give it an A+ rating for reproducing the high overtones and for uniformity of sound over the front hemisphere. I would like to see a "concert version" of the CO15P where the front end of the microphone would be tapered down to the 9.5-mm element size. Since the front end would have to be rather fragile, E-V could dispense with the "iron-pipe" handle and design a thin-wall, smaller diameter handle. Magnetic stainless steel (400 series) offers magnetic shielding, as well as durability with a thin wall housing.

I hope that some readers will try the CO15P and CS15P

microphones for concert recording and would be pleased to learn of the results. Also, those wishing E-V would make a "concert omni" microphone as outlined above should write directly to the company.

Jon R. Sank

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(Manufacturer's comment: The PE15 preamp has been replaced with the PE15A. In the phantom mode, the PE15A's constant-current diode limits current to 4 mA and permits unbalanced operation without excessive loading of the microphone's output transformer.)

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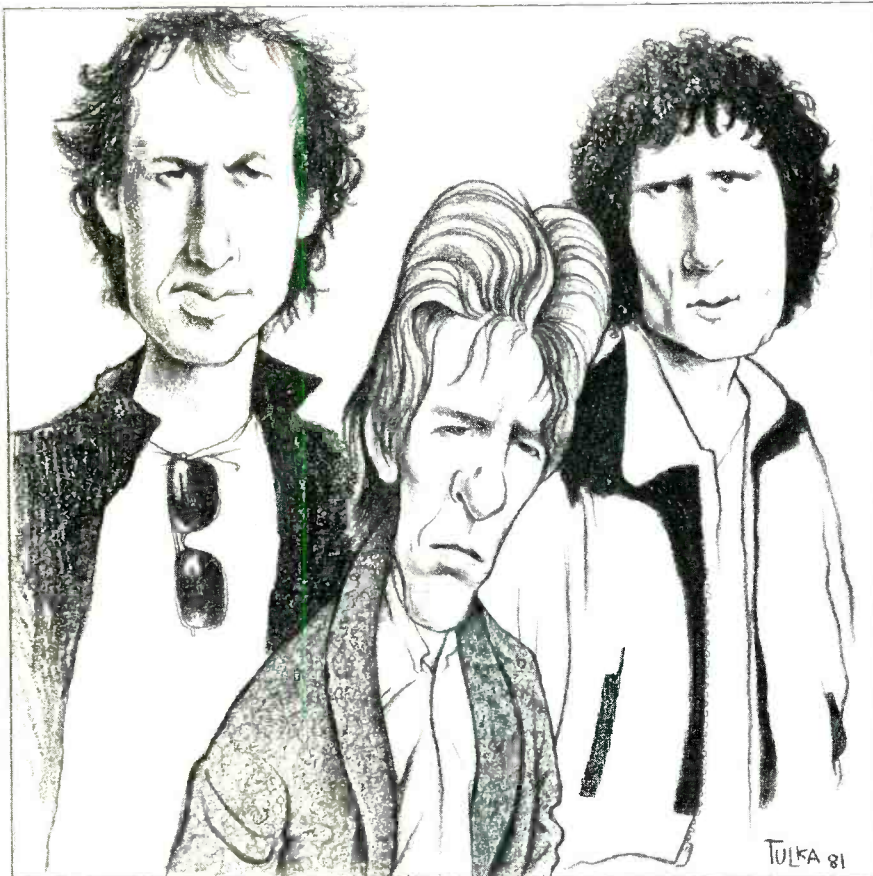
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MICHAEL TEARSON
JON TIVEN



and all. Equally vivid are the girl who wants it all in "Espresso Love" and the gay boys in the campy "Les Boys."

The recorded sound of *Making Movies* is gorgeous, full and muscular, a triumph for lovine who has made John Illsley's expressive bass and Pick Withers' drumming sound better than ever. Withers in particular is a seasoned pro who, like Levon Helm in the glory days of The Band, knows the value of each stroke he makes and, even more crucially, each stroke he doesn't. Knopfler's guitars (he plays all guitar parts this time out) are pure sounding and eloquent, never gimmicky or gratuitously flashy. He too knows what each note is there for.

Making Movies is that rarest of records, one that promises a lot and delivers on every count. Every song is a gem beautifully rendered. It is a completely satisfying record. *M.T.*

The Royal Albert Concert: Creedence Clearwater Revival
Fantasy MPF-4501, stereo, \$5.98.

Sound: B Performance: A

Never before released, this 1970 concert is the best live recording of legendary Creedence Clearwater Revival I've ever heard. They shoot out classic after classic, 14 in all that add up to 50 minutes of music. And unusually well recorded, too.

And take a good look at that \$5.98 list price. This is one excellent album, a treasure and a true bargain. Hey, come home, John Fogarty. All is forgiven. *M.T.*

Zenyatta Mondatta: The Police
A&M SP-4831, stereo, \$8.98.

Sound: A Performance: A-

On their third album The Police demonstrate that indeed they have locked into a totally unique sound as the kings of white reggae, spiced with various international influences, but have virtually turned their back on the pop side of their sound. Although songs like "Message in a Bottle," "Roxanne," and "Can't Stand Losing You" delivered minor key verses resolving in major refrains, the new album offers little release from their somewhat obtuse chord structures. While they continue to carve a well-defined niche for themselves, The Police's

Making Movies: Dire Straits
Warner Bros. BSK 3480, stereo,
\$7.98.

Sound: A- Performance: A+

Sometimes it just takes a few tries to get it exactly right. That's it in a nutshell about *Making Movies*, Dire Straits' third album.

Their first two left me with a vague feeling that they were rushing to get it all in before someone pulled the plug and stopped them. Not so this time. *Making Movies* is fully relaxed and fully realized. This must be much closer to what Mark Knopfler, Straits' writer/guitarist/leader, has been hearing in his mind's ear all along.

Dire Straits has made some important strategic changes this time. Rhythm guitarist David Knopfler, Mark's brother, departed. Mark has recruited the excellent Jimmy Lovine to help produce the album, hoping for the magic touch that illuminated the recent Tom Petty, Graham Parker and Patti Smith albums. Knopfler got it,

too, along with lovine's exquisite sense of how to shape a song on record. Toward this end lovine brought in Bruce Springsteen's piano player, Roy Bittan, to flesh out the songs, a capital decision.

For his part Mark Knopfler delivered a superb collection of songs. The narrative sense first exposed by "Sultans of Swing" has been honed and refined to an art. Streetwise survival thematically connects them.

Side one's three songs are triumphs one and all. And appropriately for an album called *Making Movies* they are visual songs, aural storyboards. The lovesick idiot serenading a girl who is stuck-up on her own success in "Romeo and Juliet," the roller-skating street girl with her radio headphones on in "Skateaway," the hustler in "Tunnel of Love," are all fleshed-out real people. In the case of the hustler, his very dress and appearance are set by a quote taken from the waltz in the score of *Carousel* that opens the track—summoning up Billy Bigelow the carousel barker, striped shirt

songwriting seems more intent upon progression than focus, and although the recording and performance of *Zenyatta Mondatta* is truly impeccable, I'd trade any five tracks for one which equalled the majesty of the singles mentioned previously.

The rock trio is a unique vehicle; in the past the guitarist carried the major responsibility (Clapton in Cream, Jimi Hendrix in The Experience), but bassist Sting provides the major entertainment with The Police. He writes almost all of the songs, initiates the musical direction, and sings lead (even though he didn't start the group). Stewart Copeland is a virtuoso on the drums, but despite Andy

Summers' letter-perfect guitar work during the vocal sections of their songs, he doesn't have the excitement to carry the solo off with anything but perfunctory execution (in other words, no excitement). If there was a fourth piece to add something this wouldn't be so much of a problem, but in effect everything is upon Sting's shoulders. He's very good, but often you wish there was a little more oomph in the guitar solos or a keyboard to fill up the occasional dull spot.

What I'm saying is not that The Police are a bad group or that *Zenyatta Mondatta* isn't a good album, just that if The Police (read: Sting) can't write consistent killer tunes a la "Message in a Bottle,"

it's time for them to take the next step. They should add another guitar, or saxophone, or whatever it takes to get them out of the practice of being only as interesting as their songs, or out of the habit of writing songs which don't transcend their basic chord structure. Sure, I like The Police, but I'm waiting for them to absolutely knock me over. This album takes me a decent part of the way, but it doesn't entirely satisfy. J.T.

Rock 'N' Roll Preacher: Preacher Jack Rouser 3033, stereo, \$7.98.

Sound: C- Performance: B-

It's not hard to see how Preacher Jack got onto Rounder Records. Jack thanks George Thorogood right on the back cover. Besides that he uses George's Delaware Destroyers Billy Blough and Jeff Simon. And who is this nearly invisible guitarist called Sleepy La-Beef?

Preacher Jack is a rock and roll piano man. Like George T., Preacher Jack is no virtuoso of anything save energy. Of that, like George, he is master. Most of the set covers classic Fats Domino and Hank Williams songs plus other assorted rock and country masters who have gone before. In addition there is Jack's self-penned credo "The Public Is My Family and Music Is My Life" followed by its natural extension, "Preacher's Boogie Woogie."

Preacher Jack is at his best when he really cuts loose, as he does on Fats Domino's "All By Myself" which closes the album. But for me he doesn't rock out often enough. I can see that, again like George T., the man loves his country roots, but, hey, Jack, next time don't be afraid to bust out.

The recording style is basic. Maybe one shade too light on the rudeness scale. M.T.

Foolish Behavior: Rod Stewart Warner Bros. HS 3485, stereo, \$8.98.

Catholic Boy: The Jim Carroll Band Atco SD-38-132, stereo, \$7.98. Stewart

Sound: B+ Performance: C+

Carroll

Sound: A Performance: A

When The Rolling Stones were hot and in their prime, they had a surefire method for making hits: They'd go into the studio, learn how to play the latest Motown single and then write new lyrics for it. Thus "My World Is Empty Without You" became "Paint It Black," "The Same Old Song" became "Under My

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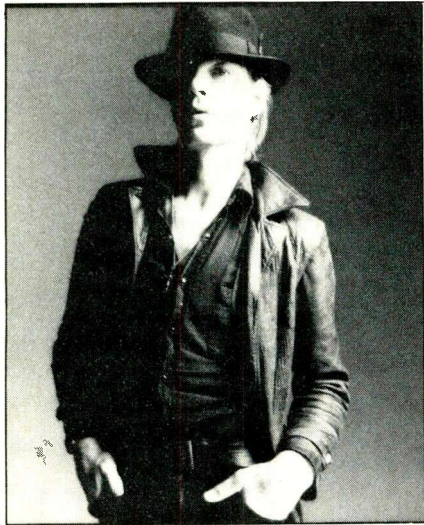
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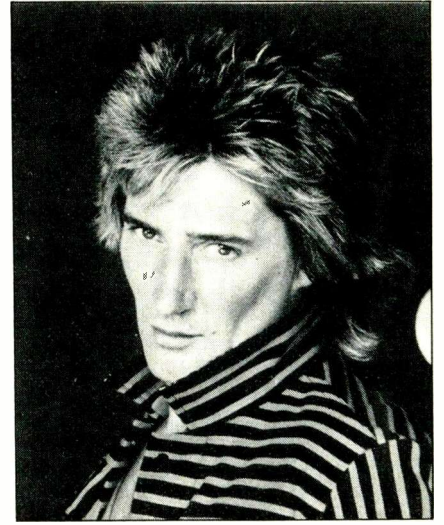


Thumb," "Something About You" became "Satisfaction" and so on. In their effort to pinch from the past The Stones created a genre all their own, using blues and R&B merely as stepping stones to leapfrog into new definitions of rock 'n' roll. Both Jim Carroll and Rod Stewart use The Rolling Stones as their base of operations, but there is one major difference. Whereas Jim Carroll manages to take the style somewhere, Mister Stewart is happy just to sound as much like history as he can.

Rod's *Some Girls* segment on side two of "She Won't Dance With Me" and

"Somebody Special," for instance, is such an obvious remake of "Respectable" and "Beast of Burden" that one wonders why Stewart bothered to change the words. On their last tour, The Rolling Stones introduced "Sweet Little Rock 'n' Roller" as a number "that Rod Stewart taught me the words to" — well, Rod's forgotten those words and titles it "Better Off Dead," kicking off the album. The title cut is an obvious remake of "It's Only Rock 'n' Roll (But I Like It)," The Stones' first outing with former Stewart cohort Ron Wood. There's nothing really wrong with any of these tracks, in fact they're the best things to be found on *Foolish Behavior*, but you'd think that with 30 million in the bank he'd have better ways to spend his time than to blatantly ape his "buddies." After four years with his backup band, "The Stonescloves," it's time for Stewart to do something aside from sell records.

Carroll doesn't have much in the way of vocal pipes, and his band isn't exactly made up of virtuosos, yet he comes on like a new Lou Reed/Jim Morrison/Patti Smith rock-poet. By every standard he *should* be exactly the kind of rocker that makes you hold your nose, but instead he's the exception that proves the rule. Carroll sings with such intensity and emotional attack that we were virtually drawn into the record upon first listening. He's a street poet with two published



works to his credit, but he doesn't parade it around like Patti Smith, for instance, who lets you know she's engaging in a "lower art" when she puts her words to music — Carroll spits out his lyrics with a vengeance that fits the rock idiom perfectly. Although he owes a debt to The Rolling Stones (he was originally signed to their record label and Mr. Richard occasionally sits in with him), Jimbo pays it all back by propelling their essence into a new dimension. He may be a little raw for some, but *Catholic Boy* ranks among the best debuts of any band in recent history. *Jon & Sally Tiven*



A: Jethro Tull
Chrysalis CHE 1301, stereo, \$8.98.

Sound: B Performance: B-

Ian Anderson, a.k.a. Jethro Tull, has made a big deal about this latest album being a giant step in a new direction for the band, and it's true in that he's kicked out various members of the ensemble (which is no more radical a chore than Zubin Mehta firing a couple of cellists) and has attempted to contemporize his lyrical approach. Regardless, the

"Jethro Toe" trademark sound is unmistakable — the Medieval-based chord patterns, progressive time changes, and Anderson's voice have always had more of a hand in bringing in the hordes than any of the other variables involved. True, Martin Barre's guitar takes a serious shuffle to the backseat, and temporary recruit Eddie Jobson (ex-Roxy Music, Zappa, etc.) becomes the focal musician for the time being. And the newly assembled rhythm section of Dave Pegg (bass) and Mark Craney (drums) puts them

closer to the Yes/Genesis school than they've been in the past, but for my money there's little here to disturb Tull fans from the past or to drag Sex Pistols fans in to see them.

In case you were worried, Jethro Tull has not gone New Wave, Punk Rock, or in any direction other than an extension of what they've demonstrated on records previous.

So now that all of you Tull fans have breathed your sigh of relief, and the rest of you have moved on to the next review, let me quickly add that this was intended to be a solo album by Jethro's lead figure but instead served to institute changes within the group which have virtually left their sound untampered with, for all practical purposes. Anderson is writing about some political-social situations here which he finds disturbing, and he blows his usually wild flute, but things remain status quo. No rock opera this time around, no concept album, just slightly less guitar and more synths — to tell you the truth I'd find it much more exciting if he'd hire the original band members back (Mick Abrahams, Clive Bunker, and Glenn Cornick) and let fly with some of that more anarchic, blues-bred stuff that Jethro Tull was originally about. Unfortunately, that would be far too risky a venture. *J.T.*

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CLASSICAL REVIEWS

EDWARD TATNALL CANBY



Brahms: Clarinet Trio, Op. 114. Beethoven: Clarinet Trio, Op. 11. George Pieterston, members of the Beaux Arts Trio. **Philips 9500 670**, stereo, \$9.98.

Sound: A- Recording: A Surfaces: A-

Here we go again — more of the buoyantly recorded communicativeness of the Beaux Arts Trio (two of its three members), sparked by that irrepressible pianist, Manahem Pressler! Their guest here is a superb clarinetist who matches their playing in every respect. Digital or no digital, the sheer recorded sound of these two works is astonishing, big, loud, clear, relaxed. It simply jumps out at you, larger than life. As a few of us keep saying, digital isn't everything.

The Brahms, one of the lesser known of the late Brahms cluster of clarinet works, is the sort of genial, powerful and easily melodious work he could write when in the proper frame of mind. Big bowlful of musical cherries. I kept saying to myself as I listened. The early Beethoven on side 2 is here perhaps a bit too big and bouncy for its time (it would have been played on a much lighter piano and a simpler clarinet). Still — enjoyable. The piano is marvelously natural in its sonic effect, the cello songful, and the clarinet as beautifully recorded as it is played, with an amazingly flexible range of tone from super-soft to squawkingly loud. Fine artist, fine instrument. So — forget digital (unless this one is clandestinely digital, unannounced!) and listen simply to superb recording of fine music.

Cherubini: Requiem in C Minor. ORF Symphony Orch. and Chorus (Austria), Gardelli. **Philips 9500 715**, stereo, \$9.98.

Brahms: Piano Quintet, Op. 34. Maurizio Pollini; Quartetto Italiano. **Deutsche Grammophon 2531 197**, stereo, \$9.98.

Beethoven: Piano Concerto No. 1. Arturo Benedetti Michelangeli; Vienna Symphony Orch., Guilini. **Deutsche Grammophon 2531 303**, stereo, \$9.98.

If you think that music today is mostly international in sound without the old patriotic distinctions — well, it's not quite. These three recent imports show us a fine mixture of Italian, German and French, both past and present, and the sounds do indeed correspond. Could any Italian musician play Brahms the way a German, or an Anglo-Saxon, or Nordic plays it? But yes! Sometimes the extraterritorial performances are splendid. And so are the compositions.

Two of France's greatest composers are Lulli and Cherubini, both native Italians. The Cherubini "Requiem," gaining much lost ground in recent years, is a major choral work of 1816, square in the middle of the Beethoven period, composed in Paris in memory of Louis XVI, who was beheaded in 1793. Louis XVIII, back on the French throne, must have appreciated the tribute to his brother. If you know the Mozart "Requiem" of 1791, this one, 25 years later, is its major successor in the same Catholic tradition, on a larger, more Romantic scale but full of the familiar "Requiem" chords, doleful brass, fugal choruses to the familiar Latin text — this work is a big step between Mozart and Berlioz, who turned out the next "Requiem" of the type in our present repertory.

Curiously recorded sound — the large chorus and orchestra are blurred and distant, the grand assemblage somehow muffled — I could not follow the text even with the words before me. The sound seems semi-mono, with little direction or spatial depth. Yet the music prevails! It is a fine performance — all chorus, no soloists — and before long you will acclimate yourself to the sonics, which aren't *that* bad, and just enjoy the big music.

Who said Italians can't play German music? The Quartetto Italiano are veter-

ans of dozens of recordings of Haydn and Mozart and the like, though they remain irrevocably Italian in a certain warmth of tone and relaxed energy. With a very dynamic Italian pianist here, they do a fabulous job on this well-known early Brahms piece, which too often tends towards the uptight, striving towards some kind of Teutonic greatness. Not here! This is the easiest-listening version of the work I can remember, never strained but always full of verve. Here is what chamber music is all about: Big music in a small space — your living room.

In spite of the talk about the glories of live performance, I have never *trusted* the live recording. Mostly, it just doesn't work, whether musically or technically. Beethoven's second piano concerto (published as No. 1) is here played in a TV-plus-live-audience broadcast. It is a curiously desultory performance, the orchestra sounding like nothing much and not very accurate, the pianist affecting assorted Italianate (!) exaggerations, the whole with little shape or tension. Enormous cadenzas do not help on disc, where all that extra solo stuff costs inches of LP money. The sound, though, is big and broad, very majestic, with the piano rather close in the usual record/broadcast fashion.

Beethoven: The Sonatas for Piano and Violin. Haebler, Szeryng. **Philips 6769 011**, five discs, stereo, \$49.98.

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

It is always a joy to put on a Philips record and hear that splendid, big, open, loud and free sound that, somehow, characterizes the Philips output beyond all others I know of. But there are some problems in this one — reasonable and familiar problems, at the heart of the recording art itself.

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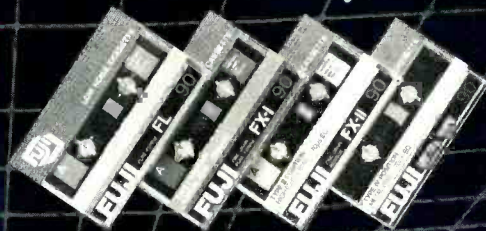
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are, all of several feet away from them. That's the problem.

Most younger musicians have grown up in a dual world, the above and, equally, the new world of the close-up microphone; their facility tends to average out, equal in each direction. But times have changed too fast. Most older performers do not have this new versatility, a sort of bilingual approach to performance. They project, always, and the recording engineer just has to do what he can to cope. Opera singers, of course! But also violinists and pianists.

I was affronted, at first, by the seemingly harsh and roughshod teamwork of these two concert powerhouses. The vi-

olin is close and often scratchy — not distortion, just the true hi-fi sound at a certain distance. And at this later stage in his career, Henryk Szeryng has developed an uneven tremolo somewhat like that which afflicted Szigeti in his later years. It's OK at a distance, but close-up, it shows. As for Ingrid Haebler, at least her piano cannot play out of tune, but she is extraordinarily forceful, especially at close range.

On first hearing, then, these two are apt to overwhelm you. *Too much*, too close, too ardent — they are "projecting" right past your head, to that audience hundreds of feet out beyond. Not pleasant, in the living room.

But look — we are adaptable! By the time the first sonata here was completed, I had adjusted my ears to their teamwork, and so will you. These are big, powerful international-scope artists. And even though we are much too close for comfort, we very quickly begin to get the (Beethoven) message which they so forcefully project. A common phenomenon with big-time recording artists.

Mozart: Concertos No. 20 in D Minor, K. 466, No. 22 in E Flat, K. 482.
Emanuel Ax; Dallas Symphony, Mata.
RCA ARL1 3457, stereo, \$8.98.

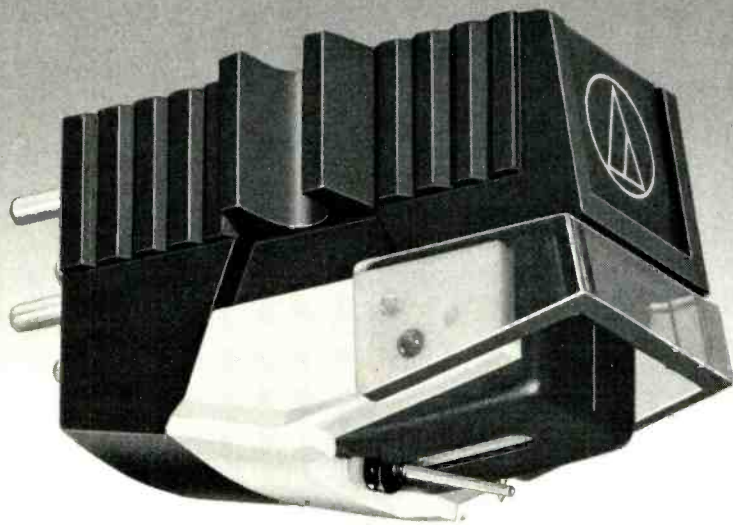
Sound: B Recording: B Surfaces: A-

"This recording was made possible by a grant. . . ." Even RCA accepts them these days to make good recording feasible. This grant could hardly have been for the recording of Mozart's two most familiar concertos, of which around 20 other recordings are already available in the case of K. 466, the D Minor. The grant must, therefore, have been directed at the performers, Emanuel Ax and/or the Dallas Symphony.

Well, I'm all for Emanuel Ax. His piano really "talks" Mozart — that's maybe the best way to put it. Not a note that is careless, every phrase, every idea alive and forthright. You can't miss it. Ax is not of the older European tradition, which treats Mozart as something infinitely precious and a bit delicate; nor does he follow the bang-bang school, which thinks the composer is much too easy, and murders him neatly in flashy playing of the notes. Ax is a relaxed modern who makes no bones about using his own instrument, not Mozart's, for what it can do today — I like the way he does it, and so would the composer, I suspect.

In Mozart, the Dallas Symphony is, alas, pretty routine, with exceptions. On its own, the orchestra develops a plodding metronomic beat — the conductor? Emanuel Ax rescues it each time, and very noticeably. The Dallas strings seem to be mushy and always a trace late. On the other hand, the woodwinds, which mostly play solo (the strings mostly play ensemble), are a lot better, right in there with the piano. Especially in the second of the two concerti, the E Flat, K. 482, which has notable passages for woodwinds alone throughout. These players understand and do these parts of the music quite enthusiastically. Nice! RCA's Mobile Unit No. 1 has got the piano sound to perfection; the orchestra is a bit undifferentiated for my particular taste (no accent mikes?) and without much spatial presence — not important in a concerto where the piano is the leader. Perhaps it was intentional.

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Saint-Saens: Symphony No. 3 "Organ." Philadelphia Orchestra, Ormandy; Michael Murray, organist.
Telarc digital 10051, stereo, \$17.98.

I got this a bit late — it was a sort of sonic time bomb waiting for my ears. Wow! This is the demo disc of all time.

You will remember that Telarc, with the Soundstream digital recording system and JVC's half-speed cutting, was one of the first to record a classical digital disc, an occasion which I wrote up here a couple of years ago. Astonishing how a small outfit, then almost in awe of one-half of the Cleveland Symphony that it had managed to acquire for its first digital recording, now has hit the top — move over RCA! The Philadelphia with its long-time senior conductor Eugene Ormandy, and of course, the Telarc house organist, Michael Murray, subject of another of my reviews.

I cannot imagine how Telarc managed to cop the Philly with its own top conductor — but here he is. Oddly enough, just before playing this disc I had sampled RCA's digital sampler, on which are three cuts of — you guessed it — the Philadelphia Orchestra under Eugene Ormandy. Sorry to have to be blunt, but the impact of the Telarc disc, same orchestra, same conductor, was absolutely hair-raising. It is an astonishingly superior sound, in all sorts of subtle human and audio ways, more than I can really account for — except sheer TLC and know-how on the part of the experienced Telarc team, which has been in digital for a long time now. Also in recording, as such.

The music, with organ — and very low-pitch pedal notes for the hi-fi bass department—has long been "demo" material. Remember the early Columbia LP of this symphony, which was heard in every hi-fi showroom during the first LP days? It is also very fine late-Romantic music, the best of that long-lived composer, old Saint-Saens (d. 1921), by his own admission. And Eugene Ormandy is one of the few conductors left of the period, with an innate understanding of this sort of music. Ditto the Philly, which is notable (under Ormandy for many years) as a vehicle for the old-fashioned classics. Often they are routine, if always expert — but here, in a work that does not get played every day, they obviously get really interested as the music



Ormandy during a practice session with the Philadelphia Orchestra several years ago.

progresses; for them it's an unusual occasion, and they sound that way. Marvelous for the sonics!

Michael Murray really doesn't have much to do, except to stand on those sub-bass pedal tones every so often. And put his all into the full-organ entrance in the last movement.

If you want the ULTIMATE, listen through the last part (the work plays continuously through four movements) and wait for that organ entrance, FORTISSIMO! I was daydreaming at that moment — I almost went through my ceiling. It is especially superb via multi-surround channels, my six including synthetic reverb — since the recording space is a vast stone church modelled on Santa Sophia in Constantinople (Istanbul), and sounds that way. 'Nuff said — it's worth every penny, this record, including tax. Here, audiophile comes to maturity.

E. T. C.

American Brass Quintet Plays Renaissance, Elizabethan and Baroque Music.

Delos DMS 3003, digital, stereo, \$17.98.

Sound: A Recording: A Surfaces: B

There's the Canadian Brass, the American Brass, New York Brass, Em-

pire Brass—I have brass pouring out of my ears.

This is an expensive Soundstream digital release with the expected pair of foldouts with incidental technical info and, I guess, you get your money's worth, what with everything done in the normal Soundstream fashion, including Stan Ricker at JVC-Los Angeles doing the cutting and the pressing out of Europe. I played three or four items of this superb example of the audio art and quit. There is the music to be considered, too, you must remember.

Sure, they play well. So do all the big brass quintets, real pros. That is exactly the trouble. They have now invaded the earlier areas of music, according to current taste, but without the slightest understanding or interest in the original styling and sound of this music, which was absolutely never played on the vastly potent modern (i.e. 19th century) instruments invariably now used for these performances. Nor in the highly proficient professional stylings, full of enormous brassy climaxes and unphrased high-speed fast notes, that thrill so many unknowing listeners.

OK, OK! Everyone to his present taste, and in truth old Leopold Stokowski did bring a generation of plain listeners to the glories of Bach, if it had to be

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In summing up their reaction to the CR-840, Stereo Review said, "Suffice it to say that they [Yamaha] make it possible for a

moderate-price receiver to provide performance that would have been unimaginable only a short time ago."

And the CR-840 is only one example in Yamaha's fine line of receivers. For instance, High Fidelity magazine's comment about the Yamaha CR-640 receiver: "From what we've seen, the Yamaha CR-640 is unique in its price range."

And Audio magazine has remarks on the Yamaha CR-2040 receiver: "Without a doubt, the Yamaha CR-2040 is the most intelligently engineered receiver that the company has yet produced, and that's no small feat, since Yamaha products have, over the last few years, shown a degree of sophistication, human engineering, and audio engineering expertise which has set them apart from run-of-the-mill receivers."

Now that you've listened to what the three leading audio magazines had to say about Yamaha receivers, why not listen for yourself? Your Yamaha Audio Specialty Dealer is listed in the Yellow Pages.



To obtain the complete test report on each of these receivers, write: Yamaha International Corp., Audio Division, P.O. Box 6600, Buena Park, CA 90622.

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done by making him sound like super-Tchaikovsky. But if you, as an intelligent music listener, have gone a bit beyond that sort of stuff, then you will have your doubts here about everything from Scheidt, Gabrieli (both), Speer, Stori, to Weelkes, Simpson, Dowland — the gentle Dowland, composer for lute and voice! — Holborne, Morley, Coperario, and Ferrabosco. These guys cover the territory. Also J.S. Bach, Art of the Fugue. Every single one of these composers is better heard, more truly persuasive, in one or another of his own chosen formats. Not modern brass.

My sweeping indictment, of course, covers a lot of other brass recordings,

not merely this one, which indeed offers excellent playing within its type (and indeed some of the more outdoor festival music comes nearer than usual to an appropriate sound). Most listeners, I am aware, find the well-recorded sound of big brass really thrilling, regardless of the music played. And so this one might well be worth 18 bucks or so — to you. Don't be bashful. Go right ahead!

A curious technical facet to note: Why does each side begin here with a remarkably long lead-in stretch, containing background noise plus some groove echo? Sounds like a misbehaved direct-to-disc opening, but this is digital and, presumably, edited. E. T. C.



Michael Murray: Bach — The Great Organ at Methuen

Telarc TEL-10049, digital, stereo, \$17.98.

Sound: A Recording: A- Surfaces: A

If you like the sound of the huge 19th century organ in superb recording, Michael Murray's Bach is for you, though he is better at his own specialty, French music. This is assuming your system can do justice to the recording, of course. Keep in mind, however, that this is far from a baroque organ performance in case your Bach taste runs to the authentic in organs. Bach would be amazed.

The fabulous Murray operates this famed museum organ (the only one in the world to have its own private hall built around it for acoustic effect) with all its immense power and variety. All the more remarkable is that the bulk of the organ, though not all of it, dates back to 1857-61; made in Germany it was later installed in the old Boston Music Hall until that hall was removed for a bigger one to accommodate the new Boston Symphony back in the 1880s.

With the familiar Soundstream digital

crew on hand, headed by Dr. Tom Stockham, this disc needs little detailed comment — just try it. You'll hear other big Bach pieces—the vast "Passacaglia," "Fugue in C Minor" and the great "G Minor Fantasia and Fugue," plus the "Tocatta in F" and two chorale preludes. I don't think Murray is a very profound Bach player, frankly, and I have heard more thoughtful versions of all these works, but his finger and foot work is indeed superb and so is the sound.

E.T.C.

Haydn: Symphony In G Major No. 100 ("Military"). Mostly Mozart Festival Orchestra, Somary.

Vanguard Audiophile VA 25000, \$12.98.

Sound: A,A Recording: B Surfaces: B+

When this one arrived for review I was forcibly reminded of the Institute for Behavioral Kinesiology and Dr. John Diamond, who presented a paper — rather a demonstration — at last May's AES Convention on digital recording's

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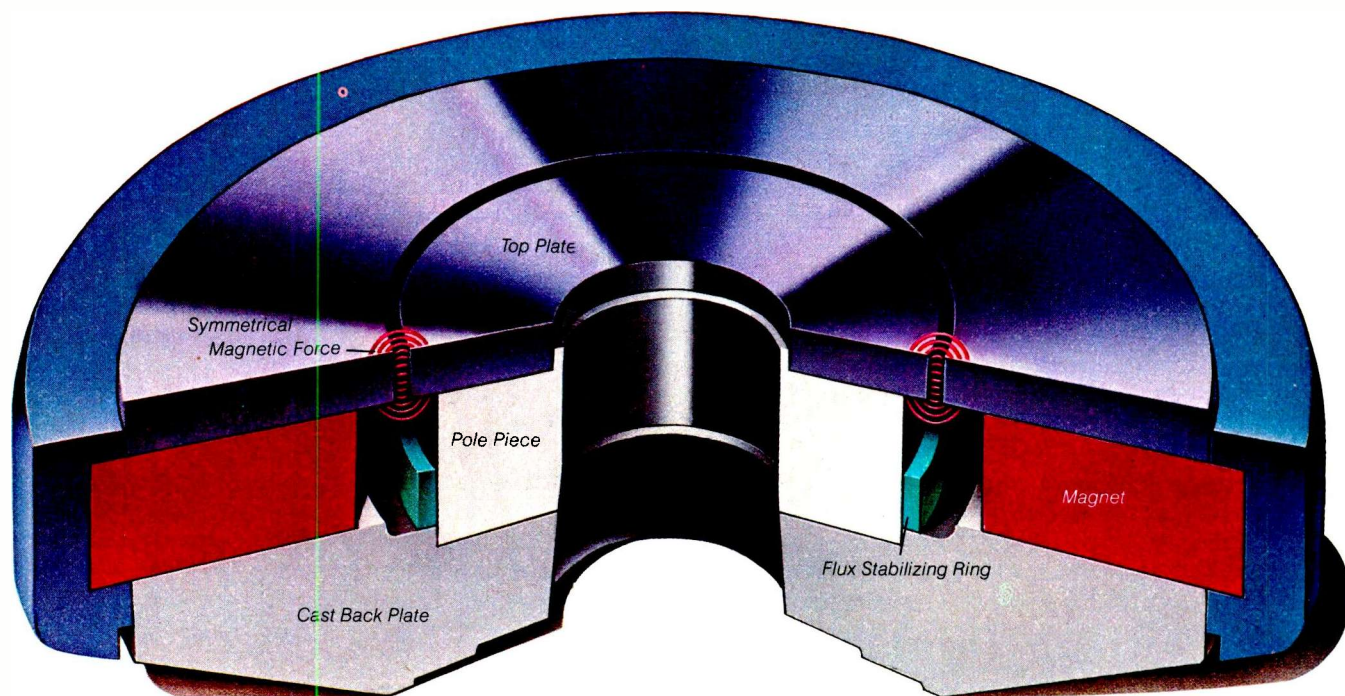
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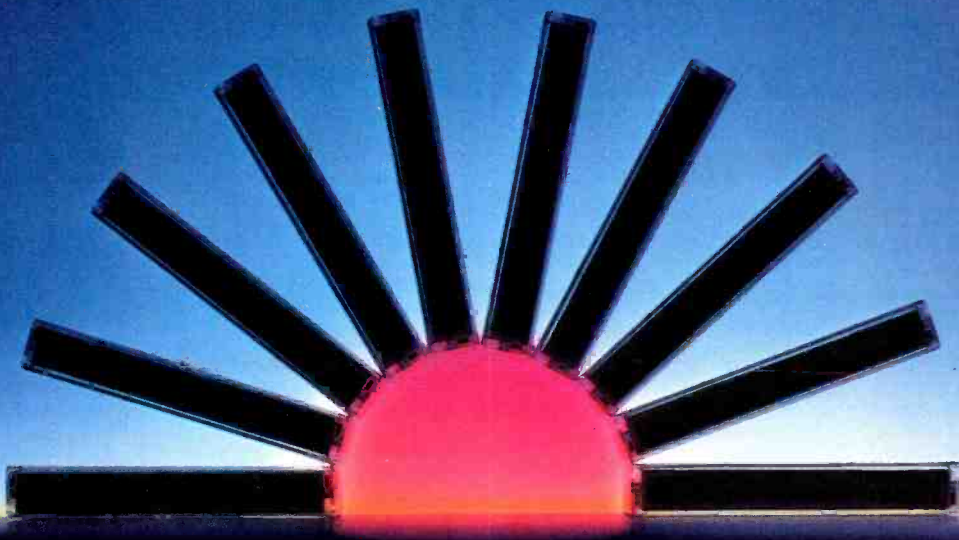
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effects on the human body. Bad, he said (I have this secondhand from an eyewitness on the very spot), and went on to prove it via an analog vs. digital experiment, something involving muscles. Apparently, a top official of the AES (well, if you wish, a president) was adequately strong during an analog playback but when the digital version of the same was played, he was rendered semi-powerless and couldn't make the grade. That is — digital chopping-up of pieces of signal, even at a fabulous kilorate, produces severe stress in the human nerve system. That's a pretty severe accusation, considering how far we are now into digital recording. Are we going to be heavily stressed ALL the time, pretty soon?

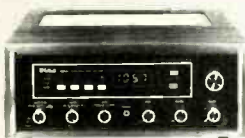
So I tried this one out on a musically knowledgeable friend of mine, explaining the whole thing beforehand to him. The two sides of this disc are identical in all respects except that the tape was made with a Sony 1600 digital recorder on one side and an MCI KH-110-B analog recorder on the other. Same identical performance. My friend took a 20-pound bag of charcoal briquets in hand and went to work on weight lifting while I played a segment of one side, then a segment of the other. Without the slightest hesitation, he announced that the first segment was digital because he had clearly felt added strain in the charcoal lift. It had been the analog recording.

My own experiment quite aside, I have my fingers crossed as to the dire significance of this digital stress theory. Maybe so, but there are other stresses in life, especially in hi-fi listening, not to mention music itself, which exerts very high stresses — pleasurable or otherwise. My own experience of digital recording on analog discs so far has been like that of my friend — it seems, rather, to give us a smoother, more relaxed sound and maybe less stress than the equivalent all-analog. Dr. Diamond's proposition, I'd say, needs to be examined in a much larger context, notably in terms of impact on the musical ear, which takes all sorts of stress in its stride if the message is acceptable.

After all that, I have to observe that this is a purely musical recording, a genuine classical disc as far as music listeners are concerned. The familiar Haydn Symphony is given a pleasant, unhyped performance, easily communicative (both sides!) and a lot less strident and unphrased than some of Johannes Somary's many vocal recordings with chorus, solos and orchestra. Like so many American-trained conductors, Somary is more at home with and sensitive to all-instrumental music than to the European mix of voice and orchestra — though this, of course, would not be his opinion. Just mine. E.T.C.

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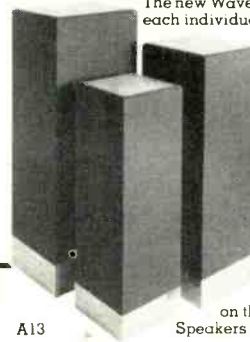
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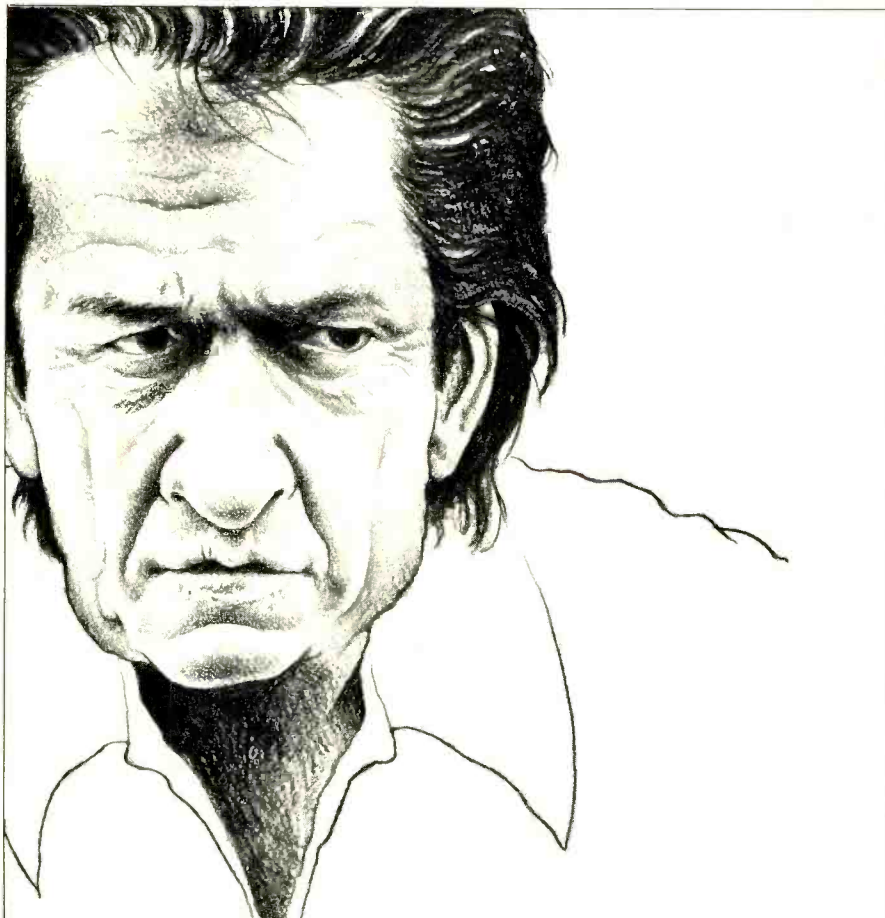
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TOM BINGHAM



Silver: Johnny Cash
Columbia JC 36086, stereo, \$7.98.

Sound: A- Performance: A

Although he began the '70s as country music's biggest superstar, Johnny Cash spent most of the decade floundering about in search of a musical direction. With its back-to-the-roots simplicity, *Silver* suggests Cash has found something that suits him, combining the rockabilly-tinged sparseness of his early Sun Records hits with a wide variety of folk and traditional influences.

The rhythm tracks of this Brian Ahern-produced album are quite considerably fleshier than Cash's original Tennessee Two sound, though Bob Wooton's taut, up-and-down staccato guitar lines (patterned after the late Luther Perkins' picking with the Tennessee Two) dominate much of the album. Ricky Skaggs' fiddle and Bob Johnson's mandocello (an in-

strument virtually unheard of in Nashville) provide much of the folk atmosphere, though trumpets add a most unfolk-like sound on three cuts. Alisa Jones (daughter of Grandpa Jones) is credited with hammered dulcimer (another Nashville rarity) on one cut, and she is no doubt the unidentified dulcimerist on "(Ghost) Riders in the Sky" as well. The playing throughout the album is clean, uncluttered, and refreshingly gimmick-free.

If the arrangements indicate a move toward folk and country basics, the material likewise bucks commercial trends. "The L&N Don't Stop Here Anymore" and the Seldom Scene's "Muddy Waters" are already well-known to folk enthusiasts, while such Cash originals as "Lonesome to the Bone" and "I'm Gonna Sit on the Porch and Pick on My Old Guitar" should likewise find eager acceptance among the folk audience. By contrast, the highly personal "I'll Say It's True" (with George Jones adding a dis-

tinctive harmony touch) is a pure country classic.

Three songs by Cash associates fit very snugly into the country-folk context. "Bull Rider," by son-in-law Rodney Crowell, is a hard-hitting and unequivocal rodeo song enhanced by a bluegrass-tinged bare-bones arrangement. Cowboy Jack Clement (Cash's producer at Sun) contributes "West Canterbury Subdivision Blues," which is reminiscent of Clement's *All I Want to Do in Life* album (probably the finest country album of the '70s). "Lately I Been Leanin' Toward the Blues" represents Billy Joe Shaver at his downtrodden best.

Cash sounded disinterested on many of his records of the '70s, but it's clear that this is one session he really believes in. His singing is natural, relaxed, filled with genuine feeling and involvement. Only on "(Ghost) Riders" is the infamous Johnny Cash wobble the least bit irritating.

In all, this is an album for which everyone deserves praise — Cash, the musicians, the writers, producer Ahern, and the engineers. One can only hope that subsequent Johnny Cash albums continue the "roots" approach of *Silver*.

Tom Bingham

Up & Up: Tom Paxton
Mountain Railroad MR 52792, stereo, \$7.98

Sound: C+ Performance: B-

Produced by old folkie Bob Gibson and recorded live in concert at Charlotte's Web and the venerable Earl of Old Town, *Up & Up* is surprisingly lively for a Tom Paxton album. His songmanship is as sharp as ever. Tender songs like "Has Annie Been in Tonight?" and "Bad Old Days" are as fine as any Paxton has written in ages. "My Favorite Spring" is a wonderful and wise song. "Outlaw," written and sung with Bob Gibson, is fun and funny but it'll never threaten Waylon Jennings. "Let the Sunshine" wants to be a solar energy anthem, but it trips over its own context.

Hearing a lively Tom Paxton record at this late date is a pleasure. The photos of the package, both the head shot on the cover and the snap with Gibson inside, are revealing icons. *Up & Up* is a delightful surprise of an album.

Michael Tearson

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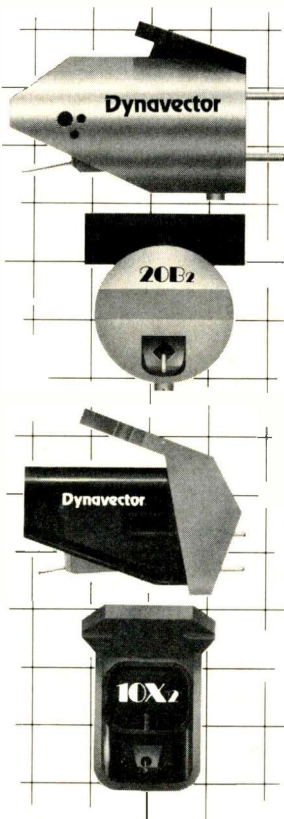
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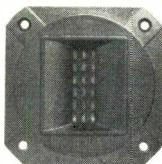
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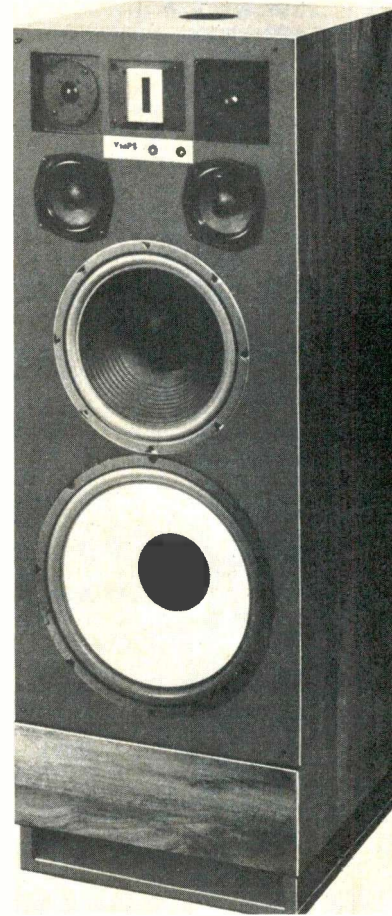
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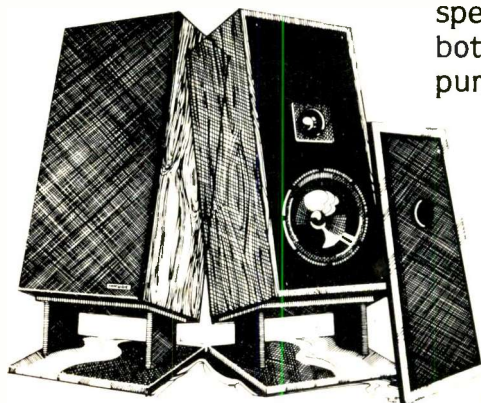
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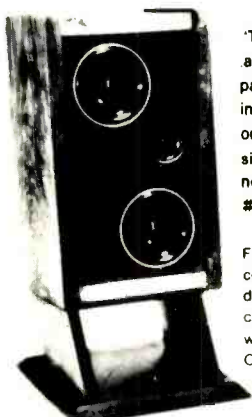
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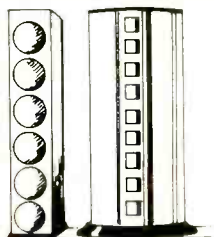


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Most of us are familiar with the founding fathers of high fidelity. Pioneers like Avery Fisher, Rudy Bozak, Frank McIntosh, H.H. Scott, Walter Stanton and others, whose dedication to the quest for high-quality sound reproduction resulted in their manufacturing the first hi-fi audio components for the consumer market.

Needless to say, this fledgling activity in the consumer hi-fi market was complemented by parallel developments in the fields of professional audio and recording. There were pioneers in both these fields as well, but within the relatively circumscribed world of professional audio, few people achieved high visibility and their accomplishments have largely gone unrecognized.

One of the most gifted of those early pioneers in professional audio is Milton T. (Bill) Putnam, currently Chairman of the Board of United Recording Corp. in Hollywood, California. URC encompasses United/Western Studios, Coast Recorders, Teletronix, and its manufacturing arm UREI (United Recording Electronics Industries).

Bill Putnam founded Universal Recorders and built his own studios in Chicago in 1946. It must be remembered that in those days, most recording studios were constructed with only rudimentary knowledge and little application of acoustic treatment. Typical studios of 15,000 to 35,000 cubic feet used draping and perforated acoustic panels, quite often applied directly to boundary surfaces with no provision for air space behind them. Some used rock-wool batts behind perforated Celotex. For the most part, there was inadequate low-frequency absorption with the ratio of indirect-to-direct sound in the low-frequency instruments causing a distinct lack of separation and presence and an unpleasant coloration of the sound. Add to this the fact that the off-axis response of many microphones (even bidirectional or cardioid types) caused time-related and spectral colorations of a signal arriving after the direct sound. Of course, at the low frequencies below 125 Hz, all the directional mikes became virtually omnidirectional, further contributing to the muddiness of the sound.

In marked contrast to this common studio environment, Bill Putnam's studio at Universal Recorders was constructed with the specific goal of increasing in-



strumental separation, and he accomplished this by lowering the overall reverberation time, with particular attention to substantial absorption of the low frequencies. To this end, diaphragmatic panels in convex splays were used, and the thickness of rock-wool batts behind perforated panels was increased by furring out frames for greater depth. Separation screens and rugs were used for absorption of higher frequency reflections.

An early type of absorptive roll-around isolation vocal booth was used, which also was occasionally used for a drum set — a forerunner of today's drum cage. A roll-around band shell was constructed with interior polycylindrical diffusers to prevent focusing, especially of strings. Instrumental positioning and mike placement in the studio were radically altered from the hand-me-down practices of early broadcasting and recording, with a view towards more separation and definition. (Remember, this was before the days of multi-track and overdubbing.) Having achieved better instrumental separation by lowering studio reverb time, Bill did not want a dead or dry overall sound, so he experimented with feeding his output signal to various types of reverberation rooms. (Note that this was

before electronic echo chambers.) Bill was looking for a reverberation room which had a smooth decay, would eliminate periodicity, and have low coloration. Bill experimented with delaying the signal sent to the reverb room to more effectively simulate early sound. He realized the importance of the control room in his studio, and it was acoustically treated. This led to measuring monitor-speaker response in the room and even some attempts at room/speaker equalization.

Because of all the factors in studio design and recording practices Bill had incorporated into his Universal Recorders studios, he developed a distinctive and easily recognized high-quality sound which generated considerable business. In the early and mid-fifties, the advent of exotic high-quality condenser microphones such as the Telefunken U-47, along with greatly improved mono feedback cutterheads such as the Westrex 2B and Gramplan, resulted in rapid advances in the quality of recordings. Bill Putnam adopted these and other aids to high-quality mastering, and in competition with several other studios, the "Hi-Fi Spectacular" record was a new specialty product for what was called the audiophile market! Imagine that, way back in 1955! As tape recorders and tape formulations improved, permitting greatly

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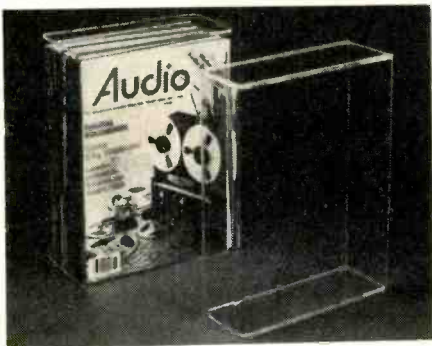
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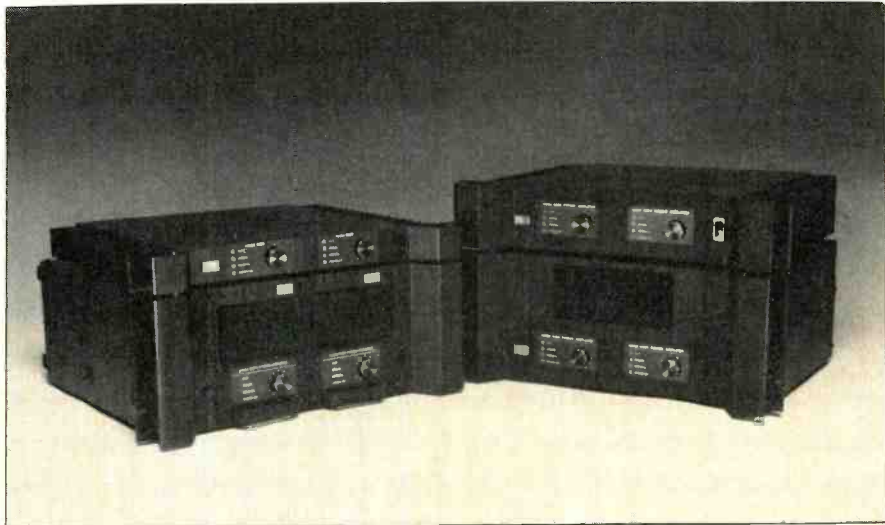
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extended high-frequency response, the battle to produce even more spectacular hi-fi records intensified. In 1955, Bill managed some neat technical one-upmanship by recording at 30 inches per second and mastering the tapes at half speed. Shades of Mobile Fidelity back then!

I had the pleasure of meeting Bill Putnam in 1951 in Chicago, where I was in technical sales and served as music director for Magnecord, one of the pioneer manufacturers of tape recorders. This is where stereophonic sound enters the picture. I had been recording in stereo for some time, and Bill had been experimenting with stereo too. The Magnecord stereo recorder used a staggered head configuration which gave adequate stereo separation but also caused certain problems. Bill recorded some stereo in this format. Ever the innovator, in 1954, in cooperation with the Pentron Corp. of Chicago, he used a recorder with eight channels on standard quarter-inch tape in a staggered head configuration to record an instrumental group. In the eight-channel playback, eight loudspeakers were arrayed in the listening room in the same positions in which the instruments had originally been recorded. Portents of a future as yet unrealized.

In 1958, Bill Putnam moved to Hollywood, California, formed United Recorders and constructed the first purpose-built studio for stereophonic recording. The studio was an amalgam of Bill's original ideas, with important new acoustic design work by Michael Rettinger. In later revisions, the Time Delay Spectrometry (TDS) measurement system of Au-

dio's own Richard Heyser was extensively employed, as were some of Don Davis' pioneering ideas on room equalization. John Eargle contributed new data on monitor speaker response in acoustically treated control rooms. Bill Putnam and Ed Long (a frequent contributor to *Audio*) collaborated on a joint R&D program to upgrade the quality of monitor speakers. The result was a speaker which was designated a "Time Aligned" studio monitor. The technique takes into consideration the time (phase) response of the speaker, and by proprietary design of the crossover network and the placement of the loudspeaker driver elements, the system is said to be "Time Aligned" and free of group time-delay anomalies. In essence, there is near-perfect alignment of the frequency components in a complex transient waveform.

Bill Putnam had formed a company — United Recording Electronics Industries, UREI — to manufacture specialized equipment for the professional recording market, and the new "Time Aligned" studio monitor was to be built at this facility. UREI has been in existence for some years now and is one of the most successful of Bill's companies. I have used a number of UREI's more exotic products, and when I was invited to visit their new plant, I gladly accepted.

The UREI plant is a modern one-story building in Sun Valley, one of those pleasant little towns in the San Fernando Valley, and just a short drive to the United Recording studios in Hollywood. DeWitt "Bud" Morris, President of UREI, is an old friend. He's an easygoing and genial man, but nonetheless runs a tight

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ship at UREI, aided by Brad Plunkett, Chief Engineer, and Ray Combs, V.P. Work flow is very well organized, beginning with in-house testing of incoming parts, then sub-assembly build-up and unit fabrication on various dedicated technology assembly lines. While vendors supply many parts, whenever possible and economically feasible, UREI makes their own. For example, most transformers and certain coils are made

on the premises. UREI is subject to the same inordinately long, delivery times on parts as most companies these days, but they invest heavily in quantity buying and as a consequence are usually in a strong inventory position. Thus, most of the equipment they make is readily available from stock.

In addition to a well-equipped R&D lab, a modern test lab monitors quality-control procedures. Fortunately, subject-

tive testing of many UREI products is given high priority and is carried out in a purpose-built, acoustically treated listening room. Currently UREI is producing a new generation of "Time Aligned" monitor speakers, the 811A (single 15-in. woofer with exponential HF horn), the 813A (same as 811A with addition of another 15-in. woofer in a large enclosure), and 815A (same as 811A with two 15-in. woofers in a still larger enclosure). The HF horns are newly designed for improved frequency response and dispersion characteristics. The "Time Aligned" crossover network has been redesigned for more power transfer to the speaker driver.

UREI is now heavily committed to amplifier production. Their big brute, Model 6500, was introduced at the May, 1980 AES Convention, and I described it in the August, 1980 issue of *Audio*. At the November, 1980 New York AES, the 6500 was joined by the 255 W/channel Model 6400, the 150 W/channel Model 6250, and a slim-line design, only 1 3/4-in. high, the Model 6150 with 76 W/channel. All of these units are 19-in. rack-mountable and are of highly rugged construction.

UREI continues to produce such specialized items for professional recording as limiters and compressors and various types of equalizers and filters. A new electronic crossover is currently in the works, and UREI still makes their invaluable Model 200 XY plotter and recorder with the Model 2000 frequency response module, the Model 2010 level and frequency detector module, and the new Model 21 warble generator for room measurements. When I was visiting the UREI plant, a huge new Neve mixing console with the Necam automated mix-down feature was undergoing tests prior to installation in Bill's studio at United Recorders.

Over the years, Bill Putnam has always tried to stay just a bit ahead of current recording technology. His early experiments with time delay and subsequent manufacture of the Cooper Time Cube is an example, as was his issuing of four-channel matrix evaluation test records. Bill's quadrasonic recordings of the late Stan Kenton and his orchestra are among the very best ever done in this medium. Today Bill Putnam continues in his pursuit of recording excellence, and his UREI company translates many of his ideas into products that find favor in professional audio. **A**

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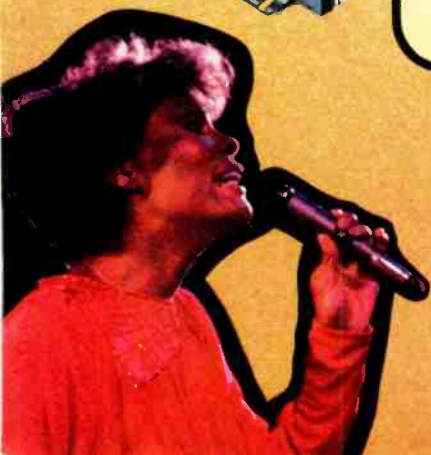
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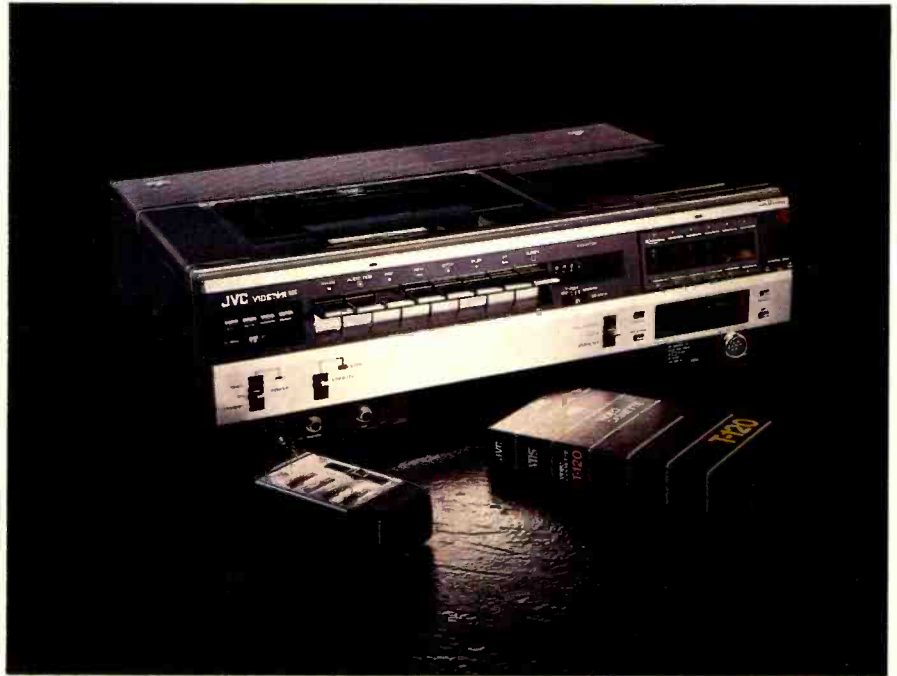


With all the hullabaloo about the videodisc, which system is the best, which system is likely to be chosen as a standard, what the chances are for some degree of inter-system compatibility, etc., it might appear that the videocassette recorder is taking a back seat in the world of video. Nothing could be further from the truth!

The fact is that 1980 was a banner year for videocassette recorder sales. Perhaps even more important is the degree to which the VCR implanted itself in the public's consciousness. The VCR is no longer an exotic object of today's high technology, something that most people approach rather gingerly, tentatively. Good old "word of mouth," contact, and demonstrations of VCRs in department stores and appliance dealerships have removed many of the apprehensions and misconceptions about the VCR. In short, the VCR has gained recognition as a useful time-shift device and as a practical means for greatly enhancing the enjoyment of television. Above all, it must be kept in mind that the primary function of a VCR is to record, whether it be off TV or with a video camera. While there has been some talk about the possibility of home recording of videodiscs, the technical problems are so formidable that its likelihood appears to be far off (if ever) in the future.

Part of the public's acceptance of the VCR is a matter of price. Not that there has been much of an "official" reduction in the prices of VCRs and blank videocassettes, but substantial discounting is widespread and has given considerable impetus to the market. Some portion of the rapid growth in sales of VCRs must be attributed to a "stabilization" in the general design and features of both Beta and VHS recorders. Not long ago, VCRs changed models so frequently, offering new convenience features and technical improvements, that many people put off making purchases for fear of obsolescence. Presently, while there certainly is no stagnation in the design of VCRs, there is a commonality of features in most recorders and it's become more a question of refinements within the design parameters.

A good example of a videocassette recorder, which has what might loosely be termed "all the standard features" and which has been brought to a highly



refined state, is the new JVC HR-6700U. At first glance, this unit appears smaller and more compact than most VHS recorders and is less flashy looking than its competitors. While it may look slightly intimidating to some people because of its multiple control knobs and switches, all the controls are logically grouped, thoughtfully functional and, with minimum experience, not at all difficult to master.

As most videophiles are aware, JVC is the company that invented the VHS videocassette recorder, and the firm quite justifiably wanted to establish a reputation for its VCR in terms of picture resolution. They succeeded admirably in this respect, since most critical viewers gave the JVC VCRs high marks for consistently good picture quality. However, when the "pressures" of the video market forced its licensees to offer VCR units with extended playing time, JVC resisted this change, stating that in their view, picture resolution at the slower playing speed would be considerably degraded.

When JVC finally decided that their VCR must "go with the market," and offer extended playing time, they caused quite a furor by introducing a VCR that could record up to six hours on a T-120 videocassette. As I'm sure you know, in-

creased playing time in a VCR is accomplished by either reducing tape speed or using thinner tape, or a combination of both modifications. While these expedients do permit increased playing time, there is, unquestionably, a concomitant degradation in picture quality. This is what JVC contended all along, so they countered this apparent contradiction of their stand by equipping their extended-play (two six-hour) VCRs with a special four-head recording drum. Two heads are for standard tape speed, and the additional two heads are for the slower extended-play tape speed. The gaps in both pairs of heads are optimally configured for the particular tape speed. By using this special four-head technique, JVC is able to offer six-hour extended-play capability with a picture quality remarkably close to what is obtained at standard tape speed.

This JVC Vidstar HR-6700U is distinguished by its four-head drum, but is loaded with other features and amenities. I have been using one of these units for some months now, and I have found it to be exemplary in all respects, performing flawlessly within its specifications and design parameters. There are many little touches that are appreciated — for example, the cassette compartment is specially damped and rises

smoothly and quietly when the eject button is pressed. These days, most VCR units emphasize their capabilities in the area of programming and special effects. In this respect, the HR-6700U is very versatile indeed. This VCR offers double-speed play (in standard play mode), with minimal picture distortion due to noise generation, and also permits intelligible audio to be heard. In the six-hour extended-play mode, triple-speed playback is afforded with, however, no audio. Slow-motion playback is available in the s-p mode with variable control from 1/4 to 1/30th of normal speed. There is a slow-motion tracking control, which I found can be of considerable help in reducing noise bar distortion. Still picture playback is possible in the s-p mode, but to me, there still is too much noise generation in this mode, which is a common fault with all other VCRs. A hand-held, wired, remote control duplicates all the motional special effects. I personally do not often use the special effects available, but I should sound a warning that if you do much still or slow motion picture viewing, this can seriously reduce the longevity of the tape and even damage it. To this end, the HR-6700U has a clever automatic release mechanism which cancels any still, slow motion or pause mode longer than seven minutes.

One of the big features of the HR-6700U is its versatile micro-computer programming function. The permutations possible with this system are almost frightening, and first-time users of the system are urged to diligently study the excellent instruction manual. Once you run through the procedures a few times, it actually becomes quite easy and there are quite a few aids built into the system to guard against various goofs. You can program this VCR to record six different programs on six different days of the week, or the same TV soap opera every day for six days, or six different programs on the same day, etc. In fact, you can program more shows than the six-hour capability of a T-120 cassette. Another neat little touch is that in the event of a power failure, the commands in the memory in the programmer will not be erased. The HR-6700U has its 12 VHF channels pretuned, and I found them pretty accurate.


However, there is provision for performing your own pretuning of each channel, and I found I could get even more precise results and a better picture by doing it this way.

Unlike many VCR units, I found that the HR-6700U runs smoothly and generates little mechanical noise. Tapes recorded off the air via my local cable service were of exceptionally good quality. The picture was stable, with little evidence of "jitter" distortion noted. Color quality was excellent, bright and clear with good saturation, and whites were clear with no color overcast. From a video viewpoint, the JVC HR-6700U has to be judged as the best of the VCRs with extended play capabilities I have used so far. But the audio is another matter. The sound in s-p mode is barely acceptable, and while in the e-p mode, wow and flutter can make such things as bells and pianos quaver excruciatingly. This is a common problem with all VCRs, and how they can even consider the ultimate possibility of stereo sound telecasting is beyond me.

In connection with testing this JVC HR-6700U, I wanted to check how well it worked with commercially available prerecorded video cassettes, which are almost all feature films. Among other things, I wanted to see how the cassettes held up physically, and in playback after repeated use. Mr. Paul Cirino, the forward-thinking director of my local library, loaned me a number of videocassette films which had been borrowed many times by his library members. Some had been run through VCR units more than 50 times, yet very little degradation of picture quality was apparent. However, the sound was often quite distorted and noise levels were high.

During the course of these tests I came across an unfamiliar aspect of prerecorded videocassettes. I had just enjoyed viewing "Close Encounters of the Third Kind" and "Chapter Two" through the JVC HR-6700U and had inserted the videocassette of "The Blues Brothers" in the unit. Imagine my surprise when the picture was immediately subjected to violent vertical rolling. Thinking that this might be a cassette recorded at the wrong speed, I checked with my friend at the library and found out that all prerecorded videocassettes

of movies are recorded at standard play only. My next move was to try a Panasonic VCR, thinking something might have gone wrong with the JVC unit. Result? Same thing — violent rolling of the picture! Getting more perplexed, I hooked up the JVC Vidstar to a different TV set in another room, inserted the "Blues Brothers" film and — voila . . . the picture played perfectly! Now thoroughly confused, I called a couple of experts I know in video technology, explained to them what happened, and was told with a laugh that I had run afoul of something called "Kopyguard" which is a negative-going, inverted sync pulse encoded on some prerecorded videocassettes and which prevents them from being copied illegally by consumers. When an attempt is made to copy a protected cassette, all you get is this uncontrollable vertical rolling. You can't blame a film company for employing a way of protecting their copyright material. Some companies protect all their videocassettes with Kopyguard — others don't use it at all.

However, the Kopyguard process presents a problem. About 30 percent of the TV sets on the market have what is termed "sloppy vertical sync circuitry." In other words, when these sets encounter the Kopyguard signal via playback from a prerecorded videocassette on a VCR, their vertical sync circuits are not good enough to overcome the vertical rolling induced by the Kopyguard signal. Obviously, if the VCR owner is a perfectly honest person and merely wants to see a movie, not copy it, he is nonetheless penalized if he happens to own one of these TV sets influenced by the Kopyguard signal. For example, there was nothing wrong with my JVC Vidstar unit — it was the particular TV set I was using that was the source of my trouble. As you might expect, such a situation demands some sort of remedy. There is, in the form of a black box device called a Kopyguard Stabilizer, which enables TV sets with "sloppy sync circuits" to produce pictures without vertical rolling. This device also enables one to make copies of prerecorded videocassettes, but the device is sold with a warning that it is illegal to use it for copying. The Kopyguard stabilizer costs about \$95.00. You live and learn. 

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Firm (Reader Service No.)	Page	Firm (Reader Service No.)	Page
Acoustic Research	48 & 49	Lux	37, 89
ADS	13	MXR (13)	54
Allison	8	McIntosh (14)	69
Audible Images (1)	68	Maxell (15)	15
Audio Critic	66	Micro-Acoustics (16)	4
Audio-Technica (2)	62	Nakamichi	59
BSR (3)	20	Pickering (17)	3
Bang & Olufsen (4)	43	Pioneer (18)	Cov. II & I
Cambridge Physics (5)	56	Radio Shack	63
Consumers Company (6)	88	SME (19)	14
Crown (7)	17	Sansui (20)	7
dbx (8)	11	Sennheiser	4
Discwasher	2, Cov. IV	Shure (50)	90
Electro-Voice	18	Sonus (21)	16
Empire (9)	19	Sony (22)	41
Franklin Mint	30-33	Soundcraftsmen (23)	12
Fuji	61	Speakerlab	69
IMF Electronics (30)	66	TDK (24)	39
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THAT'S THE WAY IT WAS

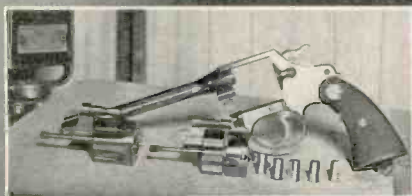
WALTER I. SEIGAL

Editor's Note: "A veritable treasure trove," we thought when we first heard of a collection of negatives recording historic events and people of broadcasting from as early as the 1920s. Under the care of Martin Silver-

stein, Director of Photo Operations, CBS Entertainment Division, the photo files contain rare and highly interesting views of broadcasting personalities and events and will form the basis for a new monthly column, "That's The Way It Was," by

Walter "Izzy" Seigal, who worked in the photo department for more than four decades and was director at his retirement. Our deep appreciation goes to Mr. Silverstein for making the files available.

— E.P.



Fool-Proof Sound-Effect Pistol Guns used to provide the sound of shots for radio shows such as "Gang Busters"

were a strong concern of police department and broadcast officials alike, who feared that real guns might fall into the hands of criminals. A special revolver was therefore developed that had a plugged muzzle, slotted barrel for the release of gasses, and a cylinder which only accepted blank cartridges. Max Uhlig of the CBS Sound Effect Dept. fires the revolver for a demonstration in 1938 for the N.Y. Police Dept.

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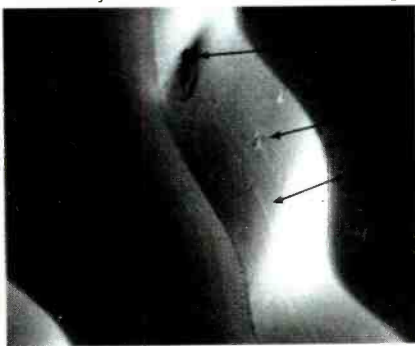
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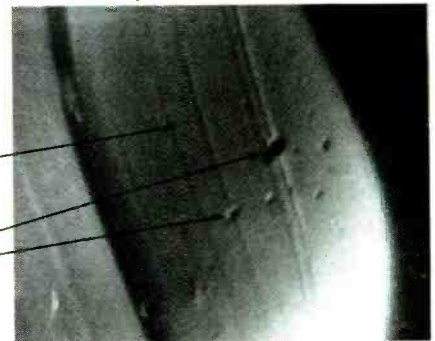
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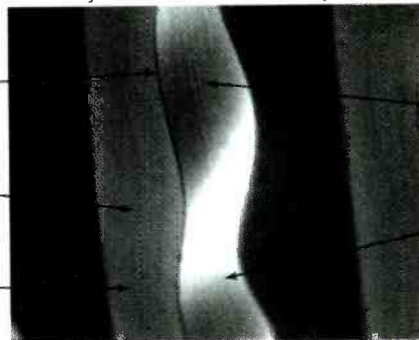
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