

# UNFORTUNATELY FOR THEM THIS ONE SELLS FOR UNDER \$300\*

M PIONEER STERED RECEIVER MODEL SX-E

68

SPEAKERS

povo

BASS

# MOST \$600 RECEIVERS SOUND AS GOOD AS THIS ONE.

OPIONEER STERED RECEIVER MODEL SX-BU

88

FM

POWER

SPEAKERS

90 <u>92 94</u>

BASS

The average \$600 receiver sounds as good as the new Pioneer SX-650 until you start listening to prices.

If \$600 is your kind of price, an SX-650 should qualify as your kind of receiver. Not only will it give you the kind of features and sound quality you'd expect for that kind of money; it'll also leave you with roughly half your receiver budget unexpectedly unspent.

But suppose your idea of a receiver price is somewhere under \$300. The SX-650 is going to sound better to you than anything you thought you could afford. Because it has more power, a wider frequency range, less distortion, and far greater versatility than most other receivers in that category.

All this might sound a little extravagant; but an authentic breakthrough, an achievement like the SX-650, doesn't happen often. We've learned that when our promises seem to sound especially rich, the best thing to do is simply review the facts.

It's a fact that the SX-650 provides a continuous power output of 35 watts per channel, min. RMS into 8 ohms, from 20 to 20,000 Hz, with no more than 0.3% total harmonic distortion. It also delivers each instrument and voice at its intended level, balanced within  $\pm$  0.3% of the RIAA curve.

The facts of its stereo separation, selectivity and sensitivity, however, must be experienced: numbers are impressive, but sometimes only hearing is believing.

You'll also be impressed by what you don't hear from the SX-650. You won't hear an assortment of background noises, or the thousand miscellaneous acoustic devils that live in the limbo between FM stations on lesser receivers.

On your next visit to a high fidelity dealer, listen to a Pioneer SX-650 with any reasonably accurate speakers. You'll find either its price or its performance amazing. Depending on which you hear first.



U.S. Pioneer Electronics Corp., 75 Oxford Drive, Moonachie, New Jersey 07074. For informational purposes only, the SX-650 is priced under \$300. The actual resale price will be set by the individual Pioneer dealer at his option.



# LenTek From England With Love.



The Lentek Speaker System-elegant in appearance, impeccable in sound. The Lentek Monitor is a four-way system with a nine-foot transmission-line for extremely tight and flat bass response.

Lentek-so well reviewed by the cryptic journal Gramaphone that we were accused of bribery!-from England, with love.



At American Audioport Dealers. 1407 N. PROVIDENCE RD. COLUMBIA, MO 65201



Feature	36	Pink Noise Filter/ Dr. Robert Mauro		
Articles	40	Phono Cartridge Noise/ John Maxwell		
Anticles	44	Movie Sound Reproduction/ John K. Hilliard		
Equipment Profiles	62	Radio Shack STA-2000 Stereo Receiver/ Leonard Feldman		
riomes	66	Sony TAE-5450 Preamplifier/ George W. Tillett		
	72	Marantz 510M Basic Amplifier/ George D. Pontis		
Record	78	The Column/ Michael Tearson & Jon Tiven		
Reviews	91	Classical/ Edward Tatnall Canby		
Reviews	94	Theater Music/ Donald M. Spoto		
	96	Jazz & Blues		
	4	Audioclinic/ Joseph Giovanelli		
	8	Audio ETC/ Edward Tatnall Canby		
Audio	16	Tape Guide/ Herman Burstein		
In General	20	Behind The Scenes/ Bert Whyte		
in General	26	Dear Editor		
	32	What's New In Audio		
	98	Classified Advertising		
	102	Advertising Index		
		0		

Editor Eugene Pitts III Associate Editors

Edward Tatnall Canby Bert Whyte Assistant Editor Eugene J. Garvin Jr. Marketing Director Sanford L. Cahn Design Frank Moore Circulation Manager Jean Davis Advertising Production Gloria Klaiman

#### **Senior Editors**

Richard C. Heyser Bascom H. King B.V. Pisha

#### **Contributing Editors:**

Tom Bingham, Herman Burstein, Leonard Feldman, Joseph Giovanelli, C.G. McProud, Dan Morgenstern, Howard A. Roberson, Donald M. Spoto, Michael Tearson, George W. Tillet, Ion Tiven.

# Publisher Jay L. Butler

AmericanRadioHistory Com

About the cover: Audiochicken has just hatched a family of the finest stereo/ quadraphonic phono cartridges available. She seems to say, "Break out of your shell and hear all the sounds encased within the grooves of your records."

AUDIO (title registered U.S. Pat. Off.) is published monthly by North American Publishing Co., Irvin J Borowsky, President; Frank Nemeyer, and Jay L. Butler, Vice Presidents; R. Kenneth Baxter, Vice President/Production; Vic Brody, Promotion Director; Mary Claffey, Circulation Director. RATES-United States only: 1 year for \$8.00; 2 years for \$14.00; 3 years for \$20.00; outside the U.S.: 1 year for \$10.00; 2 years for \$18.00; and 3 years for \$26.00. for \$10.00; 2 years for \$18.00; and 3 years for \$26.00. Printed in U.S.A. at Columbus, Ohio. All rights reserved. Entire contents copyrighted 1977 by North American Publishing Co. Second class postage paid at Philadelphia, Pa. and additional mailing office. Back issues, \$2.00 each. World Library Congress Number: ISSN 0004-752X. Dewey Decimal Number: 621.381 or 778.5.

REGIONAL SALES OFFICES: Jay L. Butler, Publisher and Sanford L. Cahn, Marketing Director, 545 Madi-son Ave., New York, N.Y. 10022, telephone (212) 371-4100.

Jay Martin, 2525 West 8th St., Los Angeles, California

90057, telephone (213) 385-2917. **REPRESENTATIVES: Europe**, V. B. Sanders, Interna-tional Publishers Advertising Service, Raadhuisstraat 24, P.O. Box 25, Graft-de-Ryp, Holland; telephone, 02997-1303; telegrams, Euradteam-Amsterdam



AUDIO Editorial and Publishing Offices, 401 No. Broad St., Philadelphia, Pa. 19108 Postmaster: Send Form 3579 to the above address.





# WKLS, Atlanta, broadcasts 100% disc-to-air. That's why it uses Stanton's 681 series... <u>exclusively</u>.



Top notch broadcasters who capture a large share of the listening audience, are critically aware of the necessity to achieve a superior quality of sound. Station WKLS is just such a station.

As Bob Helbush, chief engineer, states: "We broadcast 100% disc-to-air except for some commercials. So, for maximum quality sound and phase stability. we use the Stanton 681 SE for on-the-air use. We consider it the ideal answer for that application. And our program director uses Stanton's 681 Triple-E for auditioning new releases before we air them".

And Don Waterman, General Manager, added: "Today, every station in the SJR Communications group . . . all eight of them, all in Major Markets . . . use Stanton 681 cartridges on every turntable".

There are good reasons for this vast acceptance. Stanton's 681 Calibration Series cartridges offer improved trackBob Helbush, Chief Engineer, making a quality control check using a 681 cartridge.

ing at *all* frequencies. They achieve perfectly flat frequency response to beyond 20 Kc. And the top-of-the-line, superb 681 Triple-E has an ultra miniaturized stylus assembly with substantially less mass than previously, yet it possesses even greater durability than had been thought possible to achieve.

Each 681 Series cartridge is guaranteed to meet its specifications within exacting limits and each one boasts the most meaningful warranty. An individually calibrated test result is packed with each unit.

Whether your usage involves recording, broadcasting or home entertainment, your choice should be the choice of the professionals...the STANTON 681. Write today for further information to Stanton Magnetics, Terminal Drive, Plainview, N.Y. 11803.





Check No. 40 on Reader Service Card

# Empire's Blueprint For Better Listening

No matter what system you own, a new Empire phono cartridge is certain to improve its performance.

The advantages of Empire are threefold.

Cne, your records will last cnger. Unlike other magnetic cartridges, Empire's moving ron design allows our diamond stylus to float free of its magnets and coils. This imposes much less weight on the record surface and insures longer record life.

Two, you get better separation. The small, hollow iron armature we use a lows for a tighter fit in its positioning among the poles. So, even the most minute movement is accurately reprocuced to give you the space and depth of the original recording.

4

Three, Empire uses 4 pcles, 4 coils, and 3 magnets (more than any other cartridge) for better balance and hum rejection.

The end resu t is great listening. Audition one for yourself or write for our free brochure, "How To Get The Most Our Of Your Records." After you compare our performance specifications we think you II agree that, for the money, you can't do better than Empire.



Autochis

Joseph Giovanelli

# To Leave On, or Not to Leave On

Q. A few of my friends, who work at a local FM station, tell me how I am causing the downfall of my stereo equipment by turning it off when not listening to it. At the radio station all equipment, except motors, is constantly on. Keeping the equipment on, they say, will prevent power surges and prolong the life of my equipment. What do you suggest for a home system?—Larry M. Bauer, Dayton, Ohio.

A. I don't think it makes much difference in terms of a home entertainment system whether the equipment is left turned on, or whether it is turned on when it is to be used. With tube equipment, especially when it was to be used frequently, it was a good idea to leave it turned on, but with solid-state equipment, I don't think this is necessary.

It is true there are power surges which occur when a piece of equipment is turned on, and this takes place because the filter capacitors must charge up and the charging current is initially very high. However, if the capacitors and diodes are of good quality, these surges will be easily be handled and will not degrade the life expectancy of the equipment.

As you can see, if the broadcast equipment was repeatedly turned off and on the power surges might be a factor in the deterioration of the equipment, not to mention the physical wear and tear on the switches themselves. But under average home equipment conditions, these factors are not problems.

# Power Failure and Equipment Protection

Q. Suppose a fuse blows or a circuit breaker trips shutting off power to the stage during a rock concert. Does it matter if all the equipment is left turned on until power is restored? Or is it better to immediately turn off all equipment, wait until power is restored, and then turn on the equipment, one unit at a time?—Thomas Young, Thomaston, Conn. A. I prefer to turn off all equipment when a fuse or circuit breaker shuts down the equipment as this avoids unnecessary line voltage transients. Although nothing will happen *most* of the time, there is always that one chance that a high-voltage spike can damage some components. So play it safe and turn all the equipment off. Then turn it on, one component at a time, once the power has been restored.

# 50 and 60 Hz Strobe References

Q. As is commonly known, all a.c. power line circuits are designated as 60 Hertz. I have noticed, however, that some turntables include stroboscopic reference markings for 50 Hertz. What exactly is 60 Hertz in a.c. power line circuits? What is the purpose of the 50-Hz reference markings?—Chris H. Jones, Boone, N.C.

A. In order to transmit electric power efficiently over great distances, alternating current is used. In this country, the number of complete alternations per second has been standardized at 60 per second, or 60 Hz. Having an accurate standard power line frequency is important because some devices, such as turntable motors and electric clocks, are sensitive to power line alternation frequency. If that frequency changes, the speed of rotation changes. (With d.c. servo motors and the like, some turntables are not frequency dependent.)

Another reason why a standard power line transmission frequency is important is that this enables us to use that frequency to determine the correctness of turntable speed. Because of the constantly varying voltage on a power line, an electric lamp, especially fluorescent or neon, will flicker at the speed of the power line alternations. This fact is taken advantage of by the strobe markings found on many turntables. The spacing between any two successive dots is such that, when the table is rotating at the correct speed, the speed at which dots pass by an observer exactly corresponds to the flicker rate of the power line. Because of this fact, the dots appear to be standing still when

# " 'Super' FM tuners are usually priced from \$1000 up. Sansui's new model TU-9900 tuner, at (under) \$450", matches (their) performance..., at least in the most important respects".

# Julian Hirsch, Hirsch/Houck Laboratories

These are excerpts from the Julian Hirsch test report on Sansui's new Model TU-9900 as it appeared in Popular Electronics, January 1977.

"The Model TU-9900 ... is an ideal mate for the highest quality amplifiers and speaker systems ..... [It is] esthetically impressive ..... The S/N at 65 dBf ( $000\mu$ V) was 74 dB in mono and 71.5 dB in stereo while distortion measured an incredible 0.021% and C.052% respectively. (These figures ... leave no doubt that the tuner has stretched the capabilities of cur test equipment to its limits) ..... Image rejection was unmeasurable, exceeding the 100 dB range of cur test equipment ..... Stereo channel separation was almost as unbelievable as the distortion figures, exceeding 60 dB from 60 – 600 Hz ..... The alternate channel selectivity [narrow mode] was unmeasurable (greater than 100 dB) and the adjacent-channel selectivity of 17 dB was one of the best we have ever measured on a tuner ...

"Clearly, the Sansui Model TU-9900 tuner is a very superior performer ... [and] any untoward sounds heard via this tuner originate from the FM station ..... In sum, this separate tuner excels in virtually every area of FM performance......It's a top value unit."

Visit your nearest Sansui franchised dealer today for a demonstration of the TU-9900 or any of the other models in Sansui's impressive line of amplifiers and matched tuners, the AU/TU series.

# A whole new world of beautiful music.





. . . SME: a worthy companion for the world's great instrument-makers. The best reproduction of music, either by electronic or accoustic means, requires a combination of sensitivity and strength: sensitivity to the delicate vibrations which make up the sound, but strength enough to ensure that only the *right* vibrations are heard.

6

The SME arm achieves this delicate balance by precision engineering, setting a standard that others have tried to equal. Now with improved lift, the SME arm remains the essential component for a complete sound system.

For complete specifications and independent reports, write to :

Dept 1439, SME Limited Steyning, Sussex, England. BN4 3GY

Exclusive distributors for the U.S: Shure Brothers Incorporated 222 Hartrey Avenue Evanston, Illinois 60204 and in Canada: A. C. Simmonds and Sons Ltd 975 Dillingham Road Pickering, Ontario, L1W 3B2



The best pick-up arm in the world Check No. 138 on Reader Service Card the table is running at its correct speed, and appear to move when the speed is not quite accurate. The apparent motion is because the dot travels either a little more or a little less than the actual distance between two dots during the period between flashes of the lamp.

While it is universally recognized that alternating current offers the most efficient means of power transmission, the frequency of alternations used has not been agreed upon from one nation to the next. The United States and Canada have standardized their power line transmission rate at 60 Hz; much of the rest of the world has standardized on a power transmission frequency of 50 Hz.

Therefore, for a strobe card to be useful at 50 Hz, the spacing between successive dots must be greater than it is for 60 Hz, to correspond with the slower flicker rate of the 50 Hz power standards. You can see the differences in dot spacing when examining a strobe card having both sets of speed references.

If a turntable is to be sold worldwide, it is convenient for it to have both 50 and 60 Hz speed checks, so that no changes need be made when supplying the components for one country as opposed to what is required in another.

# **Additional Phono Cable**

Q: I am rearranging my components and I find that I need three more feet to connect my auto turntable to the preamp. Can standard cables which come with the table. or, to the existing low-capacitance cables w1hich come with the table. (These are presumably for CD-4 applications.) The standard cable to which I am referring are the usual Switchcraft type as used between tape deck and preamp, or from tuner to preamp, etc.

Is it necessary to acquire the exact same capacitance cables for attachment as are now on the auto turntable?—J. Paul Browne, Garden Grove, Cal.

A. If you are not using a CD-4 demodulator and cartridge, chances are there will be no degradation of performance with the extra cable. However, because the extra length does raise the possibility of hum pick-up, be careful as to how you route this extra cable. Keep it away from a.c. lines and well clear of speaker lines. In the latter instance, the problem is not one of hum but rather possible oscillation at high volume levels, especially where the treble is advanced. If you are using a CD-4 system, then you probably will get into trouble by adding standard cables. In fact, even the addition of more low-capacitance cable might reduce the carrier signal to a level where the demodulator would not work properly.

## High and Low Impedance Microphones

Q. I would like an explanation of the differences between low- and high-impedance mikes. What are their physical differences, and why the use of one as opposed to the use of the other?—Thomas Young, Thomaston, Conn.

A. The impedance in low-impedance mikes ranges from 50 Ohms up to about 600 Ohms, while the highimpedance mikes go from about 25,000 Ohms up to several megOhms.

High-impedance mikes suffer from degraded performance with their high frequencies drastically rolled off by any reasonable length of microphone cable, a 20-foot cable might have response down 6 dB at 10 kHz. A low-impedance mike may be used with hundreds of feet of cable with essentially no loss below 20 kHz.

The low-impedance mikes overcome this problem, and the higher quality public address systems were always designed to accommodate low-impedance microphones. As all solid-state input circuits tend to be of low impedance, these mikes are the best choice, even for the less expensive equipment.

While the outward physical appearances between the high- and lowimpedance mikes are similar, a complete description of the various types would be too lengthy to go into in this column. Generally, however, ceramic and crystal mikes are of the high-impedance type, while the dynamic, ribbon, and electrostatic ones are usually of the low-impedance design.

At the present, the dynamic mike is the most popular. These employ a small diaphragm and a voice coil, similar to a dynamic loudspeaker, moving in an intense permanent magnetic field. Sound waves striking the surface of the diaphragm cause the coil to be moved in the magnetic field, thus generating a voltage proportional to the sound pressure at the surface of the diaphragm.

If you have a problem or question on audio, write to Mr. Joseph Giovanelli, at AUDIO, 401 North Broad Street, Philadelphia, Pa. 19108. All letters are answered. Please enclose a stamped, self-addressed envelope.



As the photograph above so eloquently expresses, these are not plain-vanilla loudspeakers.

They're the new B-I-C VENTURI Formula 5 and Formula 7 Monitor Series speakers.

And they embody the most innovative thinking, and the most advanced technology, in speakers today.

Beyond delivering exceptional clarity, bass response and dynamic range, these speakers perform a series of monitor functions that improve the rest of your system.

**Amplifier 'Clipping**' Until now, there's been no way for the user to accurately identify amplifier distortion (clipping), or the precise point at which it takes place.

But these new speakers come with a test record that lets you pinpoint the output level where your amplifier begins to clip the peaks of the waveform. (Its maximum 'clean' output.)

The CLIPPING INDICATOR (center-right, above) is then set to that threshold. Once matched to your particular amplifier, the indicator lights when clipping occurs.

And by observing that signal to lower amplifier volume, you eliminate a major source of distortion.

**Speaker Overload.** Where an amplifier has the power to overload speakers *before* clipping, this same circuit can be set to serve as an early warning device.

However, if overload persists, both the Formula 5 and 7 automatically shut off the power to the stressed speaker component.

Individual OVERLOAD INDICATORS will identify the component affected, and help you trace the problem to its source.

**Tonal Balance.** Scientists have demonstrated that the ear is not a perfect musical instrument. As sound levels are lowered, the ear rapidly loses bass and treble tones.

So B·I·C developed the DYNAMIC TONAL BAL-ANCE COMPENSATION circuit (patent pending). It automatically adjusts speaker frequency response, as volume changes, to compensate for what the ear can't normally hear.

Musical balance is thus preserved.

**Sound Pressure.** The Formula 7 can even let you see what you're hearing.

That bank of indicators (left-center) displays SOUND PRESSURE LEVEL. As speaker output increases, they light in sequence.

The chart interprets the readings, and relates them to the size of room and the listening distance.

The indicators can also be used to correct for channel imbalance in phono cartridges, amplifiers, tuners, tape decks.

**System Monitors.** What we have here, as you may have sensed, is a long-overdue role reversal.

Until now, a speaker had to take whatever the system dished out, and make the best of it. Now we have speakers with the brains to control the system.

The Formula 5 and Formula 7 elevate the loudspeaker to a new and larger role in the stereo system. That of a system monitor, with the ability to make your entire system perform better.



B-I-C VENTURI Westbury, N.Y. 11590. B-I-C, B-I-C VENTURI and BICONEX are trademarks of British Industries Co. Division of Avnet, Inc. In Canada, C.W. Pointon, Toronto.

BIC VENTURI SPEAKER SYSTEMS TOMORROW'S TECHNOLOGY TODAY Check No. 7 on Reader Service Card

American Radio History Com

# Edward Tatnall Canby

Two spaces in one? That weird binaural/stereo double space from JVC I described last month in only the beginning of what's new. Did you read Len Feldman, in Audio last December, on two of the new home synthesizers, delay/reverb makers that create synthetic halls within our living rooms? If anyone could get *m* to understand the inner technicalities of these devices, it had to be Len, but what interests me comes beyond where he left off, and where I have to start, being

an audio musician. What do these gadgets do to the sound of recorded music, already well endowed with space? Some astonishing things. See Feldman's last paragraph.

8

The new devices take your present audio signal, from tape, disc or broadcast and out of it fashion a new and variable surround, produced artificially -a concert hall, a church, gymnasium, Olympic swimming pool or even a sedate front parlor, all to choice and taste via pushbuttons. And not one bit of it is in the recording itself. Amazing how we can trick the

ears into hearing what isn't there but isn't that the art of sound reproduction?

These illusions, of course, can't be had out of your stereo pair. They need surround sound—how else are you going to get all four walls and yourself inside? And so the same old story in a new twist; we tailor the sound of music so as to make one space out of another, your living room. Only now this is Space No. 3. The recording already has its own built-in space, doesn't it? We've had room sound, liveness, in our records ever since c. 1929 and for just this reason, to give the music a place to exist in.

Liveness, I remind you, was one of the great discoveries in the history of recording though it was surely an accidental one at the beginning. Electrical recording had suddenly made it possible to take down sound in large places, at a distance, at low levels; whereas the earlier acoustic-powered horn required ultra-close-up performance—or else. Liveness as such had never been recorded before. But by the mid-thirties all had changed. Perceptive ears had heard, and recording engineers came to understand, that this very smearing and blurring, if recorded, could in fact bring a suggestion of *place*, of surroundings, to a recording and so into the home. Thus, we left behind that drastic acoustic vacuum in which earlier performers had to exist, like it or not. Play an old Caruso and you will hear it. A voice disembodied, without space or distance. Like trying to talk

naturally in an anechoic chamber ever try it? Under the circumstances Caruso et al. did remarkably well.

#### Sonic Symbiosis

Well, you know the rest. Much later we began to add extra reverb from outside sources, first naturally via echo chambers (that famous indoor fire stairway at CBS), then via the various synthetic analogs, from wire springs and metal plates to digital delay lines. But mind you, this was all a part of record production; every last bit was built into the final product, which was delivered to you com-

plete and ready to play. And in truth, aside from volume levels and tone control plus maybe a bit of contouring, we have not really done much to alter that package in our homes, if we discount the urge to push speakers around, to add drapes, throw out rugs and, of course, to buy new equipment, all to help the recorded message do its thing. No longer! Now we can use that message as so much raw material for an entirely new space, right on top of the built-in recorded space and the space of your living room. Triple exposure, 1'd call it.



Now, oddly, you will find that the earliest electric recordings, much like the old acoustics, are remarkably dead in sound, if louder and wider in tonal range. Apparently the engineers took it for granted that we still wanted direct sound, free from any smearing and blurring by room reflections. A reasonable thought and it still held sway a decade later in the New York NBC Studio 8-H, where Toscanini put forth symphonic music in an all but anechoic surround, including silk programs that wouldn't rustle. Dead was good, or so they thought.

#### AmericanRadioHistory Com

Is there going to be any reason, you may ask, why we should continue to build space into our recordingswhich is the whole art? A point for engineers to ponder! Of course you must have some concert space, in classical, at least, because the musicians require it; but in theory it isn't necessary, or won't be once we all have inexpensive space makers in our lovely living rooms. We may! As they say, it is within the realm of probability.

And so the art of recording becomes semi-redundant? We may soon be receiving the product like a sonic kit, partly finished. We add the rest. Either that, or we have the sonic redundancy of all time, this triple spacing thing.

Well, no. Those two words sum up my recent long and fruitful session with the thing itself, the one that caught up with me—Audio Pulse. No, it is not redundant at all, unless pushed to extremes. I wouldn't have believed.

No, not in my own home was my reaction. For it instantly struck me when I first heard the enthusiasm for Audio Pulse (a catchy name) that as a record reviewer I had no business adding new synthetic spaces to those already recorded and intended. Neat point of ethics. I still want to know what the recording engineer had in mind, within the permissible vagaries of my own equipment and listening room. So I am not using Audio Pulse or any other synthesizer at my home. And this even though I do use guadraphonic enhancements, as well as QS and SQ decoders, to doctor up my stereo, because all of these make use of spatial clues already in the recording. See what I mean?

So one engineer friend raved about Audio Pulse for the entire AES convention last fall; he had bought it as part of a modest \$15,000 equipment update. I was invited, but he lives thousands of miles away. When I later ran into still another young enthusiast (this concept definitely appeals to hifi youth), I moved fast; he was only a mile or two from my weekly commuter route out of New York. So in no time you would have found me walking into a strange place and a brandnew listening room, to hear what I could hear.

### **Aural Reorientation**

Now when I first enter such a room, with reproduced music playing, I hear just one thing, the room itself. Strange, indefinable, confusing, different. I am at sea. I have lost my sonic bearings. I cannot judge anything in the way of sound until this initial confusion is sorted out, and that takes time -listening time. It should, of course, for anybody who listens to more than audio machinery. Half an hour, maybe, preferably a lot more. Then, in all due time, the room just fades away and you can hear what is in it.

I climbed a flight of suburban stairs and landed in the center of a sidewise oblong space full of equipment and roaring with music. Jargon! Held my ears. I couldn't even see which way

was front-I was helpless until I got that straight—front speakers to my left (as I entered the room), back to my right, and a third pair right in the middle. Audio Pulse goes beyond four when you have the stuff to do it. Loud music, very clean, from Phase Linears and such, and from decoders, demodulators, enhancers, and on top of it all-Audio Pulse. Phew-it was a sonic mess, at least as I heard it. Ta-tata-ta! Was that a built-in, intended echo, in the music, or had Audio Pulse done it? I didn't ask. I would not

Soundcraftsmen , the Great Equalizer... Guaranteed to improve any fine stereo system! WE CARE about HOW an equalizer does its job BEST! That's why we provide our customers with our exclusive .... **10-POINT "TOTAL-SYSTEM EQUALIZATION" PROGRAM** 

Now, in a few minutes, you can accurately TEM program. You can easily adjust for: ROOM "tune" the frequency response of your stereo system and room environment to a flat  $\pm 2 \text{ dB}!$ All you need are your own ears and a Soundcraftsmen EQ (with its step-by-step instruction record) to transform your listening room environment into an acoustically-perfect concert hall! You can also perform many other vital EQ "musts" thru our exclusive 10-point TOTAL SYS-

CHANGES such as drapes open or closed, REC-ORDS like old 78's or new discs that a recording engineer mixed-down to poor tonal balance. TAPES with recording or production deficiencies. AM or FM transmission variations, SPECIAL-LISTENING idiosyncrasies such as specifically boosting or cutting an orchestra's brass section.

11



"TOTAL-SYSTEM EQUALIZATION" requires more than just an "EQUALIZER." - Only the SOUNDCRAFTSMEN 10-POINT PROGRAM provides you with all of the indispensable features and accessories you need



FOR MORE DETAILED INFORMATION, CIRCLE READER CARD

Check No. 50 on Reader Service Card

AmericanRadioHistory Com

even look at the unit for the first half hour or so, and I fear my friend got a bit discouraged. I was simply listening to that room. All sorts of music, classical, pop, direct, Pulsed, SQ'd, or several combined.

But patience is rewarded. After a sandwich, I began to hear. The room was going away, the music emerging. It happens. So we could go to work. My first thought, of course, was redundancy. Three spaces? My second thought was to play records I already knew well. Best test you can imagine, for a safe listening anchor. Give you only one example-what better than the test pressing of my own forthcoming disc, the Canby Singers (Josquin Des Prez, Melchior Franck), recorded in a gorgeous big church acoustic with great bass and inspiring reverb. Add more space to that?

Well, you'd never guess. To my astonishment, Audio Pulse produced no redundancy at all that I could hear, nor any sense of several superimposed spaces. Not even in this extremely reverberant recording, a tough test. Nor any confusion, added distance, loss of presense. You could of course achieve extremes via the controls, maximum slow decay and longest delay. The Olympic pool sound. But you don't have to. There

12

are choices, shorter delay (i.e. a smaller synthetic room), guicker decay (i.e. not so live). I very guickly found a right and tasteful combination, which left the musical effect unchanged and unblurred but the sense of present space startlingly enhanced. Like the original! After all, I had set up the mikes and conducted the music myself, right on the spot. And so I went on to other records, with similar results, including the deadest recordings I could find and even some in mono. Audio Pulse takes care of that with ease, thanks to crosswise random intermix as well as back-to-front delay. Surround space out of mono! That's really something. Note well, vou collectors.

# Quadraphonic Quandary

Now all this was a serious revelation to me. Not only does the synthetic space work, but it goes beyond anything I have heard in quadraphonic recording, any system. Specifically, there was that elusively quick, wide, instant sense of space, of being there, which is a phenomenon I treasure above all sounds, having learned to hear it in the flesh at a thousand real concerts. I have waited and waited for this to appear on dists, as decoded or demodulated. It is present, fleetingly, in a few rare four-channel discs when everything is going just right. Period. Too subtle, too quick, too mercurial, for present disc.

Don't jump too far. At least 95 per cent of the spatial impression we need does get through on disc via the various systems including stereo. Many people can't even hear that last elusive five per cent. I myself am devoted to my four channels and the various decode, enhance, demodulate subtleties that do in fact make my music highly listenable. But what a marvelous five per cent, for those lucky enough to hear it! The ultimate reality, and it is the Audio Pulse clincher—all synthetic.

The finest thing I can say, then, is that unlike synthetic grapejuice or genuine vinyl leather, Audio Pulse is neither oversimplified nor crude, but in some respects can do even better than the normal packaged product. Take that, you recording engineers. A very sophisticated and carefully thought-out device, both in the operating parameters (semi-randomized) and the ingenious translation of these into analog-digital-analog circuitry. I do not think life will be quite the same for me, even if I don't use a synthetic space maker for record reviews. Well, not yet, anyhow. A



# JVC Professionals. The only receivers that adjust sound to the acoustics in your room.

Listening to a demonstration of music systems at a dealer is an excellent way to make a buying decision. But it can be misleading. Because what you hear in the dealer's acoustically designed sound room may not be what you hear at home.

Wierster

S400

The reason is simple. Sound quality is determined by various factors, including the size of a room and its acoustic elements. Drapes. Carpet. Furniture. Windows. Ceiling height. Walls. They all play a role in the sound you hear.

To help you get the best sound from your music system—wherever you listen to it—JVC has built into its top three receivers (S600, S400, S300) their exclusive SEA graphic equalizer system. This unique 5-zone control lets you create 371,293 different tone adjustments. As a result, you can custom tailor the sound to compensate for any room size and acoustic surfaces. The graphic equalizer also enables you to overcome deficiencies in old or poor recordings and the placement of speakers. Nobody else has this built-in feature. Nobody. And the only



Exclusive 5-zone SEA graphic equalizer system for better performance from components and listening room.

way any other make of receiver can match the sonic versatility of these three JVC models is by your adding to it (at an additional cost of \$100 or more) a separate, outboard graphic equalizer.

When you consider that you get the built-in graphic equalizer plus JVC's

Check No. 16 on Reader Service Card

many other outstanding features for the price of a conventional receiver in their price ranges, you can understand why the JVC professionals are rapidly becoming the #1 receiver to own.

\$300

S600

JVC also offers the less sophisticated, moderately priced S200 and S100 receivers with precision, linear slide controls for bass, treble and volume. Regardless what you plan to spend for a receiver—think like a professional and get the best. Think JVC.

Visit your local JVC dealer, or call toll-free (outside N.Y.) 800-221-7502 for his name.

JVC America, Inc., 58-75 Queens Midtown Expressway, Maspeth, N.Y. 11378 (212) 476-8300. Canada: JVC Electronics of Canada, Ltd., Scarborough, Ont.



# A Very Different Stereo Receiver From Advent.



The new Advent Model 300 is a unique stereo receiver that, within its power capabilities, is designed to sound as good as the best combinations of separate-chassis preamps, tuners, and power amplifiers.

At a suggested price of \$269.95, the Model 300 receiver is designed for people who can appreciate but generally not afford the level of sound quality produced by the finest audio components. We think there are a lot of people in that category.

## The Holman Circuit.

A major reason why the Advent Model 300 sounds the way it does is an entirely new phono preamp section that is audibly equal or superior to any separate preamp at any price. Designed by Advent's Chief Electrical Engineer, Tom Holman, the new circuit is the product of exhaustive listening, testing, and rethinking.

It came about largely because our checking of preamps of all kinds and prices kept turning up no reliable correlation between test measurements and audible quality. That turned out to be because standard measurements for preamps weren't checking their performance *under actual conditions of use* a fact that became the center for our own development effort.

We found, for instance, that frequency response measurements weren't being made with signals from phono cartridges, but simply with the use of test generators. This meant that important impedance interactions between preamps and various cartridges of different design—causing very audible differences in actual high-frequency performance—weren't showing up in standard tests. Phono noise measurements also didn't cover the effects of cartridges. And asymmetrical waveforms representative of music weren't being employed to check overall performance under in-use conditions.

If you would like a full technical description of how the Holman Circuit came about as a result of findings like these, we will be happy to send you a reprint of a paper prepared by Tom Holman for the Audio Engineering Society. (Please see our coupon.)

The main facts about the new preamp, however, are these:

■ It provides the full performance potential of any cartridge used with it.

■ Its effective noise is as low as any preamp's.

■ It handles actual asymmetrical musical signals flawlessly.

■ It incorporates a unique subsonic filter that eliminates the often severe performance problems (such as acoustic feedback, amplifier instability, added IM distortion in power amps and speakers, and loudspeaker damage) caused by ultra-low-frequency pulses generated by warped and eccentric records and by subsonic turntable rumble. This unique filter is far more effective than a rumble filter, with absolutely no audible effect on wanted low frequencies.

And the preamp sounds, as you will hear, the way we say it does.

# The Tuner.

Like the Model 300's preamp, its FM stereo tuner is designed for optimum performance under real conditions of use.

That means it is deliberately not designed for the

highest possible sensitivity rating. Our tests of receivers and separate tuners (and subsequent checks of in-use performance) indicated to us that the race for on-paper sensitivity was causing audible problems for many people in the typical urban and suburban reception areas across the country. The straining for impressive sensitivity specs tended to result in severe overload problems in many cases — causing strong stations to show up at several points along the dial and interfere with (or entirely blot out) other stations. The loss of effective reception quality for listeners is very real and important.

The Model 300 is consequently designed for the best *combination* we can manage of sensitivity, selectivity, and overload margin. It shows up virtually one-to-one in this crucial combination in direct comparison with most separate tuners costing far more.

The tuner section also offers Phase-Locked-Loop multiplex circuitry that provides excellent stereo separation and unusually effective suppression of the very common "birdie" interference from stations that broadcast background music and other subsidiary SCA signals along with their regular stereo transmissions.

And the Model 300's unique vernier tuning system and LED tuning indicator make for consistently easy, precise tuning year after year, with no chance for dial-cord slippage and apparent changes in station location on the dial. Perfect tuning is indicated when the two LED's light with equal intensity.

# The Amplifier.

The Model 300's amplifier will provide ample acoustic output levels with virtually any speaker we know of (including all Advents) under the usual home listening conditions — with no sense of strain or constriction. Yet it's rated very conservatively at a minimum of 15 watts per channel into 8 ohms, 40-20,000 Hz, with less than 0.5% THD. The facts here are well worth going into.

Because of the emphasis on power output in audio advertising, manufacturers in the highly competitive receiver market are under pressure to offer the highest *rated* power per dollar. To do so, the usual design approach operates output transistors at or near their limits and then protects them with voltage/current limiting circuitry.

A receiver designed that way will deliver its rated power into the usual test load (a resistor connected across the output terminals) without difficulty. But a speaker presents a more complex load than a simple resistor, and when a receiver of such design operates into a loudspeaker, the protective circuitry usually triggers at well *under* rated power. The result is that a receiver of that kind just isn't as powerful, in real use with a speaker, as its rating indicates.

The Model 300 approaches things differently. It uses output transistors of the type usually found in units of twice the rated power. It doesn't operate them near their limits, and so doesn't require the usual protection. It will deliver its full rated power into a speaker load, and the actual loudness it can achieve before clipping is more than ample for driving speakers under home conditions.

We realize it may be hard to believe that a receiver rated at 15 watts per channel can do the full job with a pair of speakers. But this one will — and we say this as a speaker manufacturer with a good knowledge of what's needed for satisfying overall sound. It does so well, in fact, that when we introduced the Model 300 to audio salesmen and asked them how powerful they thought it was after hearing it, they averaged a guess of twice its rated power, and some guessed it at four times the reality.

Equally important, the output design of the Model 300 insures that there will be no audible side effects during clipping at maximum output. The protective circuits in many receivers can and often do cause disturbingly audible side effects during clipping, and some of them generate high-frequency pulses that can damage loudspeakers. The Model 300 doesn't.

# The Model 300 As A Tuner-Preamp.

If there ever comes a time when a Model 300 user wants higher power output (for super-loud listening in a very big space), the logical direction to go is toward one of the high-power separate amplifiers rated at upwards of 60 watts. (A 30 or 40 watt receiver just doesn't offer that much more actual acoustic output than the Model 300.)

In that case, and in lots of others, the Model 300 can serve as a separate tuner-preamp of superb quality — fully as good as separate-chassis units in audible performance, at a fraction of the cost. It won't offer quite as much flexibility as the separate units, but the sound will be every bit as good.

Not only does the Model 300 offer a tuner-preamp output jack for this use, but it also has an input jack to its power amplifier, so that it too can be used separately—with other speakers, or with one of the new generation of time-delay devices now starting to appear.

# The Mobile Model 300.

In addition to the standard Model 300, we are also manufacturing a special version, the Model 300/12, with a switching-mode power supply for use on a 12-volt electrical system in a van or boat or where-have-you away from home. The unique power supply of the Model 300/12 allows it to provide *full rated power in portable use*, so that you can enjoy the same level of sound quality away from home as in your living room.

If you would like more information before going to hear the Model 300, please send us the coupon. Thank you.



Advent Corporation, 195 Albany Street, Cambridge, Massachusetts 02139.

# Herman Burstein

# **Treble Troubles**

Q. When I record from records, I get almost perfect reproduction in playback with the source. But when I record off the air, the result is a dramatic loss of treble on playback. The tuner has a somewhat defective treble response, so when listening to the tuner I boost the treble to compensate. But the tape recordings from the tuner have much less treble than even the original signal.—Granville Harper, San Francisco, Cal.

A. It may be that treble loss in the original FM signal and treble loss in the tape deck combine to produce a very noticeable loss to the ear, whereas treble loss in either the tuner or in the deck seem slight. To illustrate, a loss of 2 dB is hardly noticeable, whereas a loss of 4 dB is guite noticeable. Also, you may be saturating the tape at high frequencies which has the effect of reducing the treble to the rest of the audio range. If you are applying treble boost to the tuner signal before recording, this would increase the likelihood of tape saturation and treble reduction. You can check this by recording FM at lower levels.

#### Alligator Clip Alternative

Q. I want to feed the signal from my hi-fi into my tape deck, but my hi-fi only has jacks for either playback or microphone so I bought some alligator clips and hooked them into the speaker leads to record from either the radio or the turntable. To do this I must turn the sound up very high, still the tape playback is very low, although clear. How can I make a proper hookup?—Noah McDougal, Port Washington, N.Y.

A. You are obviously not getting enough signal voltage at your amplifier.output to the speaker. Probably you can get enough signal at the am-

plifier volume control, that is between the hot and ground terminals of the control. This is a fairly simple connection to make for a technician or an experienced audiophile, or alternatively, you can continue to take the signal from the amplifier output and feed it into one of those small preamps that audio stores sell for tape playback, phono playback, and microphone amplification. You would use the microphone facility for flat response. However, such a hookup would probably not give you as flat and undistorted a signal as would be obtained at the volume control of your amplifier.

#### Demagnetization

Q. I have both a TEAC and a Sony tape deck. I have regularly demagnetized both machines but have never detected any audible difference in sound quality either before or after demagnetization, even though I have tried a number of demagnetizers. What is the explanation about the need for demagnetization?—James Sipkins, Northfield, Minn.

A. There are several factors that may have a bearing on your inability to hear differences before and after demagnetization. If your hearing acuity in the treble range drops off appreciably above 12,000 Hz, the treble loss due to magnetization may not have much impact, the quality of the tape deck as some units are better designed to resist magnetization than others by avoiding current surges, and the number of times a recorded tape is played since with repeated playings the treble response gradually deteriorates, thus slight magnetization might have a noticeable effect only after a considerable number of playings. To preserve response out to 20,000 Hz, it is generally agreed that magnetization should be kept to a minimum if a tape is to be played fairly often. Furthermore, demagnetization is a preventive measure, and one should demagnetize before significant harm can be done by magnetized heads and other surfaces. This preventive maintenance would also reduce the opportunity for noting differences.

#### **Reel Shortage**

Q. Is there any possibility in the near future that  $10\frac{1}{2}$ -in. reels of blank tape will be easier to purchase? I have a tape deck which takes  $10\frac{1}{2}$ -in. reels and it frustrates me not to be able to purchase such tape.—James Sauerbier, Wash., D.C.

A. You are correct in pointing out the relative scarcity of  $10\frac{1}{2}$ -in. tape on the consumer level. However, it is available from the larger audio supply houses. If you query the catalog houses such as Lafayette, or discounters in your area such as Saxitone, you should have no trouble locating  $10\frac{1}{2}$ -in. tapes.

#### Head Replacement Snafu

Q. A number of years ago I purchased an Allied TD-1030 tape deck. I was able to record at fairly high volume without audible crosstalk, and after about 1,000 hours machine use I installed a \$6.00 replacement head, but have had some trouble with it. The crosstalk level is considerably higher than with the old head even though the azimuth alignment has been verified by a professional serviceman. Would I get appreciably better results by using a replacement head in the \$25.00 range? What is the proper bias frequency?—John Streby, Flint, Mich.

A. When one considers that highquality tape heads cost as much as \$50.00, \$75.00, and \$100.00 or more, it is difficult to expect much from one costing \$6.00. Your problem might

# The Sensuous Speaker.

Ya maha's new two-way beryllium dome NS-500.

A very responsive speaker with a rich, luscious sound. Highly defined, finely detailed. A deeply involving sound.

# In a word, sensuous.

With the NS-500, you get all of beryllium's advantages (transparency, detai, and lack of distortion that go beyond the best electrostatic speakers), but at a price roughly half that of the NS-1000. Only \$500 the pair, suggested retail price.

# . The joy of beryllium.

The ideal dome material for a high frequency driver must respond instantly to changes in amplitude and frequency of the input signal. So the ideal dome material must be virtually weightless as well as extremely rigid.

Beryllium is the lightest and most rigid metal known. Its density is less than two-thirds that of commonly used aluminum, and its rigidity is almost four times as great - thus preventing dome deformation and consequent distortion. What's more, beryllium's sound propagation velocity is twice that of aluminum.

The beryllium dome found on the NS-500's high frequency driver is the world's lightest – about half the weight of one petal of a small sweetheart rose. Which is one of the reasons for this speaker's exceptional sensitivity and response. And for its sensuous sound.

# A closer look.

To be able to offer the sophistication of beryllium at a more affordable price, without sacrificing quality of performance, Yamaha designed the NS-500 as a two-way bass reflex system.

This gives the NS-500 a trace more erotion at the low end than the resolucely objective NS-1000. But it also gives the NS-500 more efficiency (91dB SPL at one meter with one

watt RMS input). Which means you don't have to invest in the highest powered amplifiers or receivers in order to drive the NS-500 to its full rated output.

For an optimum match with the beryllium tweeter, Yamaha developed a very light, very rigid "shell" woofer. And a special hermetically-sealed air core LC crossover with a carefully selected 1.8kHz crossover point.

As a result of these design parameters, the NS-500 boasts an insignificant 0.03% THD below 50dB SPL, from 40Hz to 20kHz, making it the perfect complement to Yamaha's state-of-the-art low distortion electronics.

Underneath the sleek monolithic styling of its solidly crafted enclosures, the NS-500 is full of many exclusive Yamaha features and distinctive Yamaha touches of craftsmanship.

But to fully appreciate the beauty of the NS-500, you really should visit your Yamaha Audio Specialty Dealer.

And if you're not familiar with the name of your local Yamaha Audio Specialty Dealer, drop us a line. In turn, we'll also send you a free preprint of the Audio Engineering Society paper on Yamaha beryllium technology mentior ed above.



P.O. Box 6600, Buena Park, CA 90622 Check No. 45 on Reader Service Card



**Bert Whyte** 

20

Lennes he scenes

In the August, 1976, issue of Audio I gave a brief description of the new Ampex ATR-100 tape recorder which was introduced at the 54th AES convention in Los Angeles. I promised that when I got a chance to play with one of these recorders, I'd do an indepth report on it.

Well, friends, I've been living with an ATR-100 for some months now, and—to put it simply—the ATR-100 is a new breed of tape recorder, unlike any other machine, displaying technological advances in a number of areas which show an ultra-sophisticated conception of the tape recording art.

Modular construction has been a feature of recent Ampex recorders, and the ATR-100 carries this concept still further. Not only is there the basic modular system for tape transport, head assembly, control unit, electronics assembly, and power supply, but the tape transport is further divided into sub-assemblies. All are electrically interconnected with polarized wiring harness plugs. As is usual with Ampex tape recorders, the tape transport is built around an extremely rigid, precision-machined, cast aluminum base. The capstan, supply, and take-up motors; constanttension supply and take-up arms, and tape-timer wheel assembly are all mounted to the base, which also serves as a transistor heat sink for the power supply.

As I noted in my initial description of the ATR-100, the tape transport is a closed-loop servo system, which maintains constant tension between supply and take-up reels and neither needs nor uses a pinch roller! Let's follow the tape path...From the supply reel, the tape passes around the constant-tension supply arm, which is equipped with a metal roller and ceramic tape guides. (These roller/guide assemblies are easily and quickly changed with a single screw and are available for either quarter- or halfinch tape.) Tension arm position is sensed by a photo-resistive element and activated by an LED attached to the arm. It isn't indicated, but I presume a cadmium sulfide cell is used, as it would have the requisite sensitivity for the low output level of the LED. Voltage output is proportional to the arm position, and any positional errors are corrected by commands to vary the torque of the supply reel servo motor. Tape then passes around a knurled, large diameter (2<sup>1</sup>/<sub>4</sub> in.) tape timer wheel, which has an optical tachometer whose output appears on the digital time readout on the control panel. The tape path continues through the headblock, around the capstan, which is also knurled and the same diameter as the tape timer wheel. The capstan speed is servo



controlled. A solid-state optical device reads a 1200-line tachometer disc on the capstan shaft, and this signal is compared with the reference signal from a master crystal oscillator. Special circuits make appropriate corrections for any speed anomalies. The capstan servo has two modes of operation. One is a phase-lock constant velocity mode used for play and record; the other is a controlled acceleration mode for fast-forward and rewind, as well as start and stop. Complex circuitry automatically controls switching from one mode to the other. Thus, the capstan is independently driven, and all controls of tape motion is by the capstan controlling the reels. The capstan and the reel servos are mechanically linked by the tape and are electrically linked as well. From the capstan, the tape passes around the constant-tension take-up arm and roller/guide on the right side of the deck. This arm, of course, functions in the same manner as the supply arm. This completes the closed-loop servo system.

### **Tape Motion**

With this system, drive to the reel motors is bi-directional...the reels are capable of feeding tape with as much force as they are of holding back tape. All control of the servo system is by 5 volt TTL (transistor/transistor logic). With this logic and the servo system, constant tension can be maintained on each side of the capstan. This results in superb tape handling, very smooth and gentle, with no danger of inaccurate tape timing through tape elongation. The ATR-100 can handle any size reel from 2 to 14 inches with a total disregard of tension problems which would ordinarily arise with such disparities in reel size. While I haven't tried this, I understand the ATR-100 constant-tension system is so precise and gentle that reels of flimsy cassette tape can be handled without any problems...even in fast-forward and rewind modes! The ATR-100 is also very easy to thread. When the machine is turned on, the constanttension supply and take-up arms are not activated. Threading the tape into the closed loop, the Stop button is depressed and held, and the supply reel given a little "jiggle" to simulate holdback tension. The constant tension arms then pull-in and lock, activating the reel servos, and the recorder is then in operating mode.

The ATR-100 can operate at  $3\frac{3}{4}$ , 7  $\frac{1}{2}$ , 15, or 30 ips, and any two speeds can be selected at one time, even something as incongruous as  $3\frac{3}{4}$  and 30 ips. Equalization and bias are automatically switched for the two speeds chosen on the tape transport speed switch. If you select the wrong speeds on the switch, a red "lockout" light glows next to the speed, and the

# OPINALM.

LIMITER

AUTO PHOGRAM LOCATE DEVICE

# The first cassette deck that can find selections automatically.

Now there's a cassette deck that plays it your way.

OPTONICA

2-motor drive system RT-3535

ZZZZZZZZZZZ

The Optonica RT-3535. It's the world's only cassette deck with APLD, the Automatic Program Locating Device that lets you select the songs you want to hear automatically, instead of manually searching for each cut. But that's not all.

This Optonica cassette deck also has the kind of specifications that will impress the most dedicated audiophile.

The high quality tape transport features a 2-motor drive system, and a precision polished capstan shaft. Which results in a wow and flut-

ter of an amazingly low 0.04%. Compare that figure with other top of the line cassette decks and you'll see why Optonica can honestly call the RT-3535. The Optimum.

A built-in Dolby System means you won't have to worry about hiss and noise ruining the performance of your tapes. And the ultra-hard Permalloy head means you'll have greatly improved frequency response, especially in the high range.

We invite you to test the Optimum cassette deck at one of the select audio dealers now carrying the full line of Optonica stereo components. Call toll-free, 800-243-6000 day or

Check No. 34 on Reader Service Card

night (In Connecticut dial 1-800-882-6500), for the name and address of your nearest Optonica showroom, where you can see the complete Optonica line and pick up your free copy of our catalog. Or for further information, write Optonica. Dept. C3B, 10 Keystone Place. Paramus, New Jersey 07652.

DO TANK NOT

From our cassette deck that finds selections automatically to our unique turntable built on granite, find out why throughout Europe and Japan. Optonica is one of the fastest selling lines of stereo components on the market today.





In just a few minutes your "subconscious" tells you they're the best!

An insidious form of distortion you may not even be aware of, is causing "listening fatigue" as you play your records. After about 15 minutes of a complex, musically demanding record, it shows up. You feel vaguely anxious, irritable, and ready to turn off the music. That's "listening fatigue" virtually eliminated at last with the new Sonus phono cartridges.

You can hear and feel the difference in the time it takes to play one side of a record. Sonus has reduced Intermodulation and related distortions to previously unachieved levels, reducing these sources of "listening fatgue" to the vanishing point. As you listen, you discover that the emotional tension formerly caused by this distortion is gone. The music comes through with an effortless clarity and definition, as you listen with more attention, more relaxation, and far more pleasure than ever before.

The new Sonus cartridges take you closer to an actual performance than any other cartridges have been able to, until now.

"At one gram, the SONUS Blue Label was audibly superior . . . the sound was excellent in every respect." Stereo Review/Hirsch-Houck Laboratories

High Definition Phono Cartridges for The Most Accurate Sound Reproduction Possible.

Write for further information Dept. A

SONIC RESEARCH INC.

27 Sugar Hollow Rd., Danbury, Ct. 06810



transport won't operate. If you want to change to another speed pair, linking plugs on the audio control board must be transported to another position...again changing equalization and bias. In fast-forward and rewind modes, the ATR-100 can strip a 2400ft. reel of tape in less than 60 seconds. There are no mechanical brakes on this recorder...braking is completely dynamic and very positive. While ripping tape off at 500 ips, depressing the play button slows the tape rapidly: the machine does not stop but rather locks smoothly into the Play mode speed. As you probably know, professionals like to wind off their tapes in the "tail out" position. This takes time, especially if you have only 1000 feet of program on a 2400-ft. reel. To facilitate this, the ATR-100 has two spooling speeds, which can wind tape at either 80 or 160 ips. Even at 160 ips, with back-coated tape, the wind is so smooth it looks like brand-new tape.

## Headblock Features

Underneath the pull-off head cover is the headblock which is completely removable. The headblock is very solidly constructed, and the underside has three well-machined locating pins which mate with another precision machined area on the transport casting. There is heavily spring-loaded T-bar that, with a 90 degree turn of an Allen wrench, locks the headblock securely to the machined plate. Electrical connection is by means of PC board edge "finger" connectors, which mate with a mother board. The headblock is fitted with an upper and two lower ceramic tape guides, a scrape flutter filter, and either full

track, half-track or stereo, erase, record and reproduce ferrite heads for quarter-inch tape, or with the same complement of ferrite heads with four channels for half-inch tape. There is space for a fourth head, and if not fitted, there is a dummy head metal post. Automatic solenoid-operated tape lifters come up into the headblock from the transport top plate. A spring-loaded, press on and off headgate shields against hum. The use of ferrite heads by Ampex might raise a few eyebrows because of some of the well-known problems associated with this kind of heads. (For example, ferrite is easily saturated; it is a friable material which chips easily, and when this happens in the gap, it causes gap scatter. On the other hand, extreme hardness cuts head wear drastically, compared to permalloy, and its composition permits high bias frequencies.) The ampex ferrite heads are very special. They are literally "grown" and thus are known as monocrystalline ferrite. They retain the advantages of hardness for long wear, and their suitability for high bias freguencies is indicated by the ATR-100's bias of 432 kHz. With single crystal structure, saturation is not a problem. Extended high frequency response is another virtue of these heads. Most fascinating of all is that the gaps of these heads in multi-track configuration can be aligned with such precision, that when used with a special record circuit, they are phasecoherent and can record square waves! Before we leave the headblock, it should be noted that the record and replay heads are precision mounted and require no adjustment

# The first tuner and amplifier that won't scare you into buying a receiver.

Most people buy a receiver instead of a separate tuner and amplifier because they think it's easier to handle, less complicated, not as frightening, even less expensive.

OPIONICA

FM/AM stereo tumer

51

51-3535

Nothing could be further from the truth. Which is amply proven by the Optonica ST-3535 tuner and the SM-4545 amplifier, a pair so easy to get along with, and so easily affordable, you'll be glad you didn't settle for a receiver.

The Optonica ST-3535 tuner is designed for clear reception and high sensitivity and has a built-in meter that detects multipath distortion.

And here's a feature we bet you won't find on a receiver: an air check calibrator to give you an accurate FM Air Check. Just flip on the switch and a level signal equivalent to that of the FM signal is generated. Then all you have to do is set the recording level to 0 VU on the tape deck.

Why does Optonica call its amplifier the Optimum? Just try to find a receiver or amplifier that can match our newly developed SLAD (Spikeless Amplifier Design) circuitry, designed to prolong the life of your amplifier by eliminating notching distortion at high power output. This also results in excellent low distortion characteristics with 0.1% total harmonic distortion at 65 watts per channel, minimum RMS at 8 ohms, from 20 Hz to 20 kHz.

We invite you to test the Optimum tuner and amplifier at one of the select audio dealers now carrying the full line of Optonica stereo components. Call toll-free, 800-243-6000 day or night (In Connecticut dial 1-800-882-6500), for the name and address of your nearest Optonica showroom, where you can see the complete Optonica line and pick up your free copy of our catalog. Or for further information, write Optonica. Dept. A3B , 10 Keystone Place, Paramus, New Jersey 07652.

From the first tuner and amplifier that won't scare you into buying a receiver to our unique turntable built as steady as a rock, find out why throughout Europe and Japan. Optonica is one of the fastest selling lines of stereo components on the market today.

# OPTONICA THE OPTIMUM.

Check No. 35 on Reader Service Card



Check No. 29 on Reader Service Card

for height or zenith. Azimuth is adjusted with an Allen wrench turning a gear-toothed wheel underneath the heads.

The control panel on the ATR-100 is really unique. Except for the power switch and tape speed selector which are on the headblock cover, the panel contains all other function controls.

There are pushbuttons for Play, Record, Stop, Fast-Forward, and Rewind. On a computer/calculator type panel are buttons for Safe, Ready, Sel-Sync, Repro, and Input arrayed vertically on the right side of the unit. In horizontal array underneath are buttons numbered one through four; any of which can be punched up to any or all of the four channels of control. The mode selected is indicated by varicolored LEDS. The electronic timer is extremely accurate, within 0.5 second for a 2400-ft. reel of tape. On the control panel hours, minutes, and seconds are shown in an illuminated digital readout. Now get this editing routine...the capstan protrudes through the headblock cover and has a knurled knob on top of it. With the tape stopped, but with the constant tension arms in servo lock, you can turn the capstan manually for editing, with a smoothness and precision of cut point that has to be experienced to be believed. Then, if you want to spill tape, the Edit button on the control panel puts the recorder into the Dump Edit mode. The take-up motor stops, and the right tension arm roller moves a thin rubber tire, which acts as a pinch roller on the capstan to spill the tape. Ingenious! The control panel also is available in a remote control



version with 25-ft. cable, and this duplicates all functions except the *Dump Edit* mode. While the ATR-100 is normally shipped with the control unit on the right side of the transport, it can be easily installed on the left side for those engineers who are southpaws.

I was supplied the four-channel, half-inch version of the ATR-100 (with interchangeable stereo head and tape guides as well) in the pedestal/cabinet configuration. In this set-up, the electronics package is mounted underneath the transport, behind a hinged cover. All electronics are on what Ampex calls "printed wiring assemblies" (PWA). We call them printed circuit boards, and like most of them, the Ampex PWA plug into a motherboard. There are four main audio boards, each with what is called a "padnet" (parameter determining network) which plugs into the PWA boards. Then there are the audio control PWA, transport logic and tape timer PWA, capstan servo PWA, and reel servo PWA, with many controls to explain on these boards. Next month I'll get to these, plus the input/output modules (levels, metering, etc.) plus the results of the extensive measurements of performance parameters, plus listening tests and a subjective evaluation. А



# The first turntable that's as steady as a rock.

Turntables shouldn't cause howling and screeching through the night. But that's exactly what happens, thanks to mechanical and acoustic feedback caused by loudspeakers vibrating an insecure turntable.

()

Since most turntable bases have been made of laminated plywood, beech, die-casting or plastic, howling has been a problem that just wouldn't go away.

Until today, that is.

Announcing the Optonica RP-3636 Direct Drive Turntable. We built the ideal turntable. literally as solid as a rock because it's built on 15.8 pounds of Mikage granite stone. Which means that vibrations from the speakers are absorbed, reducing acoustical feedback and maintaining maximum signal to noise ratio.

The Optonica RP-3636 also features a highly sensitive S-shaped tonearm. Which means that the stylus will pick up subtle sound signals as accurately as the cutter stylus that recorded them. And an oil-damped cueing control that gently lifts and lowers the tonearm so your records will be protected from damage

We invite you to test the Optimum turntable at one of the select audio dealers now carrying the full line of Optonica stereo compo-

Check No. 36 on Reader Service Card

nents. Call toll-free 800-243-6000 day or night In Connecticut dial 7-800-882-6500+ for the name and address of your nearest Optonica showroom, where you can see the complete Optonica line and pick up your free copy of our catalog. Or for further information, write Optonica. Dept. T3B , 10 Keystone Place, Paramus, New Jersey 07652.

From our unique turntable built as steady as a rock to our cassette deck that automatically finds your selections, find out why throughout Europe and Japan. Optonica is one of the fastest selling lines of stereo components on the market today.



## **FM Defender**

Dear Sir:

26

Before we are swept away on waves of nostalgia and AM audiophilia, I would like to balance the comments of some radio old timers who have written to your delightful magazine regarding the potentials and practices of A(ncient) M(odulation).

As an engineer for two FM and one AM radio station, I am only too aware of the pressures of the broadcasting marketplace to provide the strongest, loudest, clearest, and brightest signal possible. Thanks to recent FM technology, such as the Orban "Optimod" limiter/stereo generator, loudness and fidelity are no longer mutually exclusive entities. Recent stateof-the-art FM exciters, such as the Collins 310Z, have harmonic distortion measurements around 0.08 per cent. And with cartridge and stylii combinations like the Stanton 681SE, composite microwave studio-transmitter links, and integrated circuit consoles, it is virtually impossible to transmit a bad FM signal without gross ineptitude or deliberate intention.

On AM, however, we are hampered on every front. FCC rules for AM technical standards permit distortion of 5 per cent, noise levels of only 45 dB, and frequency response of  $\pm 2$  dB from only 100 Hz to just 5 kHz. Frequencies 15 kHz away from nominal center carrier frequency must be down 25 dB below the unmodulated carrier level. As to the actual broadcasting equipment in use, I can recite cases of 17 per cent intermodulation distortion in a popular brand AM transmitter and have had experiences of horrendous low-frequency phase shift in high level plate-modulated AM transmitters which do not affect harmonic distortion measurements on sinusoidal tones, but completely alter amplitudes and waveshapes of audio signals, causing intermodulation, overloads, and sonic muddiness. Only the very newest all solid-state low-power AM transmitters, such as the Haris 1 kW, have eliminated such problems.

So even if one listener out of 500,000 owns a McKay-Dymek tuner, we cannot as broadcasters supply AM high fidelity due to both equipment shortcomings and the necessity to make our signals heard in a spectrum crowded with stations, man-made and natural interference, and modulation-mad program directors and managers. The situation is not completely hopeless; it is just that there are inevitable compromises that must be made on AM that *do not* have to be made on FM and indeed are not made on the FM stations I work for.

Stephen R. Waldee Broadcast Technical Consultant KSOL San Mateo, Cal.



# Victor Brociner

Victor Brociner died of a heart attack the day before Thanksgiving at the age of 66. During the 30s, he developed a high fidelity, broad-band AM receiver, a low-tracking-force record player, and speaker component system, which set new standards and later was made a part of the Smithsonian collection. In 1937, Brociner founded the Philharmonic Radio Co. with Avery Fisher and a third partner, and after WWII he founded Brociner Electronics. During the early 50s, Brociner produced one of the first integrated amplifiers, a Williamson at 30 watts which was quite powerful for that period, and some of the first high fidelity components using printed circuits. Another product, the Brociner Transcendent loudspeaker system, was noted for its combination of efficiency and high sound quality. When financial problems forced Brociner to close his company, he did not simply declare bankruptcy, but instead paid off every creditor in full.

Afterward Brociner joined University Loudspeakers, but when that firm moved to Oklahoma, he joined H.H. Scott as Engineering Vice President, working on a variety of products including speaker systems, tuners, amplifiers, and receivers. When Scott ran into difficulties in 1972, Brociner moved to the Avid Corp. as Vice President for Engineering and Stereo Products. While there, Brociner took on responsibilities far wider than one might assume from his title-from conception and basic product design, through vendor selection, production line engineering, and quality control. In the few short years since the firm was founded, Avid speakers have become one of the industry's accepted lines, largely through the efforts of Victor Brociner.

Brociner was a widely published author, a member of numerous industry committees, a fellow of the Audio Engineering Society and a member of its board of governors in 1955, and a member of the IEEE, the Acoustical Society of America, and the Audio Hall of Fame.

Notes courtesy of James Brinton and Dick Lewis

# Sooner or later, all good things must come to an end.



# This is not the end of the line, but the beginning of a new relationship.



We've got some Model 202's left that we want to sell before we're ready to show you our new Model 203 Preamplifier. Ask the man who owns a BGW about the 202's in-side reputation. Then ask any of the BGW dealers about their <sup>1</sup>/<sub>3</sub> Off ticket price. This is not the kiss-off. It's the Welcome Aboard. Hurry, while they last.





BGW Systems 13130 South Yukon Ave., Hawthome, Ca 90250 (213) 973-8000 In Canada: Omnimedia Corp., 2024SCote de Liesse. Dorval. Quebec H99 1A3 (514) 036-0971 Worldwide Export Agents: Telesco International Corp., One Dupont Street South. Plainview, LL, New York, (516) 433-6320

Check No. 6 on Reader Service Card

# Take a spin on our new fully automatic turntable. And leave the direct driving to us.



With Sony's new PS-4300, you just sit back and enjoy the ride. Wherever the record takes you.

That's the blissful simplicity of a fully automatic turntable.

But the PS-4300 is more than purely practical. We like to think of it as a model union; combining the convenient and the complex.

It is a profoundly engineered machine, with intelligent design slashing through down to the smallest detail.

# We gave brushes the brush.

The motor that powers the PS-4300 is brushless and slotless. Direct drive, if you will.



This deceptively simple construction makes for a smoothrunning motor with less friction and noise than traditional DC motors. And it eliminates cogging.

What's more, this smoothrunning motor is monitored by a



smoothly-engineered 8-pole magnetic pick-up head. And our magnetic speed sensor works through an intricate electronic feedback system; driving the platter directly—without a jumble of belts and pulleys getting in the way.

So our torque is not a turkey, and we've got low wow and flutter and high speed stability to boot. An electric eye. For your ear. Hands off the PS-4300!



Our optical sensing system automatically returns the arm when your record is over.

Optical sensing is light years ahead of the conventional mechanical linkage. Eliminating the pressure and distortion you'd ordinarily get at the end of a record.

# A tone-arm that's a strong arm.

Now we're not calling anyone clumsy. But there is the chance you might make a mistake and grab hold of the tone-arm while it's in motion.



That's why the PS-4300 has a tone-arm that's more than just statically balanced. It comes with a protective clutch device. (The only clutch you'll find on our fully automatic turntable.)

This latching set-up protects your arm against too much strain.

Moving from arms to feet, ours are designed to cut feedback. They're rubber-soled: suspended by cup-shaped rubber shock absorbers.

And they're adjustable, letting you level the turntable. So you might say our feet come with elevator shoes.

Our vibration-reducers are great shakes. Sometimes the cabinet itself can vibrate—distorting what comes out of it.

Not so with the PS-4300. Our cabinet is built out of a material with a low Q. Low Q

materials hardly vibrate, and nobody watches their P's and Q's like Sony.

Even our platter has been undercoated with a damping material.



And what looks like a bad case of acne on our record mat is a series of bumps that provide an air cushion and absorb vibration.

# An exercise in self-control.

You can see that we've covered just about everything when we created the PS-4300.

Even the cover.

Our dust cover is ingeniously simple. When closed, it leaves the controls accessible.



And what controls they are! One-touch, LED-indicated switches for start/stop and repeat.

One light tap starts everything going, while your record, under the dust cover, is in splendid isolation.

So if what you're looking for is an unmatched fully automatic direct drive turntable, drive on over to Sony.



Check No. 39 on Reader Service Card



The chances are good that you've already invested in Quam loud-speakers without even knowing it. You'd be surprised how many of the famous manufacturers of hi-fi speaker systems have Quam drivers lurking anonymously behind their far cy grille cloth! For over forty years we've cher-

ished our anonymity at the consumer level while enhancing our reputation with the audio professionals who buy speakers in quantity. They appreciate the return on investment they derive from our attention to materials, our quality control and our performance specifications. The experts know that Quam Speakers are the brand to buy when you're buying more than one!!

If Quam speakers can pass the rigorous tests of the prestige speaker system manufacturers for incorporation in their high-priced original equipment, can they pass your listening test for replacement or extension use in your stereo system? Only if we "go public" and tell you about them! Ask your audio distributor about Quam, the not-quite-so anonymous loudspeaker.



# **Four-Channel Programming** Dear Sir<sup>1</sup>

Martin Clifford's article "Syndication of Quadraphonic Radio Programs" in the November, 1976, issue of Audio has performed a service by pointing out to the readers that many FM stations carry guadraphonic programs without fanfare. However, I was surprised that Mr. Clifford's article emphasized the syndication of the Boston Symphony Orchestra programs in the QS mode since I was aware that Richard Kaye of WCRB, Boston, who is manager of the Boston Symphony Transcription Trust, had been syndicating the Boston Symphony Orchestra principally in SQ. I. talked to Mr. Kaye, who told me that the story as published in Audio was true, but incomplete, in that of the guadraphonic tapes he distributes, 20 are encoded in SQ and four in QS. Naturally, he will furnish any code reguested by a station's sponsor, and it may be well to note that CBS does not sponsor any syndicated guadraphonic programs.

Another statement which needs clarification is the last paragraph relating to the "Live from the BBC" program. When I visited Mr. Rickey Merrett, the transcription engineering manager of BBC, in London last September, he told me that he issues 80 quadraphonic programs per year, of which 90 per are encoded in SQ. A phone call this morning to him confirmed these figures.

I owe Mr. Clifford and the readers of Audio an apology for not having been more diligent in furnishing information about SQ syndication to Mr. Clifford in a sufficiently timely fashion to have avoided any erroneous impression which his article might have created about the significant role of SQ in broadcast syndication.

Benjamin B. Bauer Vice President and General Manager **CBS** Technology Center Stamford, Conn.

# Jaws Disc Imported

Dear Sir:

I thought you might be interested in knowing that JVC has decided to make the Jaws CD-4 Quadradisc album available in the U.S. To order a copy, you can send \$7.00, which includes postage, to: JVC Cutting Center, 6363 Sunset Blvd., Hollywood, Calif. 90028

> Brian A. Moura Hayward, Calif.

# **Audio Library**

Dear Sir:

I am in charge of developing a student audio engineering library. If you have any literature concerning audio engineering, electrical engineering, music, physics, or other subjects appropriate to the audio field that you no longer use, their donation would be greatly appreciated.

Usable printed matter would include periodicals such as Audio, db The Sound Engineering Magazine, Audio Engineering Society Journals, Recording Engineer/Producer, Studio Sound, etc., plus textbooks, service manuals, charts, and photographs. Out of date or obsolete materials all have their value in student learning situations and anything will be welcome.

Thank you for your interest in further promoting education in the audio field.

> The Student Library c/o T.W. Woynicz P.O. Box 7347 Hollywood, FL 33021

## **Receiver Remembrance**

Dear Sir:

I have just read your feature article "Nothing New Under the AM Sun" by Michael N. Stosich in the January, 1977, Audio with extreme interest. I happen to own an E.H. Scott 30-tube Philharmonic receiver as well as the 23-tube All Wave High Fidelity Receiver, an earlier model. Because of this excellent article I am renewing my subscription to Audio. For years I have wanted to track down the history of E.H. Scott and his radio laboratory, but never guite got around to doing it. This article was an answer to my prayers, to say the least.

I purchased both Scott receivers used and in need of repairs. I have the John Rider service manuals on both sets, and having been in the audio service business for more than 31 years, I agree that it takes more than an amateur to repair them. I know of nothing that can be added to what Mr. Stosich said, as he put it perfectly.

Lawrence M. Henry North Platte, Neb.

30

Check No. 30 on Reader Service Card

# Dolby FM and Conventional FM Symmetry is the Difference



These block diagrams show the difference between Dolby FM and conventional 75 microsecond FM. The difference is symmetry. With Dolby FM, the circuits at the transmitter are matched by complementary circuits in the receiver. Such symmetry of signal handling has long been valued in disc and tape recording - and indeed in noise reduction systems. Unfortunately, in conventional FM broadcasting the standards were set so long ago (back in the 40's) that modern widerange program material causes problems; high frequency limiting has to be used, and thus there is an extra process at the transmitter which is not matched by any complementary treatment in the receiver.

The Dolby B compression and ex-

pansion system is well known for its mathematically exact mirror-image operation; this is a key element in permitting FM stations and receivers to function in a symmetrical way. Here's how. First the conventional 75 microsecond high frequency boost and roll-off are reduced to the point where high frequency limiting is no longer reguired at the transmitter (this happens with a reduction to 25 microseconds, which gives a boost and cut beginning at about 6 kHz instead of 2 kHz) Unfortunately, this step is inherently accompanied by about a 5 dB increase in receiver noise. In the second step, however, the addition of the Dolby B system not only takes care of the additional noise but results in a noise level some 5 dB lower than conventional FM

Thus, the overall effect is that about half of the 10 dB Dolby noise reduction capability is traded off for symmetrical signal handling. But, considering the two extremes of the dynamic range, there is still a genuine *total* increase of 10 dB in available dynamic range above about 3 kHz.

If you like the idea of a symmetrical FM system with reduced noise, then we invite you to write to us for further information. The following information is available:

- Technical details and explanations of Dolby FM.
- 2. A list of stations with Dolby FM encoder units.
- 3. A list of receivers with built-in Dolby FM circuits.

# Listening to Dolby FM

Basically, listening to the improvement brought about by Dolby FM is like listening to any audio equipment improvement – such as those made to turntables, pickups, amplifiers, and speakers. A particular improvement in a component may well be there all the time, but its noticeability will depend on various factors, such as the listening environment or the type and quality of the program material.

In the same way, the overall Dolby FM listening improvement is subtle most of the time; occasionally, however, it will be quite obvious. It should be remembered that in FM the 10 dB action of the Dolby system is distributed nearly equally between the low-level noise and the high-level signals. The audibility of any change is therefore less obvious, and depends more on program material and other conditions, than the effect of the Dolby system on cassettes.

Relative to the hiss level of conventional broadcasting and reception, a somewhat (but not startlingly) reduced hiss will be noticed by listeners with weak-signal reception conditions; listeners with a strong signal will note no change (as with conventional FM, the noise will be determined by the station's source material). Listeners in any reception area, though, will notice a full recovery of source material high-frequency dynamics, regardless of signal strength. On most stations, cymbal crashes and other program material containing high-level high-frequency components will sound distinctly brighter and cleaner. Otherwise, for those rare stations which conventionally hold down modulation in order to preserve high-frequency signal integrity, the introduction of Dolby encoding allows an increase in overall level by several dB. Of course, this increase will be apparent to all listeners, regardless of location and whether or not they have receivers equipped with Dolby FM circuits.

We think that critical listeners can hear and enjoy the various improvements described above often enough to make the extra cost of Dolby FM well worthwhile.



Dolby Laboratories Inc 'Dolby,' and the double-D symbol are trade marks of Dolby Laboratories Inc. 731 Sansome Street San Francisco, CA 94111 Telephone (415) 392-0300 Telex 34409 Cable Dolbylabs 346 Clapham Road London SW9 Telephone 01-720 1111 Telex 919109 Cable Dolbylabs London

S76/172

31

# **Threshold Amplifier**

The Model 800A is a 200watt Class A amplifier employing dynamic biasing circuits with claimed harmonic and intermodulation distortions of 0.1 per cent at rated power, a frequency response of  $\pm 3$  dB 2 through 200,000 Hz at small signal levels. ±0 dB 20 through 20.000 Hz at 400 W per channel, a damping factor of 1,000 at 20 Hz and 200 at 20,000 Hz, and a slew rate of  $40V/\mu$ S. The protection circuits include current and voltage limiters



32

with analog controlled reaction times and thermal monitoring. There are individual channel level controls, a saturation control, and a twospeed fan switch, and displays include individual channel average watt output meters, amplifier On/ Off and thermal excess indicators, and a saturation control threshold indicator/peak indicator. The unit is notched for rack mount, and the chassis dimensions are 17 7/16 in. W x 8 1/16 H x 16 13/16 D. Weight is 85 lbs.

Check 70 on Reader Service Card

# **MXR** Noise Reducer

The Compander is a noise reduction device for openreel and cassette decks, compressing the dynamic range of signals being recorded and expanding them on playback. Compatible with dbx encoded material, it is claimed to offer more noise reduction than comparable systems. Price: \$129.95.

Check 71 on Reader Service Card



# **B**•I•C Turntable

The Model 1000 Electronic incorporates two motors, the first a 24-pole, 300-rpm synchronous motor to drive the turntable, while the second motor controls the cueing and cycle change. The program panel allows the unit to be operated in three modes, single-play manual, singleplay automatic, and a multiplay automatic. Both the tracking force and anti-skate range are adjustable from 0 to 4 grams in ¼-gram increments. The stated wow & flutter is 0.04 W rms, and weighted rumble is -70 dB (DIN B). Price: \$279.95.

Check No. 72 on Reader Service Card



## Amber Test Set

The Model 4400 is a multipurpose audio test set, and can be used with any d.c. oscilloscope to measure level, gain, noise, crosstalk, distortion, frequency, and phase. The generator section has a pink noise source, log sine wave sweep and comb generator, facilities for tone bursts, a  $\pm 30$  dBm balanced output capability, and very low distortion. The receiver section contains an autoranging digital frequency counter, a spectrum analyzer, a band pass and reject, high and low pass filter, a digital level meter reading in dBm rms, and a four channel digital memory to store response plots of amplitude or phase versus time or frequency. Price: \$3000.00.

Check 73 on Reader Service Card

# **Technics Cassette Deck**

The Model RS-9900US cassette deck has a closed-loop, double-capstan, three-motor drive, with a separate electronics chassis, and a tape timer with readings in minutes to indicate the time remaining on a cassette. The three-head system has separate record and playback heads for tape monitoring. A built-in 8-kHz oscillator provides for azimuth adjustment for optimum high frequency response. There is full IC logic transport control with no relays, and a ±5 per cent



pitch control provides accurate tuning. The stated frequency response is 30 Hz to 18 kHz  $\pm$ 3 dB, wow & flutter 0.04 W rms, and weighted S/N ratio above 5 kHz w/Dolby of 65 dB. Price: \$1500.00.

Check 74 on Reader Service Card

#### **GenRad Meter**

The Model 1981-B sound level meter has both digital display and linear analog meters, with the capability to hold and display the maximum level measured on the digital display while the analog meter continues to indicate lower levels using either the fast or slow detector response. The meter spans 30 to 120 dBA in two switch-selectable 50-dB ranges, while the analog scale spans the range linearly in 1 dB increments. Price: \$975.00.

Check 75 on Reader Service Card

# WHY MOST CRITICS USE MAXELL TAPE TO EVALUATE TAPE RECORDERS.

Any critic who wants to do a completely fair and impartial test of a tape recorder is very fussy about the tape he uses.

Because a flawed tape can lead to some very misleading results.

A tape that can't cover the full audio spectrum can keep a recorder from ever reaching its full potential.

A tape that's noisy makes it hard to measure how quiet the recorder is.

A tape that doesn't have a wide enough bias latitude can make you question the bias settings. And a tape that dcesn't sound consistently the same, from end to end, from tape to tape, can make you question the stability of the electronics.

If a cassette or 8-track jams, it can suggest some nasty, but erroneous comments about the drive mechanism.

And if a cassette or 8-track introduces waw and flutter, it's apt to produce some test results that anyone can argue with.

Fortunately, we tesevery inch of every Maxell cassette, 8-track and reelto-reel tape to make sure



they don't have the problems that plague other tapes.

So it's not surprising that most critics end up with our 33 tape in their tape recorders.

It's one way to guarantee the equipment will get a fair hearing.

Maxell. The tape that's too good for most equipment. Maxell Corporation of America, 130 West Commercial Ave., Moonachie, New Jersey 07074.



# **SAE Amplifier**

The Model 2400L stereo amplifier offers 200 watts per channel rms with a claimed THD and IM of 0.05 per cent, a 100 dB S/N ratio, and a slew rate of 40 V per  $\mu$ S. The unit has LED displays of power output in 3 dB increments from 40 mW to full power. Price: \$800.00.

Check 76 on Reader Service Card

# **PAIA Phlanger**

The Model 1500 Phlanger uses a 1024-stage Reticon analog shift register to produce variable time delay to a portion of the audio signal, a low-speed control oscillator



provides automatic sweeping effects such as chorusing, while other front panel controls handle sounds ranging from voice doubling and reverb to phase shifter simulations. External control voltage inputs allow hands-free foot pedal control as well as easy electronic music synthesizer interface. Price in kit form: \$59.95.

Check 77 on Reader Service Card

#### Scott Speaker

34

The Model PRO-70 is a floor standing, acoustic suspension loudspeaker system with a 12-in. woofer, a 4<sup>1/2</sup>-in. midrange, and two 1-in. dome tweeters with a claimed frequency response from 35 Hz to 20 kHz  $\pm 4$  dB, using crossover frequencies at 800 Hz and 4 kHz. Reguiring a minimum amplifier power of 15 watts per channel, the speakers are stated to handle up to 150 watts average. Price: \$299.95 each.

Check 78 on Reader Service Card



# Sennheiser Headphones

The HD-224X is a dynamic headphone with circumaural cups and a stated frequency response from 16 Hz to 20

THD of ±1 per cent. Price: \$99.80. Check 79 on Reader Service Card

kHz, a 94 dB SPL for 1 mW at

1 kHz, and a DIN-weighted

# Marantz Cassette Deck

The Model 5020 is a frontloading cassette deck with Dolby noise reduction and a peak limiter circuit, reducing the possibility of tape saturation. The unit features a Permaloy record / playback head, 3<sup>1</sup>/<sub>2</sub>-in. VU meters, a tape counter, and total shutoff and disengagement of the tape transport when the end of the tape is reached. The independent mike and line inputs have their own level controls, and there is a master gain control to facilitate mixing inputs. Price: \$269.95.





# Grace Tonearm

The Model 704 tonearm is a low-mass, unipivot, oildamped unit, machined from a solid block of aluminum alloy in a U shape of decreasing width from pivot to headshell. Features include a printed circuit slide-in head shell, gold plated contacts in the arm connections, and viscous-damped cueing with a small magnet in the lift to prevent skipping at the record's lean-in grooves. The counterweight is calibrated for ease of setting stylus force, and a lateral balance weight can be adjusted for axial alignment. Price \$225.00.

Check 81 on Reader Service Card



mericanRadioHistory Corr

# **Brookstone Catalog**

The catalog lists hard-tofind tools and accessories for the audiophile and electronics hobbyist through mail order. Price: \$1.00 for a year's subscription (five issues). Brookstone,

Dept. A, Vose Farm Rd., Peterborough, N.H. 03458.

# Spectra Sonics Speaker System

The Model 3000 is a ported loudspeaker system with a 15-in. woofer, a mid-range horn, and a high frequency horn, with a specified fre-



quency range from 20 Hz to 20 kHz, and crossover frequencies of 800 Hz and 4 kHz. The unit measures  $37\frac{3}{4}$ in. H x 17 in. D x 24-5/8 in. W, and weighs 118 lbs. Price: \$869.00.

Check 82 on Reader Service Card

# **Dual Turntable**

The Dual CS 721 is a fully automatic, single play, direct-drive turntable with the tonearm mounted in a fourpoint, twin gimbal with adjustable height control. The anti-skating mechanism is calibrated for conical, elliptical, and CD-4 styli. There are two anti-resonance filters located in the counterbalance housing, a built-in illuminated strobe, and electronic pitch control for both 33 1/3 and 45 rpm speeds. Price: \$400.00.

Check 83 on Reader Service Card



# Nikko's dedication and your patience are now rewarded.

The people at Nikko have a very unique philosophy about the way they produce and market audio products.

It starts with producing only state-of-the-art components, the testing of every unit before you buy it, a three-year parts and labor warranty\* and conservatively rating every specification. Only in this way do you reap the benefits of true performance. Nikko now presents its finest discrete matched components: the Alpha-1 dual channel power amplifier has a three-stage Darlington direct-coupled OCL pure complementary circuit, large electrolytic capacitors (33,000 mF), and a rack mount design with optional side panels.

A matching Beta-1 "FET" preamplifier features highvoltage FET circuitry, three-stage direct coupled with twostage differential amplifier, and a number of useful features, including a phono impedance selector and tape monitor (play 1, play 2, dubbing 1 to 2, dubbing 2 to 1). Beta-1 is also provided in a rack mount design (shown stacked atop Alpha-1).

Alpha-1 specifications		Beta-1 specificati	(@) 🗋		
channel, both cha	output of 220 watts per nnels driven from 20 to	Input Sensitivity.	Phono 1 & 2 Tuner Aux	2mV 100mV 100mV	
20kHz into 8 ohms with no more than 0.08% total harmonic distortion.		Input Impedance.	Phono 1 & 2 Aux Tuner	22K/47K/100Kohm 50Kohm	16270 Rayn
Intermodulation distortion:	no more than 0.08% (at rated output)	Total Harmonic Distortion:	no more than	0.015% (at rated output)	Su
Frequency response: Imput sensitivity/impedance:	10 Hz-100kHz +0dB1dB 1V/50Kohms	Signal-to-noise ratio (I.H.F.):	Phono 1 & 2 Aux	72¢B 100dB	
Signal-to-noise ratio (I.H.F.): Dimensions: Price:	100 dB	Frequency Response	Phono 1 & 2 (RIAA equalization)	30-15kHz ±0.2dB	
	7" high, 11½" deep, 19" wide \$599.95	Dhana Quarland Laval	Aux Tuner	20-20kHz ±0.1dB	
		Phono Overload Level: Dutput: Power Consumption: Dimensions:	400mV RMS @ 1kHz 1V rated, 10V max. 120V 25VA 50/60 Hz 2 %" high, 11%" deep, 19" wide		Check No.
Specifications subject to change without notice.		Price:	\$299.95		



ikko Electric Corp. of America mer St., Van Nuys, Calif. 91406 In Canada uperior Electronics, Inc., Montreal

> \*See the warranty card with the product for full details

24 on Reader Service Card

The above prices are shown for informational purposes only. Actual retail price will be set by the individual Nikko dealer at his option

# Simple PINK NOISE Filter

# Dr. Robert Mauro\*

In the acoustics field, white noise sources are frequently employed along with octave and one-third octave band filters. Typical applications include the measurement of transducer characteristics, material absorption-reflection and transmission coefficients, and room parameters such as reverberation time. One problem commonly encountered in making these measurements is that the noise signal detected falls off greatly at low frequencies since the rms noise passed by the filter varies as the square root of the filter bandwidth, and hence the center frequency of the filter.

Generally one compensates for this effect by increasing the power-amplifier gain when the lower frequencies are to be examined; but, since the filter is usually connected at the output (Fig. 1), this increased gain can result in an overload of both the power amplifier and the loudspeaker.

A more practical solution to this problem is to convert the random noise source from one having a constant ener-

\*Assistant Professor of Electrical Engineering, Manhattan College, Riverdale, N.Y.





Fig. 3—Audio pink noise filter design.

AUDIO • March 1977
# 

Our concept: the cassette is a component of your sound system, not an accessory. Because a cassette, unlike its open-reel counterpart, actually becomes an integral part of your system the instant you put it in your cassette deck.

This philosophy was one of the underlying principles behind the development of TDK SA cassettes. TDK SA was the first non-chrome tape compatible with chrome bias and equalization. It gives you better high-end performance than ferric-oxidebased tape, and unlike chrome tapes, it gives you greater dynamic range at low and midrange frequencies, with far less distortion.

But our engineers put as much emphasis on the design and construction of the SA cassette housing as they did on the SA tape inside. Our cassette shell and tape carriage system are made to the same high standards as the tape they carry. So you get the kind of jam-proof, friction-free reliability you want in

every cassette we make. Judging from our sales and fan mail, you agree with our philosophy.

TDK SA cassettes offer both superior tape and precision mechanics. That's why quality tape deck manufacturers either use SA as their reference cassettes, or recommend it for their machines.\* And why you'll get the best from your system by using our machine in your machine.

TDK Electronics Corp., 755 Eastgate Boulevard, Garden City, New York 11530. In Canada, contact Superior Electronics Industries, Ltd.





Fig. 4-Single stage characteristic.

Model

**INTRATEC** 

Distributed in the U.S.A. in conjunction with

And in Canada : Smyth Sound Equipment Ltd, 595 Parc Industriel, Longueuil, Quebec J4H 3V7

399 Jefferson Davis Highway Arlington Virginia 22202



gy/cycle, or white noise frequency spectrum, to a constant energy/octave, or pink noise response. This may be accomplished by employing a conventional white noise source and connecting a "pink noise filter" to its output. This type of filter basically has a transmission characteristic which falls off inversely as the square root of the applied frequency (Fig. 5). The rms output from such a pink noise source will then be independent of the octave band being examined (Fig. 2).

A simple circuit for achieving this type of filtering in the audio range from 10 hz to 20 khz is shown in Fig. 3, with the general form of one of the stages given in Fig. 4.

Since d.c. coupling of the stages is employed, R<sub>b</sub> is set equal to zero to minimize the d.c. gain of each stage, and hence the effect of d.c. offset voltages on filter stability. Using Fig. 5 as a guide, a -20 dB/decade piecewise approximation is employed using three stages with their break frequencies selected to provide the best possible fit to the -10 dB/decade desired slope. This requires three curves of the type shown in Fig. 4, spaced a decade apart in frequency, and allows for the use of the same resistors in each stage by simply changing the capacitor by a power of 10 to shift the breakpoints to the desired location. The addition of the RC break frequency at  $f_1 = 17.78$  kHz at the input of IC3 extends the accuracy of the response to beyond 30 kHz.

It should be noted that when using the filter there is no impedance matching problem since its frequency characteristics are essentially independent of the source and load impedances connected to it; in addition, any available supply voltages from  $\pm 6$  to  $\pm 18$  volts can be utilized. If 1 per cent resistors and 5 per cent capacitors are employed, the response should be accurate to within one dB of the desired characteristic.

## One step nearer the reference

Computer-based analysis has led KEF engineers to a significant advance in speaker performance – the acoustic Butter worth (aB) filter network. Now, replacing conventional filter circuitry in the renowned Model 104, it transforms performance with reduced coloration, increased stereo depth and imaging. A difference you can **hear**. An advance radical enough to justify making the new network available for replacement in existing Model 104's – see your dealer about this. Power rating is higher too – 100 watts program – with fuse protection for the tweeter. So KEF engineers have seemingly done the impossible – taken the superb 3 speaker system that reviewers already praised for its clean, uncolored 'reference' sound – **and improved it**.

KEF Electronics Limited Maidstone Kent England



Check No. 18 on Reader Service Card

AmoriconPodial liste

You may have noticed that few turntable manufacturers call your attention to the critical role of the tonearm in record playback. Dual is an exception. Whatever the shape, materials, or mechanics of a conearm, the goal is always the same: to maintain the carridge in the correct geometric relationship to the groove, and to permit the stylus to follow the contours of the groove

## Why we want you walls freely and accurately. Whenever the stylus cannot follow the groove to know more about undulations, it will gouge its own way. And as we have tonearms. And why frequently reminded you, there is no way to repair a damaged others may not signer should consider

record. Every tanearm de-

geometry, mass. balance, resonance, bearing friction, and the accuracy and stability of settings for stylus force and anti-skating. However, despite the simple fact that the shortest distance between two points is a straight line, some designers are more concerned with copearance. Hence, the curved to earm. whose deviations between pivot and stylus simply add mass, reduce rigidity and increase the likelihood of resonance.

Dual engineers have always designed for optimum performance. The essential differences in approach and results are indicated below. You might keep al this in mind when you are considering your next turntable. Chances are you'll want it to be a Dual.



United Audio Products, 120 So. Columbus Ave., Mt. Vernon, N.Y. 10553 Exclusive U.S. Distribution Agency for Dual

The curvec tonearm may appear larger than the Dual tonearm, but both actually have the identical effective length and horizontal tracking cng e.

Actual size of Dual tube (A) and typical curved tonearm (B). For the same effective length, straight Dual tonearm has lower mass and resonance, yet greater regidity.

play 6% pitch cante of siluminated strobe; cue-controliviscous-damped in both directions; multi-calibrated anti-skating. Less than \$280. Dual 510. Similar except semi-automatic:<sup>9</sup>Lead-in groove sensor Tonearm lifts automatically at end of play and motor shuts off Less than \$200. Dual 502. Semi-automatic. Less sensor

Specifications (DIN B): Romble, >66dB; Wow and flutter <= 0.05



Gimbal-mounted Qual tonearms pivot horizontally and vertically on identical sets of pivot points and high-precision

Stylus force, applied by long coiled spring around vertical pixet, remains perpendicular tracecard even if turn-

## BIRTH OF A SPEC?

## PHONO CARTRIDGE NOISE

Present methods of measuring signal-to-noise (S/N) ratios do not represent the true noise performance of phono preamps under real operating conditions. Noise measurements with the input shorted are only a measure of the preamp noise voltage, ignoring the two other noise sources, the preamp current noise and the noise of the phono cartridge.

Modern phono preamps have typical S/N ratios in the 70 dB range (below 2mV @ 1 kHz) which corresponds to an input noise voltage of 0.64  $\mu$ V which looks impressive but is quite meaningless. The noise of the cartridge ' and input network is typically greater than the preamp noise voltage, ultimately limiting S/N ratios, and this must be considered when specifying preamplifier noise performance. A method of analyzing the noise of complex networks will be presented and then used in an example problem.

40

## John Maxwell\*

**Review of Noise Basics** The noise of a passive network is thermal, generated by the real part of the complex impedance, as given by Nyquist's relation:

$$\overline{V_{p}^{2}} = 4 \text{ kTRe}(Z) \Delta f$$
 (1)

- where  $\overline{V_n^2}$  = Mean square noise voltage,
  - k = Boltzmann's constant (1.38 x 10<sup>-23</sup> VAS / °K),
  - T = Absolute temperature (°K),
  - Re (Z) = Real part of complex impedance (ohms), and af = Noise bandwidth (Hz)

The total noise voltage over a frequency band can be readily calculated if it is white noise (i.e., Re (Z) is frequency independent). This is not the case with phono cartridges or most real world noise problems. Rapidly changing cartridge network impedance and the RIAA equalization of the preamplifier combine to complicate the issue. The total input noise in a non-ideal case can be calculated by breaking the noise spectrum into several small bands where the noise is nearly white and calculating the noise of each band. The total input noise is the rms sum of the noise in each of the bands  $N_1$ ...  $N_n$ .

V noise = 
$$(V_{N_1}^2 + V_{N_2}^2 + \dots + V_{N_N}^2)^{1/2}$$
 (2)

This expression does not take into account gain variations of the preamp which will also change the character of the noise at the preamp output. By reflecting the RIAA equalization to the preamp input and normalizing the gain to 0 dB at "Senior Engineer.

National Semiconductor, Santa Clara, Calif.

## Table 1—Summary of phono cartridge calculations

f Range (Hz)	25-50	50-100	100-200	200-400	400-800	800-1.6K	1.6K-3.2K	3.2K-6.4k	6.4K-12.8K	12.8K-20K
f Center (Hz)	37.5	75	150	300	600	1200	2400	4800	9600	16.4K
<sup>f</sup> Bw <sup>(Hz)</sup>	25	50	100	200	400	800	1600	3200	6400	7.2k
$Q = \frac{\omega Ls}{Dr}$	.156	.313	.625	1.25	2.5	5.	10	20	40	68.4
$Q^2 = KS$	.0244	.098	.391	1.56	6.25	25	100	400	1600	4678.6
$1 + Q^2$	1.0244	1.098	1.391	2.56	7.25	26	101	401	1601	4679.6
$\frac{1 + Q^2}{Q^2}$ $\frac{R_p(\Omega)}{L_p(H)}$	42	11.24	3.56	1.64	1.16	1.04	1.01	1.0	1.0	1.0
$R_{\mathbf{p}}(\Omega)$	1.16K	1.24K	1.57K	2.9K	8.2K	29.4K	114K	454K	1.8M	5.29M
L <sub>D</sub> (H)	31.5	8.43	2.67	1.23	.87	.78	.76	.75	.75	.75
$\mathbf{R}_{\mathbf{p}}^{r} \  \mathbf{R} \ $ ( $\Omega$ )	1.13K	1.21K	1. <b>52</b> K	2.74K	7K	18.1K	32.9K	42.6K	45.8K	46.6K
$X_{L}^{F}(\Omega)$	7.42K	3.97K	2.52K	2.32K	3.28K	5.88K	11. <b>45</b> K	22.6K	45.2K	77.2K
$X_{C}(\Omega)$	17M	8.48M	4.24M	2.12M	1.06M	.53M	.265M	.1 <b>3</b> 3M	66.3K	38.8K
$R_{e}(Z)$ ( $\Omega$ )	1.11K	1.11K	1.1 <b>1K</b>	1.15K	1. <b>26</b> K	1.73K	3.86K	12.4K	41.5K	34K
IZI (Ω)	1.12K	1.15K	1.3K	1.77K	2. <b>97</b> K	5.59K	11. <b>7K</b>	24.4K	43.6K	40.1K
$e_{nz} (nV/\sqrt{Hz}) V_{N(nV)}$	4.24	4.24	4.24	4.31	4.51	5.29	7.9	14.2	26	23.5
$V_{N(nV)}$	21.2	30	42.4	61	90.2	149.6	316	803	2080	1994
$V_n^2(nV^2)$	449.4	900	1798	3721	8136	22.4K	99.9K	645K	4.33M	3.98M
A <sup>2</sup>	63.0	29.5	10.7	3.85	1.66	.85	.49	. 154	.043	0.019
$A^2Vn^2$ (nV <sup>2</sup> )	28.3K	26.6K	19.2K	13.2K	13.5K	19K	48.9K	99.3K	186K	76K

 $(\Sigma V_n^2)^{-1/2} = 3 \mu V$  unequalized noise

 $(|An|^2 V n^2)^{1/2} = .73 \mu V RIAA$  equalized noise

## NO ONE PUTS A TURNTABLE ON TOP OF A SPEAKER, RIGHT?

We realize no sane person ever puts their turntable even close to their speakers, but we did it to prove a point.

Which is, it's now possible to build turntables that effectively deal with that unbearable "howl" known as mechanical and acoustic feedback.

The first of these new turntables are the Kenwood KD-3055 and KD-2055.

How did we do it?

With a special base made of an anti-resonance concrete so dense it absorbs vibrations from the speakers and the floor before they get to our new S-shaped tone arm.

To prove it, we did the unheard of.

We put the turntable right on the speaker box. The worst place for vibrations. Then we turned up the music.

Nothing happened. No howl. No screech. Just music, loud and clear.

To make a believer out of you, ask your Kenwood dealer for a demonstration comparing the Kenwoods with any other turntable in the store.

And once you've made the comparison based on performance, make a comparison based on price.

The semi-automatic KD-2055 is only \$139."The fully-automatic KD-3055, only \$179."

And that's amazing, right?

15777 South Broadway, Gardena, CA 90248 72-02 Fifty-First Ave., Woodside, NY 11377 \*Suggested resale price. Actual prices are established by Kenwood dealers. Check No. 19 on Reader Service Card

AmericanRadioHistory Com





Fig. 2-Normalized RIAA gain.

phono cartridge consists of a series

inductance and resistance shunted

by a small capacitor. Each cartridge

has a recommended load consisting

of a specified shunt resistance and

capacitor. A model for the cartridge

and preamp input network is shown

quite formidable to analyze and

needs further simplification.

Through the use of Q equations<sup>2</sup>, a

series L-R is transformed to a parallel

L-R, as shown in Fig. 4.

This seemingly simple circuit is

in Fig. 3.

1 kHz, the equalized cartridge noise may then be calculated.

$$V_{EQ} = (|A_1|^2 V_{N_1}^2 + |A_2|^2 V_{N_2}^2$$
(3)  
+ . . . + |A\_n|^2 V\_{N\_n}^2^{-1/2}

Where  $V_{EQ}$  = Equalized preamp input noise and  $|A_n|$  = Magnitude of the equalize gain at the center of each noise band (V / V).

### Cartridge Impedance

resistance.

The simplified lumped model of a



rig. 3-Phono cartridge and preamp input network.

Fig. 4—Simplified phono input network.



## SIMPLIFYING THE INPUT NETWORK



 $Rp = Rs(1+Q^{2})$  $Lp = Ls \frac{(1+Q^{2})}{Q^{2}}$ 

R = R<sub>A</sub>//Rp L = Lp C = C<sub>s</sub> + C<sub>C</sub> The impedance relations for this network are:

$$Re(Z) = \frac{R X_{L}^{2} X_{C}^{2}}{(R X_{L} - R X_{C})^{2} + X_{L}^{2} X_{C}^{2}}$$
(5)  
$$|Z| = \frac{R X_{L} X_{C}}{(R X_{L} - R X_{C})^{2} + X_{L}^{2} X_{C}^{2}}$$
(5)

$$= \frac{1}{\left[ (RX_L - RX_C)^2 + X_L^2 X_C^2 \right]^{1/2}}$$

## Example

Calculation of the RIAA equalized phono input noise is done using equations (1)-(5). Center frequencies and frequency bands must be chosen: values of  $R_p$ ,  $L_p$ ,  $R_e(Z)$ , |Z|, and noise calculated for each band, then summed for the total noise. Octave bandwidths starting at 25 Hz will be adequate for approximating the noise.

An ADC-27 phono cartridge is used in this example, loaded with C = 250 pF and  $R_{A=}$  47 kilohms as specified by the manufacturer, with cartridge constants of  $R_{S}$  = 1.13 kilohms and  $L_{S}$  = 0.75 H (C<sub>C</sub> may be neglected). Table 1 shows a summary of the calculations required for this example.

#### Conclusions

The RIAA equalized noise of the ADC-27 phono cartridge and preamp input network was 0.73  $\mu$ V for the audio band. This is the limit for S/N ratios if the preamp was noiseless, but zero noise amplifiers do not exist. If the preamp noise voltage was 0.64  $\mu$ V, then the actual noise of the system is 0.97  $\mu$ V ( $\sqrt{(0.64)^2 + (0.73)^2 \mu}$ V) or -66 dB S/N ratio (re: 2mV @ 1 kHz input). This is a 4 dB loss, and the preamp current noise will degrade this even more.

Thus, it is apparent that present phono preamp S / N ratio measurement methods are inadequate for defining actual system performance and that a new method should be used, one that reflects true performance instead of hollow specs.  $\Delta$ 

#### References

1. Hallgren, B.I., "On the Noise Performance of a Magnetic Phonograph Pickup," *J. Audio Eng. Soc.*, Vol. 23, pp. 546-552, (Sept. 1975).

2. Fristoe, H.T., "The Use of Q Equations to Solve Complex Electrical Networks," *Engineering Research Bulletin*, Oklahoma State University, 1964.

3. Korn, G.A. and T.M., "Basic Tables in Electrical Engineering," McGraw-Hill, New York, New York, 1965.

Hill, New York, New York, 1965. 4. Maxwell, J., "The Low Noise JFET —The Noise Problem Solver," National Semiconductor AN151, (Sept. 1975).

AUDIO • March 1977

 $=\frac{\omega Ls}{Rs}$ 



# Only Technics gives you the world's most precise drive system all these ways.

Technics direct drive. Radio stations use it. Discos abuse it. And now you can get it in virtually any kind of. turntable you want. Because Technics puts direct drive into more kinds of turntables than anyone else.

You'll find it in three manuals that start at under \$200\* with the SL-1500. Or for a little more money you can get a lot more convenience with our newest turntable, the semi-automatic SL-1400. The world's first turntable with a one-chip 321 element IC. That gets the platter to exact speed in only 1/3 of a revolution. There is also the fully automatic single disc 5-1300. And the world's first direct-drive changer, the S\_-1350.

But there's a lot more to Technics direct drive than just more kinds of turn-SL-1200 tables. There's also mcre precision, better performance



**Direct Drive** System

and greater reliability.

Because in our direct-drive system the platter is an extension of the motor shaft. That means there aren't any belts, gears or idlers to produce variations in speed. And that means all our turntables have less than 0.03% wow and futter (WRMS), 0.04% for the SL-1350).

5L-1400

You'll also find an electronically controlled DC motor that =pins at exactly 331/3 or 45 RPM. Regardless of fluctuations in AC line vo tage or frequency. What's more, unlike high-speed, rumble-producing motors, our motor introduces so little vibration into the system that any rumble remains inaudible (-70 dB DIN B).

And it doesn't matter which Technics turntable you choose. Because they all have the extras you need. Like variable pitch controls. A built-in stroboscope. Viscous-damped cueing. Feedback-insulated legs. As well as a dust cover and integral base.

So if you want a turntable good enough for professionals, get the turntables radio stations use and discos abuse. Technics direct drive.

\*Suggested retail price.

Techn by Panasonic Check No. 44 on Reade

SL-1100A

SL-1350

SL-1500

ATTRITUS

SL-130



## SOUND REPRODUCTION

John K. Hilliard\*



any attempts were made before the year 1928 to provide talking motion pictures for general theater use. The inability to provide recording and reproducing equipment on a practical commercial scale resulted from limitations in microphones, amplifiers, loudspeakers, disc and film techniques, and the lack of general research needed to provide tools for their commercial application.

Col. Nathan Levinson, the Pacific Coast representative of the Western Electric Co. for broadcast and public address systems, rented a public address system to Universal Studios used in the production of "The Hunchback of Notre Dame" and by supplying this equipment, he became acquainted with motion picture executives. Levinson was a friend of Ralph Bown, in charge of radio facilities for the Western Electric Co., who told Levinson that Western Electric had experimental talking motion picture equipment ready for a demonstration.

Early in 1926, Levinson talked with MGM, Goldwyn, and others to determine their interest in seeing a demonstration. Sam Warner of Warner Brothers was the only one technically interested in this new development. His brother was opposed as were other studio executives who believed movies with sound would ruin their business. Sam Warner sneaked Col. Levinson into the Warner lot by covering him up in a blanket as they passed the guard gate. After several meetings at Warner Studios, the Warners agreed to witness a demonstration at the Bell Telephone Laboratories in the early part of 1926.

The Warner brothers were so enthusiastic over the preliminary tests that they arranged for full scale tests using their own cameramen, artists, and technicians in cooperation with the Bell Laboratories staff. After several tests, the Warner Brothers were convinced that a corporation should be organized to produce and market sound motion pictures and equipment. A short subject with Bryan Foy was then made in the Manhattan Opera House in New York City. George Groves was the mixer, and he relates that many times recording was stopped due to subway noise. The first theater sound equipment was transported and installed with armed guards because of the mistaken fear

\*John K. Hilliard & Assoc., Santa Ana, Calif.

by producers and exhibitors that sound was not compatible with motion pictures, and equipment sabotage was possible.

In April of 1926, the Vitaphone Corp. was organized with "Sam" L. Warner as president, and the first major vitaphone sound picture was "Don Juan" released in August, 1926, in which music from the New York Philharmonic was featured. Plans for production in Hollywood were immediately started, and sound stages were built using the recommendations of the best acoustical experts. "The Jazz Singer" with Al Jolson was placed in production in April of 1927 and exhibited in New York City on October 6, 1927. It was so successful that almost every motion picture producer was convinced sound motion pictures were here on a real basis. The Vitaphone equipment consisted of a synchronized 33 1/3 rpm, 16 in. disc, a turntable geared to the projector using a Western Electric 4-A pickup, and their amplifiers and loudspeakers.

At this point, it is necessary to review the work of several individuals who were largely responsible for the ability of Western Electric to design, manufacture, and provide the necessary hardware needed for this important step. Edward C. Wente came to the company in 1914, and in 1917 he designed the forerunner of the famous Western 394-W condenser microphone which was produced commercially in 1926. This microphone provided the necessary sensitivity and frequency range to adequately record speech and music with excellent quality. Wente and Thuras also designed a dynamic type driver, the Western Electric 555-W receiver which, when coupled with a horn consisting of a one-in. throat and a 40-square-foot mouth area, was capable of a range of 100-to-5000 Hz and with an average midrange efficiency of 25 per cent. With five watts input, it could create more than one watt of acoustic power. By using multiple driver units and several horns, it was then possible to fill the larger theaters (3000 to 5000 seats) with ample sound power to adequately reproduce speech, sound effects, and music! This efficiency of 25 per cent compared to less than one per cent on present home high quality cone type speakers was needed because only 2.5 and 10-watt amplifiers were available. These amplifiers used filamentary type vacuum tubes requiring d.c. from batteries or motor generators for both filament and plate supplies. The power amplifiers were of the 205-D type in single ended and push-pull circuits. The recording amplifiers were of the type which were used so successfully in the first 500watt broadcast transmitters-studios and public address equipment. The 8-A and 9-A amplifiers provided the amplification from the 394-W condenser transmitter amplifier, which fed the recording equipment. A speed of 90 feet per minute and 24 frames per second was chosen for both the sound disc and the sound on film equipment which was released in 1927. Accurate speed was possible due to the work of H.M. Stoller who used a bridge balanced driving motor. Unbalance of the bridge provided the necessary change of current which increased or decreased the motor speed as required.

In January of 1927, Electrical Research Products, Inc., was formed as a subsidiary of the Western Electric Company to handle commercial relations with the motion picture producers and exhibitors. At this time, both disc and film recording methods were made available. Again, Wente was responsible for another important device, the light valve. This was a string valve using two ribbons suspended in a plane at right angles to a magnetic field. The ribbons were six mils thick and stretched to a resonant point of 8500 Hz. A fixed source of incandescent light illuminated the opening between the ribbons spaced one mil apart. Current from the recording amplifier moved the ribbons from the normal spacing of one mil to either complete closure of the slit or to double width of two mils as a maximum for 100 per cent modulation of the fixed source of light. This slit was focused on the film by an optical system with a two-to-one reduction. This is the variable density type of sound recording on film system.

## **Sound Beginnings**

In April of 1928 (six months after the showing of the "Jazz Singer"), Paramount, United Artists, MGM, Universal, and others signed agreements with Electrical Research Products, Inc. (ERPI), for licenses and recording equipment. One can only imagine the intense activity resulting from these contracts. Western Electric utilized all of its telephone plant manufacturing facilities at Kearney, N.J., and the Hawthorne plant in Chicago to produce the required 16 recording channels delivered in late 1928. What hectic days these were! Sound stages were erected with Dr. Vern Knudsen of UCLA serving as acoustical consultant. Sound directors, transmission engineers, and recording staffs were recruited from the broadcast industry, the telephone companies, phonograph recording companies, and any related field since there were few sound experts, and none with talking picture experience. An augmented staff of writers, composers, and stage actors were also assembled. The training of staff kept pace with material developments. The Academy of Motion Picture Arts and Sciences, funded by the eight major producers, gave night school instruction to 900, and this course resulted in the publication in

system. The Photophone group was organized from a three cornered arrangement between General Electric, Westinghouse, and RCA. The Photophone system of recording used the variable area method. The sound tract is produced by actually moving a light beam of uniform intensity back and forth lengthwise across a slit whose length and width are fixed. The resulting sound track in its early form had the appearance of a serrated or saw tooth edge of uniform density adjoining a uniform transparent area. Otherwise, all sound recording and reproducing equipment is essentially alike. By the end of 1929, ERPI and RCA had equipped more than 5,000 theaters in the U.S. and 2,000 abroad.



Douglas Shearer shows his sister, actress Norma Shearer, how the voice is photographed on film as it comes through the recording channels in the form of electrical impulses. (*Photo—Courtesy of Western Electric.*)

1931 of the book, "Recording Sound for Motion Pictures," published by McGraw Hill Company. I was privileged to be one of the authors.

Hollywood, the capital of the silent motion picture, now, in its reincarnation, had a voice! Stars of the silent screen recorded their voices, and many failed to qualify for the sound pictures. The success of outdoor pictures, such as "Arizona," shook off the belief that a sound stage was essential.

RCA Photophone, Inc., was organized in 1928 to promote its commercial exploration of their sound on film Warner Brothers continued the Vitaphone method of sound on disc up to 1933, at which time they switched to sound on film because of the obvious advantages of synchronization, editing, and standardization with the other studios.

#### Movie Memorabilia

It was my good fortune to have been selected for this work from a group trained in physics, engineering, acoustics, and broadcasting experience. In September of 1928, I arrived at United Artists Studio as transmission engineer in charge of the



Sound recording monitor booth first used in 1928 with John K. Hilliard at the mixer controls.

recording operation. Dr. Vern Knudsen had designed the sound stages which were nearing completion, and recording equipment was arriving from the Western Electric Co. Everyone had more than their share of work to do since our first talking picture, "Coquette," with Mary Pickford and Douglas Fairbanks, was to start in November. Both disc and film equipment were installed in duplicate since at the time of contract signing, it was thought both would be used. Actually, the disc equipment was used for instant playback of the recording, and using the soft wax for this purpose. The wax was processed into a pressed record and used as a backup in case the film recording was not adequate. This duplication was dropped after a few pictures since the use of two film machines proved to supply adequate protection.

The experience of Western Electric did not involve a full feature length film, including editing and release printing of the hundreds of prints needed for simultaneous exhibition. so we were immediately faced with the problem of creating "dubbing" facilities. This consisted of providing a number of reproducing sound heads in a re-recording room where a number of recorded films could be synchronized, including music and sound effects along with the original dialogue. A new single negative was then available for the final release. As many as 16 separate sound tracks were used to composite all of the individual sound tracks. The filamentary type vacuum tubes had many problems, and microphonics was the source of

AmericanRadioHistory Com

There are a lot of 900d loudspeakers There are a lot of 900d loudspeakers oround these days. Especially if you're 900d. fo pay \$100 or \$150. Some are pretty 900d. some are really acod. 47 ome are really good. The are really good. But good isn't great. But good isn't great. But good isn't great. But good isn't great. Ne make two loudspeakers. We make two loudspeakers. We make their systems. Survey hankshelf systems. IN HUY DIE TEOLLY 900d. Some ore really 900d. We make two loudspeakers. Both are We make two loudspeakers. Both are 3-way bookshelf systems. One is \$150; the 3-way 5,114. Both are really efficient. (Twice other \$114. Both are really efficient in that price os efficient as the current leader in that price other \$114. Both are really efficient. (Iwice osefficient as the current leader in that price as efficient as the current a big receiver to os efficient os the current leader in that price os efficient os the current leader in that price range.) You won't need a big receiver to range hin cound et a dig sound. The enclosures are the same kind used The enclosure in interentiere hit we finish The enclosures are the same kind used The enclosures are the same kind we finished for expensive loudspeakers, but we foncy wood for expensive loudspeakers. No foncy wood them in a warm-toned vinyl. No foncy wood the source warm-toned vinyl. No foncy wood the source warm-toned vinyl. No foncy wood the source warm-tone viny get a big sound. Come listen to Bolivar. Then listen to any other speaker that costs about the some. You'll buy Bolivar.

BolitVar Speaker work of the second of the s Your nearest Bolivar dealer? That's easy. Coll (800) 243-6100 in Connecticut. 1.800-8.82:6500. Bolivar Dealer? That's easy. Vorks. Bolivar. Tennessee 38008

AmericanRadioHistory Con

# THE GAP BETWEEN OTHER TAPES HAS

## INTRODUCING UD-XL I AND UD-XL II.

Maxell tapes have always been considered by many people to be the highest quality tapes in the world.

But instead of sitting back and resting on our laurels, we've spent the last few years looking for ways to move even further ahead.

The results of our efforts are Maxell UD-XL I and UD-XL II. Two tapes which are not only better than anything we've ever made, they're better than anything anyone's ever made.

To begin with, UD-XL I is an improved version of our own UD-XL.

More specifically, it's a ferric oxide tape designed for use with the tape selector switch in the normal position (120



microsecond equalization and standard bias).

Its performance characteristics include the lowest harmonic distortion level of any premium cassette on the market today.

An extremely flat frequency



# MAXELL AND ALL JUST WIDENED.

Signal-to-Noise Ratio Comparison

response from the lowest to the highest frequencies. And an exceptionally high resistance to saturation even

at the highest recording levels.

UD-XL II, on the other hand, is a ferric oxide tape specially formulated for use with the tape selector switch in the chrome position (70 microsecond equalization and high-level bias). It offers the low noise advantage of "chrome" without the disadvantages. Its performance characteristics include extremely low modulation noise and a 5 dB signal-to-noise ratio improvement over ordinary premium tapes.

If you'd like to know more about UD-XL I and UD-XL II, stop into your local dealer and ask some questions. Not just about our tapes, but about our competitors' as well.

We think you'll soon discover something that we've always known. The best just keeps getting better.

## MAXELL. THE TAPE THAT'S TOO GOOD FOR MOST EQUIPMENT.

Corporation of America, 130 West Commercial Ave., Moonachie, Check No. 21 on Reader Service Card



greatest agony. All amplifiers near or on moving equipment had to be suspended on shock assemblies. Even acoustic energy such as monitor loudspeakers or high room noise levels were responsible for many retakes. In 1931, I had a conference with M.J. Kelley at the Bell Laboratories to determine when heater type tubes would be available for recording equipment since they were appearing in radio receivers. He provided information on a series of heater type tubes having low noise, long life, and excellent stability.

In 1933, I transferred to MGM studios and began a systematic review and redesign of all recording amplifiers. The existing amplifiers had been in use from 1925 with little or no revision. We were concerned that the phase shift between the lowest and highest frequencies was on the order of 1500 degrees in the recording channel, which distorted speech and caused a loss of articulation. A large number of transformers were used in the record ¬g circuit since the amplifiers were im many locations, and each

amplifier required an input and output transformer to work on low impedance circuits varying from 30 to 600 ohms. Phase shift is reduced by using transformers having very high self-inductance (5 H per 100 ohms of circuit impedance) and relatively large coupling capacities with extremely low leakage and distributed capacity. When used in recording amplifiers, transformers-designed by E.B. Harrison and manufactured by Lansing Manufacturing Co.-reduced the overall recording channel phase shift to less than 360 degrees (in the recorded frequency range, the phase shift is directly proportional to freauency).

When these redesigned recording amplifiers were placed in service, it became very apparent that speech, sound effects, and the attack on sounds of musical instruments were greatly improved in fidelity. The techniques were then applied by others to bring hi-fi amplifiers to the disc recording and home music fields. At the same time, it became obvious that the maximum benefit of improved recording quality must be matched with equal theater reproducing equipment quality.

## **Cooperative Problem Solving**

The Research Council of the Academy of Motion Pictures Arts and Sciences was organized in 1934 to cooperatively handle technical problems for the industry. A theater standardization committee was appointed for the express purpose of coordinating the sound recording quality within the major studios and provide information on adjustment of theater equipment for a commercially acceptable quality level. Early in the program, a test reel was assembled using a short length of a regular release print from each of the studios. It was used to adjust all studio projection rooms for an optimum frequency response characteristic when reproducing typical pictures of all studios. This test reel proved to be so valuable in Hollywood that prints were made available to service companies, equipment manufacturers, and theaters. By this method, theater equipment was

Luncheon of the MGM studio sound department staff after receiving Academy Awards in 1936 for loudspeaker systems and the push-pull variable density light valve. Douglas Shearer is at the near right side.



## The new AR-12 is for people who like their music loud and clean

requiring several times the output power of a few years ago, more rugged loudspeakers must be built to convert this added power into clean acoustical energy without destroying either the speakers or your eardrums.

111111

That's why AR's Advanced Development Division designed the new AR-12 to handle double the power of its predecessors. The long-throw acoustic suspension woofer of the AR-12 allows the wide cone excursions necessary for today's bass-heavy recordings. And it's mounted in a larger volume cabinet usually reserved for our more expensive systems to give you accurate reproduction of lowest bass guitar and synthesizer notes as well as organ pedal tones.

The AR-12 midrange driver uses a new 1" coil design with magnetic fluid centering which permits vastly

With today's rock listening levels increased power handling capacity while retaining a  $2^{1}/4^{\prime\prime}$  cone with its superior dispersion for uniform listening characteristics throughout the room. The AR-12 tweeter is the same advanced hemispherical dome design used in our most expensive systems, and it also shares magnetic fluid design for crystal clear reproduction of the "hot" highs prevalent in today's recordings.

Not only does the AR-12 set a new design standard for clean reproduction at high power levels, but like all AR loudspeakers, each AR-12 is tested to perform to within 1 dB of this standard, the same tolerance applied to professional microphones.

The audible result of this dedication to excellence is described by International Musician and Recording World as follows: The depth and clarity was exceptional and I can honestly say that I heard things in the recordings I had not heard before despite many listenings

So if you like your music loud and clean we invite you to take your favorite recording to your AR dealer and ask him to play it through AR-12 loudspeakers using the most powerful electronics he has in his soundroom. We think you'll find the effortless accuracy of the AR-12 the sound you want to live with.

Write to us for complete information on the loud and clean speakers from AR and a list of demonstrating dealers in your area.





adjusted on a uniform quality basis taking into consideration the acoustics of the auditorium and the loudspeaker characteristics. Power requirements for theaters based on size was next standardized. Finally, a bulletin on theater acoustics was issued indicating the desirable acoustics for new theaters and the methods of modifying existing theaters.

Early in sound motion picture recording, the need for added artificial reverberation became apparent. Time delay for echoes and added reverberation to music was desirable, but such equipment was not available. First attempts included using several prints of sound tracks spaced one or more frames apart and delayed from energized the microphones. This was the first method which achieved a desirable added reverberation to original sounds.

One of the early pictures using artificial reverberation was "In May Time" with Jeanette McDonald. A long shot was used to establish her far off entrance, and then the camera dollied in for a "close up." We used various amounts of reverberation to match the varying camera shots. At that time, it was customary for an actress or actor to review all scenes and takes with the film editor and select the best "take." However, they did not see the dubbing in its final form before release to the theater. I went to Grauman's Chinese Theater on the



Fig. 1—The Fletcher-Munson curves.

the original track. These were then mixed together with results which fell short of the goal. Another attempt was using a long pipe, 300 to 500 feet in length, driven by a loudspeaker on one end and picked up on microphones at 100 feet intervals and added to the original sound. This gave better results than the spaced tracks, but limited the type of reverberation.

In 1934, the Hammond Electronic Organ had as an accessory a "reverberstat" which supplied artificial reverberation to the organ notes. This unit was composed of a series of coil springs of different lengths and diameters driven by a loudspeaker and the opposite ends of the springs opening day of the performance as usual to adjust the volume by a control placed on a seat near the center of the house. When this scene came on, Jeanette for the first time heard the reverberation and realized that something was changed. After the scene was over, she dashed to my seat and said, "John Hilliard, what have you done to my picture?" Of course, after the shock was over, she realized the improvement, and never again was there any question about adding reverberation where it was needed.

Later, reverberation rooms were built consisting of special rooms with little absorption so that reverberation periods of up to three to five seconds

mericanRadioHistory Co

were available. These rooms were energized by a loudspeaker and picked up by one or more microphones. At a later date, drum, disc, and tape delays augmented the supply of sources for artificial reverberation.

#### **Music Pre-Scoring**

The need to record music with vocal selections became obvious at a very early date in sound motion picture recording. Stage noise caused by the hum of arc lights, cameras, ventilators, improper acoustics, placement of orchestra, and many special handicaps forced the techniques of prescoring all musical portions of the picture. This was done by placing the orchestra and soloists in a stage designed specifically for music. (The noise levels were below 35 dBA.) The orchestra was picked up by several microphones to obtain the desired balance, and the solo and choral groups used separate microphones. Up to 1935, only non-directional microphones and the RCA ribbon microphone were used. The soloists were isolated acoustically as much as possible from the orchestra with panels (flats), but it was always necessary to have the soloists hear the orchestra and face the musical director.

An MGM representative stationed in Berlin in 1935 informed the studio in Culver City that the Siemens Co. of Germany had developed a directional microphone (cardioid pattern) so that the back side of the microphone materially suppressed sound pickup. Thus, the soloist on the front side had full pick-up and the back side suppressed the orchestra. A sample microphone was immediately sent to Culver City and first used on "Naughty Marietta" with Jeannette Mc-Donald and Nelson Eddy. The Siemens microphone was considerably larger than the condenser and dynamic microphones then in use. Since Jeannette McDonald had a very weak voice compared to Nelson Eddy, balance was a big problem. As a result, the directional microphone was first placed in front of Jeannette Mc-Donald. An immediate question from Nelson Eddy was why a new microphone was being used for her. He was told that it had pronounced directional properties so that she could be acoustically isolated for balanced pick-up. Eddy then requested we use the same type microphone on him. We explained that we only had one such unit. However, he preferred not to record until we had a similar unit for him-an ultimatum. All major studios have "prop shops" that can du-

# the SAE Revolution



Suggested Price: 1800 - \$300.00 (Top Left), 2800 - \$550.00 (Bottom Left), 2900 - \$450.00 (Top Right), 2100 - \$900.00 (Bottom Right). Cabinets shown optional at additional cost.

SAE has long been involved in the feld of tone equalization. From our pioneering efforts in variable turnover tone controls to our more recent advancements in graphic equalizers, we have continually searched for and developed more flexible and responsive tone networks. From these efforts comes a revolution in tone equalization – the Parametric Equalizer.

Parametric Equalization, long a mainstay in the recording industry, is now available n SAE preamplifiers (2100, 2900) and as separate components (2800, 1800).

With the parametric, you can control **n**ot only cut and boost, as in the graphic, but also bandwidth and center-frequency. With this extra control flexibility, you can control *precisely* any problem or create any sonic effect you wish. Whether you need a .3 octave notch filter because of room resonance, or a tailored bandwidth boost to bring out a hidden vocalist, the control flexibility of the parametric can fit these needs and many more. All of the products shown here offer the sonic per<sup>±</sup>ormance and quality of construction that is typically SAE.

SAE	A 4-3/77
SCIENTIFIC AUDIO ELECTRONICS, INC. P.O. Box 60271, Terminal Annex Los Angeles, Cal. 90060	
Please send more information on the SAE Revolution	
Name	
Address	
CityStateZip	

Check No. 32 on Reader Service Card



Fig. 2-The average voice characteristics of men and women.

plicate the physical appearances of most objects. The results were evidenced when scoring started the next morning. Two identical looking microphones were hung for the soloists; one a Siemens and one looking like a Siemens but having a small dynamic microphone inside. Everyone was happy, most of all the sound department people.

## Movie Hi Fi

The rush to release sound motion pictures in 1928 did not allow for a real analysis of naturalness. However, it was soon recognized that a flat overall frequency response characteristic resulted in an unnatural quality in speech. It was gradually recognized that voices were more natural when the low frequencies were attenuated by suitable equalizers at the time of original recording. They were called "dialogue equalizers" (voice effort equalizers). The shape of the equalizers was arrived at empirically for best natural sound. In later years, studies arrived at basic concepts of why these equalizers provided a subjectively flat quality.

The Fletcher Munson curves, shown in Fig. 1, represent equal loudness contours over the hearing range. Each of the curves represents the various sound intensities required to produce a constant sensation of loudness for the listener throughout the audible range. One of the first examples to be theater needs to be reproduced at a level 5 to 10 dB higher than in faceto-face communication. The higher level is required since the picture image is larger, the distance to the listener is much greater, plus the background noise in the theater is high due to audience and ventilator noise. The opposite is true on the recording stage, where background noise is low and the performer talks at a lower

recognized was that dialogue in the

Figure 2 shows the average voice characteristics of men and women. Normal and soft-spoken dialogue has a high content of low frequencies as compared to the loud voice where there is a large shift to higher output in the 500 to 700 Hz region.

than average level.

There was also a large variation in the amount of initial equalization used. This resulted from the fact that in some studios the actors were permitted to speak at a low volume while in other studios they were required to use a loud voice because of the varying ambient background level. Figure 3 illustrates the minimum and maximum amount of attenuation in the dialogue equalizers under the conditions discussed. The maximum equalization is similar to the A weighting networks in the sound level meter.

There was a decided difference in the amount of dialogue equalization needed for outdoor scenes as compared to indoor scenes, similar to the response of a loudspeaker outside and inside. Outdoor scenes required less dialogue equalization because the sound is spreading uniformly in all directions. The low frequencies are less directional and are, therefore, attenuated more than the higher noise frequencies which have marked directional characteristics. Indoors, reverberation builds up the low frequency response.

The editing of a film sound track for orchestra and voices became very complex at the very beginning of sound pictures. Artists who were beautiful on the screen in many cases were not capable of singing an entire number without a flaw. This was overcome by making as many as 10 takes of a number. Imperfect notes were then cut out of the sound tracks and a perfect note inserted. Most musical sound film editors became so skillful in using this technique that the audience was totally unaware that there may be as many as 50 notes or bars inserted in a completed song.

The early sound recording equipment supplied to the studios by Western Electric used heavy, large marine

## Fig. 3—The minimum and maximum amount of attenuation in the dialogue equalizers.



AUDIO • March 1977

# A new concept in speaker comparison. Instead of speaker vs speaker...



If you were satisfied with conventional speaker sound, Technics would have made a conventional speaker. Then you could have compared our speaker to their speaker.

Instead, we developed Technics Linear Phase Speaker Systems and compared them to music. Live music. Look at the waveforms. On the left are oscilloscope readings. (the fingerprints) of representative musical instruments. On the right, these instruments as reproduced by Technics Linear Phase SB-7000A. Waveform fidelity that could only be achieved by a drastic departure from conventional speaker design. How did we do it? Our engineers realized there were three conditions to be satisfied. First, the crossover network should be designed to provide an overall linear phase characteristic for the whole speaker system, while simultaneously compensating for the different acoustic pressures of the individual drivers. Second, each driver unit must be precisely located in the optimum acoustic position. Third, the driver units must be designed and manufactured with flat amplitude and a wide frequency response.

By using our unique new phase-controlled crossover network, which incorporates 6 dB and 18 dB/octave cut-off slopes

# **Technics Linear Phase**

Piano Waveform reproduced by SB-7000A.

Bass Drum Waveform reproduced by SB-7000A.

and special phase-correcting circuits for each driver, Technics engineers have been able to achieve an overall phase response, linear between 0° and ±45° between 100 Hz and 15 kHz. An incredible figure in a multi-range speaker system! The special phase-correcting circuits have also eliminated "audible dip" at crossover frequencies. These circuits assure excellent directional localization of the original sound source within the acoustic field.

To align the acoustic centers of the speaker units in precisely the same vertical plane, Technics engineers had to develop a new time-delay system using BBD (Bucket Brigade Device). After alignment, each unit was fine-tuned to assure precise linearity. Additionally, each unit was positioned vertically for the best horizontal dispersion and then spaced as closely as possible for the best vertical dispersion of all sound frequencies.

Each of the wide frequency response/ low distortion driver units was designed and manufactured by Technics after exhaustive amplitude and phase studies in anechoic chambers. It is this ability to both design and manufacture that has helped us become the world's largest speaker company. Supplying many of Europe's and America's finest speaker system designers with high-quality speaker units.

# The result: Waveform Fidelity

The diagrams show the phase and amplitude characteristics of Technics Linear Phase and three other leading speaker systems.

The other speaker systems, including those promoted with "phase linearity," show severe phase shifts at different frequencies." But, as you can see, Technics Linear Phase Speaker Systems show an unprecedented flat and linear phase response. This results in more precise positioning of instruments in the stereo sound field.

What does all this mean to you?

Waveform fidelity you can hear...and see. For the first time in audio history there is a speaker system with not only wide frequency response, but complete linearity: Flat amplitude/frequency response and linear phase/ frequency response.

Technics SB-7000A, SB-6000A and SB-5000A. The world's most linear phase speaker systems. No more wandering stereo imagery, no more bass loss at high





volumes; jus® music, pure and simple, as it was originally played. Live.

And if specifications are music to your ears. Listen to these:

SB-7000A: 3-way speaker system with 13<sup>1</sup>/<sub>4</sub>" woofer, 4<sup>3</sup>/<sub>4</sub>" mid-range and 1<sup>1</sup>/<sub>4</sub>" dome tweeter. Output level (1M) of 90.5 dB/watt.

SB-6000A: 2-way speaker system with 12" woofer and 1¼" dome tweeter. Output level (1M) of 91.0 dB/watt.

SB-5000A: 2-way speaker system with 10" woofer and 2¾" tweeter. Output level (1M) of 92.0 dB/watt.

The SB-7000A cone-type units are made from a new triple layer TC/aramid fiber. This combines lightness with high Young's modulus (strength) for smooth piston motion and low distortion.

The high-efficiency dometype tweeters in the SB-7000A

and SB-6000A use a diaphragm of heat molded expanded polyurethane on a silk cloth base.

Sounds great, doesn't it. But there's really only one way to be truly convinced. Listen to Technics Linear Phase Speaker Systems. Now available for demonstration at selected audio dealers for very selective ears.

\*Test data and methodology available upon written request. Write Mr. James Parks, Technics Dept., One Panasonic Way, Secaucus, New Jersey 07094.



cable plugs and connectors for microphones and motor drives. The early sound trucks assembled at the Kearny, N.J., plant were so heavy that when unloaded from the flat car they were immediately tagged by the California highway department to reduce the weight. The marine fittings and other non-essential hardware were replaced and this weight reduction was sufficient to allow their highway use.

The early studio projection rooms had annunciator type buzzers, lights and number displays for signals between the auditorium and projection room. These were supplied by the designer, James Cannon, of Cannon Electric Co. in Los Angeles. He was an ingenious person, and we asked him if he could develop a cable connector for our microphones. He supplied a six-pin connector which was the prototype of his famous P-type connector, and this met with instant acceptance by all the studios. A small camera motor cable connector was the next plug on the list, and from this time (1929) on, the Cannon plug was history.

#### Sound Notables

The early theater and public address systems of Western Electric and RCA proved to be inadequate in the larger theaters. In 1933 there were more than 300 theaters in the USA with a seating capacity of between 3,000 and 5,000 people. The Fletcher Bell Lab stereo demonstration between Philadelphia and Washington, D.C., gave positive proof that such a system was available in a prototype. MGM, through Loews Theaters, controlled 130 of the largest theaters in the U.S. and realized a commercial version of this system was needed. The Electrical Research Products Inc. division of Western Electric (called ERPI), responsible for recording and reproduction, was notified in September of 1933 that MGM would give a contract for 150 systems as soon as a prototype system could be demonstrated. In late 1934, MGM requested a progress report and was told no action had been taken by ERPI. Douglas Shearer, head of the sound department, had initiated the request and asked me for an alternate solution. I told him we had none except to design and build our own system and seek outside manufacturers to cooperate in the final design and supply. Shearer informed Louis B. Mayer of our decision, who authorized any reasonable budget and gave us the goahead. He also authorized the head of

projection l by the deof Cannon . He was an isked him if connector supplied a

Loews Theaters, through Lester Issacc, to cooperate and provide us with theater surveys on size and configuration and recommended several New York theaters for early experimental evaluation. The Capitol Theater on Broadway was selected since it had 5,000 seats and represented a most difficult installation.

Dr. John F. Blackburn of Cal. Tech. was a friend of mine and helped seek sources. We contacted the Lansing Manufacturing Co. owned by Jim Lansing and Jim Decker, who were engaged in production of a small loudspeaker for console radios. The conusing a throat diameter of 1.4-in. and a 3-in. diameter aluminum diaphragm with a tangential compliance. The Western Electric Wente driver has a 4-in. aluminum driver with an annular compliance which proved to have poor power performance.

The Wente Bell Lab multicellular horn had a single configuration of 70° X 70° distribution pattern. We made a survey of the theaters and determined we needed several sizes using an arrangement of single cells each 17° x 17° with a 300 Hz cutoff. These took the form of a 2x4, 2x5, 2x6, 3x3, 3x4, 3x5 cells to cover the various sizes of



The first sound movie "Don Juan" starring John Barrymore opened at the Warner Theater in New York City in August, 1926. (*Photo—Courtesy of Bell Laboratories.*)

cept of using the multicell high frequency horn and drivers designed by Wente along with 15-in. cone-type low frequency units in baffles or horns was outlined. Blackburn was hired by Lansing to aid Jim Lansing with design of the 13-in. cone low frequency units and work with MGM on the design of a high frequency driver midway between the then existing Western Electric 555-W 1-in. throat with phasing plug and the Wente 2-in. throat driver having concentric phasing rings. This compromise was set at theaters. We had learned from earlier multiple horn use that it was beneficial to reduce both the number of horns and overlapping patterns to a minimum, and hence our objective was to use one high frequency horn whenever possible. Robert L. Stephens of MGM was given the task of laying out the geometry and construction of the multicell horns and having the prototypes built in our precision machine shop. (MGM had foundry casting facilities, precision machine shops for camera and printer repair



Data for a power input greater than 20 watts, or Information enabling the reader to translate

кю

tones in Some of

the original components which

9

harmonically

frequency

add new

electrical power input level to acoustic power output

and reverberant sound pressure level (SPL) in a large

listening room.

The lowest curve in each group (for 2.8 watts input

90 dB reverberant

and

SPL) represents a distinctly

toud average listening level, and distortion is insignif-

entire frequency

₽ ₽

õ

typical

Results are

icant.

occasional peaks of 10 to The loudspeaker must be such peak inputs without

I also has o rage level. 7 linearly to s

able

enor-

range. The other curves give some idea of the mous dynamic range of the ALLISON ONE.

ģ

input curves shown below

are, to the

The distortion vs power input curves snown uc-an ALLISON:ONE loudspeaker system are, best of our knowledge, the first to include either

audible strain or effort; otherwise, no illusion of reality

is possible

ISTORTION AND CLARITY

uniform acoustic power output over a wide frequency range. But a flat power output curve alone cannot guarantee clarity; low distortion and wide dynamic Clarity, or transparency, is dependent on the resolu-tion of fine detail in reproduced music. Accurate ren-dering of such detail requires that a loudspeaker have range. But a flat powe guarantee clarity; low range are also essential

addition to those it is supposed to reproduce. Some of these "extra" sounds only modify the music's timbre amount to a dissonant noise, masking subtle details A distorting loudspeaker generates spurious B above average lev to respond linearly Others are not related good recording dB above thev music;

Check No. 2 on Reader Service Card

and a complete wood working plant.) Harry Kimball was assigned the dividing network problem, and I made preliminary designs of flat baffle and horn-loaded low frequency components. At this point ERPI realized we had a viable program and provided us with one of the Fletcher systems. It was at this time we had the experience of learning that time delay and phasing were important considerations as reported in the Eleanor Powell tap dance tests. After extensive time delay tests, we determined that the physical delay between low and high frequency sources should be less than one millisecond.

When the RCA Photophone Division was informed of our goal, Harry Olson and John Volkman asked to participate by supplying versions of their loudspeaker systems and expertise, which we gratefully accepted.

By 1935, we had selected a re-entrant low frequency horn suggested by Olson, and it used four 15-in. Lansing type cone drivers and Lansing 284 driver units for the multicell horns. The MGM Shearer-type two-way theater sound system had arrived. Doug Shearer and I supervised the installation of 12 systems in various cities for the opening of "Romeo and Juliet" featuring Norma Shearer, Doug's sister. These systems were built in the MGM studios. After completion of the installation, RCA and ERPI each were given contracts to supply 75 systems for the Loews Theater Circuit. Other theater chains followed with orders, and the Academy of Motion Picture Arts and Sciences theater standardization research council was formed. I was made chairman. All studios participated, and we specified the minimum power requirements, theater acoustic recommendations, and a standard electrical characteristic since ERPI, RCA, and Lansing were supplying their versions of the twoway system for theater use.

### Divide and Merge

In 1938, a consent degree removed Western Electric (ERPI) from manufacturing and selling theater sound equipment and having service contracts for theater equipment. In December, 1938, this part of ERPI was sold to an ERPI employee organization approved by Western Electric. The new company was organized by M. Conroe and G. Carrington who had managed the ERPI theater division. The name selected was Altec Service Corp. (derived from all technical). They acquired all the equipment, contracts, and personnel who

wished to transfer from ERPI to Altec. By 1941, the Western Electric inventory acquired in the take over was becoming exhausted, and George Carrington asked for a recommendation for equipment sources. I suggested Altec buy Lansing which was done, and Altec Lansing Corp. was formed in May 1941. In the interval between 1938 and 1941, Bob Stephens had resigned from MGM and formed the Stephens Manufacturing Co. where he developed a line of home system loudspeakers in competition with the Lansing Manufacturing Co.

Ercell Harrison at Lansing Manufacturing Co. in 1937 developed a line of transformers under contract to MGM to rebuild the entire MGM recording plant. These transformers were soon known as the 20-20 line (20 Hz-20,000 Hz). They had overall characteristics superior to any commercial transformer line available in the U.S. They also became part of the amplifier used in the Lansing Iconic (Greek for likeness), a small two-way monitor system used as the standard loudspeaker in many labs such as CBS, NBC, Dr. Knudsen's lab at UCLA, and as phonograph recording monitors, I left MGM in 1942 to work at the MIT Radiator Laboratory. In 1943, George Carrington arranged with MIT that I work at Altec Lansing on a magnetic airborne submarine detection device for which Altec Lansing had received a contract to develop. In 1945, we had ready the new two-way system called the "Voice of the Theater" which included improved horns and permanent magnet drivers.

Around 1949, Jim Lansing began to have serious differences with Altec Lansing management and finally resigned. He formed a company in Santa Monica and manufactured loudspeakers, but financial troubles overtook him and the Marguardt Co. in Van Nuys supplied funds. However, he had problems there, and Bill Thomas came in and worked with him. Jim Lansing was a despondent person during these difficult times and retired to his avocado ranch in Escondido. Here, he twice attempted suicide, and on the third try, succeeded. His original partner, Jim Decker, was killed in an aircraft accident earlier. After the death of Jim Lansing, Bill Thomas became president of the now J.B. Lansing Sound Inc. Bob Stephens died in 1953, Douglas Shearer died in 1969, and I am left to tell the tale of how this group was instrumental in formulating the early works of quality sound reinforcement, theater systems, and hi-fi home music. A



## Revolutionary! Sound-shaping taping mike.



Never before — a single microphone that gives you the versatility of 16 microphones! Four tiny frequency filter switches built into the new Shure 516EQ E-Qualidyne Microphone let you tailor sound for studio effects in virtually any recording situation: flick a switch to add sizzle to vocals . . . flick another switch to highlight the sound of a bass drum. You can even compensate for the acoustic response of a room — *right from the microphone!* In all, the 516EQ creates 16 different response variations that can add a new, professional sound to every tape you make. Available singly or in pairs for stereo recording. Ask to hear a recorded demonstration at your participating Shure dealer.

Shure Brothers Inc. 222 Hartrey Ave., Evanston, IL 60204 In Canada: A. C. Simmonds & Sons Limited



Manufacturers of high fidelity components, microphones, sound systems and related circuitry.

Check No. 37 on Reader Service Card



## Realistic Model STA-2000 Stereo Receiver



### MANUFACTURER'S SPECIFICATIONS

*FM Tuner Section*  **IHF Sensitivity:** 1.7 μV (9.8 dBf). **Signal-to-Noise Ratio:** Mono, 70 dB. **Image Rejection:** 80 dB. **Capture Ratio:** 1.5 dB. **THD, 1 kHz:** Mono, 0.2 per cent; stereo, 0.3 per cent. **I.F. Rejection:** 80 dB. **AM Suppression:** 55 dB. **SCA Rejection:** 75 dB. **Stereo Separation, 1 kHz:** 48 dB. AM Tuner Section Sensitivity: External antenna, 10 μV; internal antenna, 150 μV/M. THD: 1.2 per cent. Image Rejection: 60 dB. I.F. Rejection: 56 dB.

Amplifier Section **Power Output:** 75 watts continuous power per channel, 8 ohm loads, from 20 Hz to 20 kHz. **Rated THD:** 0.25 per cent. **Frequency Response:** 15 Hz to 20 kHz.

AmericanRadioHistory Com

Input Sensitivity: Phono, 2.2 mV, High Level, 140 mV. Phono Overload: 230 mV. S/N Ratio: Phono, 70 dB; high level, 75 dB. Tone Range Control: Bass, ±10 dB @ 100 Hz; treble, ±10 dB @ 10 kHz. General Specifications

**Power Requirements:** 120 V, 60 Hz, 550 watts maximum. **Dimensions:** 19¼ in. (48.9 cm) W x 6¼ in. (15.8 cm) H x 16½ in. (41.9 cm) D.

Price: \$499.95.

The people at Radio Shack seem quite determined to find a place for themselves in the audiophile section of the market, and with the introduction of their latest series of stereo receivers, they have to some degree succeeded. Never ones for spelling out a long list of technical specifications, the Radio Shack folks appear, from the published specs given above, to have partially changed their feelings about the common practice of detailing at least the most important technical specifications associated with their new, top-ofthe-line, powerful receiver, the Model STA-2000. While the list of specs is not as complete as those from some other makers, and no attempt has been made to conform to the newly established IHF/IEEE/EIA Tuner Measurement Standards, we can overlook the omissions in light of the actual performance capabilities, design, and layout of the finished product itself.

The front panel of the receiver is styled like many other new receivers, in that it is all one color (gold) with a highly visible, centrally located dial area which extends almost the full width of the panel. FM frequency markings are linear, calibrated at every half MHz, and there is a 0 to 100 logging scale centered between the upper FM scale and AM frequency scale below. To the left of the frequency scales, but also within the cut-out area, is a signal meter which acts as a center-of-channel indicator when turning to FM frequencies and as a signal-strength reading meter when AM stations are tuned to.

The upper section of the panel has a series of light in-

dicators to the left, which tell the program source selected as well as the reception of a stereo FM signal. To the right of these are a pair of output meters which read peak power delivered by the amplifier sections of the receiver. These have calibration notations at 0.1, 1.0, 10. and 100.0 watts, referenced to 8-ohm loads, and therefore provide a fairly accurate indication of power being fed to the speakers over a little more than 30-dB range.

The lower section of the panel contains all of the operating controls, with the exception of the tuning knob which straddles part of the dial opening and the upper section of the panel at the right. Rotary controls include a program selector switch (there are two aux positions, but only one pair of phono inputs), dual-concentric bass and treble controls, a channel balance control and, at the extreme lower right, a master volume control. Located between the balance and volume controls are eight pushbutton switches and a pair of three-position lever switches. The latter combine to offer two tape monitor circuits and dubbing from either of two connected decks to the other. The upper row of four pushbuttons includes an MPX filter switch, FM muting switch, mono stereo switch, and a loudness control switch. The row of buttons below include a -20 dB volume attenuator, speaker-A and speaker-B selectors (either or both can be selected at once), and the power on/off switch. The headphone jack is located at the lower right of the panel, near the master volume control.

The rear panel of the STA-2000 contains a pair of a.c. convenience receptacles (one switched, one unswitched), a line fuseholder at the left, screw-type terminals for speaker wire connections, and two pairs of phono-tip jacks which parallel the regular speaker terminals. We know of no high fidelity speaker system which comes equipped with fixed cords terminated in phono tip plugs and, although the duplication of speaker terminals in this form costs Radio Shack just a few pennies, these jacks could lead users to presume that *both* kinds of speaker terminals can be used simultaneously. The owner's manual rightly cautions against this practice, of course, but not every eager audiophile reads the manual.

Wire jumpers are installed between the preamp-out and main-amp in jacks, permitting separation of these two sections of the receiver for independent use. DIN sockets are supplied for the Tape 1 and Tape 2 circuits, as are conventional phono tip in and out jacks alongside. The usual phono and high level input jacks come next, along with a ground terminal.

Vertically arranged screw terminals accept 300-ohm, 75ohm, and AM external antenna connections, and a pivotable ferrite bar AM antenna can be swung away from the metal chassis for AM reception. The line cord of the STA-2000 is equipped with a capacitive clamp which comes connected to one of the 300-ohm FM antenna terminals and is inteded to serve as an "indoor FM antenna." Users of this receiver should disconnect this "substitute antenna" and connect either an outdoor FM antenna or a properly oriented indoor di-pole antenna to avoid the multipath problems commonly encountered when using "the entire house wiring" as an antenna.





## Internal Construction and Circuit Layout

Individual circuit modules in the STA-2000 include a separate front end, equipped with a MOS-FET r.f. amplifier stage, four-gang tuning capacitor (three-gang for AM), and a tuned r.f. stage in the AM section which is external to the front end and located on the main tuner i.f. and MPX section. The FM i.f. section employs a guadrature limiter-detector IC as well as a phase linear, ceramic filter interstage tuning arrangement. Two bi-polar transistor stages precede the multi-purpose IC. An IC multiplex decoder employing the phase-lock loop principle is used for stereo decoding. Both phono preamp circuits are contained on their own circuit module and employ a differential amplifier pair at the input plus two more transistors per channel in a conventional feedback equalization circuit. The next board is the tone control and voltage amp section, and tone controls are of the familiar negative-feedback Baxandall design. Two identical power amp modules employ a differential amplifier input stage and are direct coupled from input to speaker outputs. A separate module contains a five-transistor plus relay protection circuit. Three forms of circuit protection insure against overdrive, thermal, and speaker problems, including "dead shorting" of speakers. Other circuit modules within the STA-2000 include a power meter circuit board, the pow-

AUDIO • March 1977



Fig. 1 — FM quieting and distortion characteristics.



Fig. 2 — Separation and distortion vs. frequency.



Fig. 3 — Harmonic and intermodulation distortion characteristics.



Fig. 4 — Distortion vs. frequency, both channels driven with 75 watt, 8 ohm loads.

er supply circuitry board, the muting circuit board, and a small board which takes care of the tape monitor and dubbing switching connections.

### **Tuner Section Lab Measurements**

Some of the more important performance characteristics of the FM section of the STA-2000 are graphed in Fig. 1. Usable sensitivity in mono was 2.2  $\mu$ V (12.0 dBf), while in stereo, the usable sensitivity point was reached with a signal input of only 5.0 µV (19.2 dBf). Switching to stereo takes place at  $3.2 \ \mu V$  (15.3 dBf). Just 2.7  $\mu V$  (13.8 dBf) were required to provide 50 dB of quieting in mono, while in stereo, it took 40 µV (37.2 dBf) to reach this quieting level. Ultimate S/N in both mono and stereo reached 70 dB at strong (65 dBf) signal levels. Distortion in stereo actually measured a shade better than in mono (0.12 per cent as against 0.14 per cent at 1 kHz), a condition which suggests that some form of distortion cancellation was taking place between the two circuit sections involved. In any event, both figures were far better than claimed by the manufacturer. Capture ratio measured 1.5 dB, as claimed. Spurious rejection measured better than 90 dB, while image and i.f. rejection were both better than claimed, measuring 85 and 82 dB respectively. AM suppression was exactly as claimed, at 55 dB.

Stereo separation at mid-frequencies was an incredibly high 54 dB, tapering off to 36 dB at 50 Hz and 38 dB at 10 kHz. Figure 2 shows the separation characteristics as a function of test modulating frequencies. Also shown are the distortion curves versus frequency for both the mono and stereo reception modes.

As for the AM tuner section, we measured a very acceptable sensitivity of 12  $\mu$ V using the external antenna connection, and distortion, for strong signals, was 1.0 per cent as against 1.2 per cent claimed, at 30 per cent modulation. I.F. rejection measured 58 dB, while image rejection was exactly 60 dB as claimed. Signal-to-noise was an acceptable 47 dB.

## **Amplifier Section Measurements**

While the amplifier section delivered 81.0 watts per channel into 8-ohm loads with a central test frequency of 1000 Hz, at the frequency extremes of 20 Hz and 20 kHz, the amplifier delivered precisely the claimed 75 watts per channel. IM distortion was 0.16 per cent at 75 watts output, while at this rated output level, THD was a low 0.056 per cent. THD and IM distortion are plotted for power levels from below 1 watt to above rated output in Fig. 3. Harmonic distortion as a function of audio frequency is plotted in Fig. 4 for a constant output of 75 watts per channel.

Frequency response from the high level inputs was flat within 1 dB from 12 Hz to 41 kHz and within 3 dB from 9 Hz to 55 kHz. Input sensitivities were virtually identical to those claimed for both phono and high level inputs. Phono overload occurred at an input level of 220 mV, close enough to the 230 mV claimed and certainly high enough so as not to present any problems when the receiver is used even with high output magnetic cartridges playing dynamically recorded discs. Unweighted phono signal-to-noise ratio was 69 dB, referenced to actual input sensitivity. Hum and noise through the high level inputs measured 87 dB below rated output, much better than the 75 dB claimed. At minimum volume settings, hum and noise measured 90 dB below full output.

Tone control characteristics are displayed in the scope photo of Fig. 5 and correspond almost exactly to published claims of range at 100 Hz and 10 kHz. Shown in Fig. 6 are several plots of response taken with the loudness control switch on, each plot some 10 dB lower than the preceding one, in terms of volume control settings. Note that this receiver

The DITTON 66

The HF-2000 soft-dome tweeter operates from 5,000 to 20,000 Hz. Its exceptionally smooth extended response and wide dispersion achieve an open, airy quality and accurate stereo imaging.

The MD-500 2½" soft-dome mid-range operates from 500 to 5000 Hz with very low distortion, wide dispersion and correct phase relationships. An extremely powerful magnetic assembly ensures critical damping and high-power handling.

The FC-12 woofer has a heavy plasticized diaphragm that effectively suppresses resonances. The neoprene roll suspension permits considerable cone excursions without non-linear effects. A massive F eroball magnet provides critical damping.

The Auxiliary Bass Radiator (ABR) is a highly effective proprietary Celestion device that operates in conjunction with the woofer/enclosure acoustic circuitry. The critically-damped moving system of the ABR has a carefully chosen mass and compliance, and it is acoustically coupled with the crossover network to control the lower range of the woofer excursion and to take over completely at the very lowest frequencies. Result: exceptionally smooth reproduction well under 40 Hz.

## If your speakers don't sound as good as they used to, perhaps you've simply outgrown them.

It happens sooner or later. Especially to those serious audiophiles who listen carefully and with discrimination. Your speakers may be as good as ever, but your taste has matured and become more difficult to satisfy. You now realize that your speakers never did have the crystal-clear highs or the solid bass promised by the specifications. And it's time to have a serious discussion with your preferred audio dealer.

We assume you'll be auditioning his finest speakers, which, of course, should include the Ditton 66 by Celestion, our top model. We'll let the British publication, *Hi-Fi Answers*, tell you why.

"The relatively high efficiency of the chosen speakers (Ditton 66) was sufficient... to cope with the loudest orchestral climaxes available (or even required)... when we wanted to provide concert levels in a large hall, 110 feet x 55 feet with a 25-foot ceiling. A most impressive performance, and... the speakers (were) perfectly ready and able to accept more power.

"Mid-range was typified by an almost complete lack of resonance, distortion or beaming effects, and certainly seemed to vindicate the new 2½ in. dome radiator. The treble end, from 5 kHz upward, was handled by the HF-2000 unit, also seen in the Rogers (BBC) monitor and several in the IMF range."

Perhaps this will help explain why the Ditton 66 by Celestion may sound better than any other speaker you audition.

Although Celestion has been designing and manufacturing individual drivers and systems in England for more than fifty years—and is well known in many other countries—distribution in the U.S. is still quite limited. If you write to us directly, we'll advise you by return mail of your nearest Celestion dealer.

And if you choose a Ditton 66, you'll find it's one speaker you're not likely to outgrow.



## Loudspeakers for the perfectionist

Celestion Industries, Inc. Kuniholm Drive, Holliston, Mass. 01746 In Canada: ROCELCO INC., Montreal 65



Fig. 5-Tone control range of Realistic STA-2000.

boosts only the "lows" when the loudness control circuit is activated. The argument as to whether both lows and highs need to be emphasized for loudness compensation has been going on for years, and we tend to agree with Radio Shack's approach.

## Listening and Use Tests

Sony TAE-5450 Preamplifier

66

Radio-Shack's receiver line has obviously come of age. All the features one looks for in a high-quality integrated receiver are there, with the possible exception of low-cut and high-cut filters. Power is clean and ample, even when the unit is driving lower efficiency speaker systems. At this price and power level, some prospective purchasers might have preferred dual phono inputs instead of the twin high level inputs, but those seeking excellent basic circuit design,



Fig. 6—Loudness control action.

good external design, and reliable long-term performance will still find it in Radio Shack's Realistic STA-2000 receiver. The only thing which seems to have been lost in the process of upgrading is the *tremendous* price advantage that earlier Realistic products offered. Just about all of the other "just under \$500" receivers around offer just a couple of watts less power, a few offer the same power and one or two offer even more power for this price than does the STA-2000. Having moved right up into the "big league," the Realistic STA-2000 must therefore be judged on the basis of its control features and its audible performance rather than solely on the basis of watts per dollar. Judged in this way, the STA-2000 is likely to capture its rightful and significant portion of the ever-growing integrated receiver market.

Leonard Feldman

Check No. 90 on Reader Service Card



MANUFACTURER'S SPECIFICATIONS Frequency Response: 10 Hz to 100

kHz, +0, −1 dB.

**Residual Noise:** Less than 200 µV, volume control at minimum.

**Sensitivity:** Phono, 1.5 mV; high level, 150 mV.

Signal-to-Noise Ratio: Phono, 70 dB; high level, 90 dB.

**Rated Output:** 1 volt; maximum, 14 volts.

**Dimensions:** 18  $\frac{1}{4}$  in. (46.36 cm) W by 12  $\frac{3}{4}$  in. (32.39 cm) D by 6  $\frac{3}{4}$  in. (17.15 cm) H.

Weight: 29 ½ lbs. (13.41 kg), Price: \$450.00.

Sony's TAE-5450 preamplifier could, I suppose, be considered an economy version of their \$1300 top-of-the-line TAE-8450. And while it is true that the "little brother" has no meters, microphone inputs, or some of the other refinements, in terms of basic performance parameters, such as frequency response, low distortion, and signal-to-noise ratio, the TAE-5450 is very similar to the all-out version. But, most im-

portantly, it is only about a third the price of its big brother-which makes it a bargain by any standard.

Styling is fairly conventional, with the brushed stain front panel angled back for an inch or so, to meet the black top plate, and the two wooden side pieces finished in walnut veneer. The On/Off switch, which incidentally has an illuminated indicator in its center, is on the left-top, while just

## HOW TO TELL & FISHER CASSETTE DECK FROM ANY OTHER.

Fisher manufactures only 3-head cassette decks. For the important reason that all professional recordings are made on 3-head decks.

The only way to make consistently perfect, high fidelity tape recordings is to listen to the sound as it is recorded. The way professional recording studios do.



The 3-head design of the Fisher CR5115 and CR5110 permits monitoring directly off the tape while recording. You hear exactly what is recorded on the tape. No second guessing. No hoping for the best. No more poor recordings or missed opportunities because of operational errors or tape problems.

The CR5115 and CR5110 incorporate four preamplifiers — two for recording and two for monitoring. Two head decks use two preamplifiers.



A Tape/Source switch enables instantaneous comparisons to be made between the incoming signal (source) and the

recorded signal (tape). Indicator lights for each mode let you see at a glance which signal is being monitored.

Tape Heads. The CR5115 and CR5110 have separate heads for erase, record/playback, and monitor. The CR5115 uses ferrite heads for extremely long life and superior frequency response.



**Tape Transport.** In the CR5110 a large, dynamically-balanced heavy weight flywheel is driven by a regulated speed DC motor. The CR5115 uses servo control to provide even more precise tape speed. A precision-ground capstan provides good tape-to-head contact and accurate tape movement. Wow and flutter on the CR5110 is less than 0.09% WRMS: on the CR5115. less than 0.07% WRMS.

Limiter. The CR5115 has switchable limiter circuitry to prevent excessive peak levels from causing distortion. Sudden loud passages are automatically recorded at the maximum

CrOs

NORM

distortion-free level — without affecting the overall input level and while maintaining high signal-to-noise performance — better than 58dB with Dolby.

Tape Selector. Fisher includes a three-position tape select switch which sets the recording electronics for all of the latest tape formulations. You get full compatibility between recording circuitry and the type of tape used...for CrO<sub>2</sub>, and standard tapes, as well as FeCr tape. **Dolby.** Both the CR5115 and CR5110 have built-in Dolby noise reduction circuitry. It virtually eliminates tape hiss and improves the signal-to-noise ratio by as much as 10dB.



The CR5115 has switchable Dolby FM circuitry, complete with the 25 micro-second de-emphasis necessary for the proper demodulation of Dolby-encoded broadcasts. Even if your receiver has no FM Dolby circuitry built-in, you can enjoy the full dynamics and noise-free reception of Dolby-encoded FM with the CR5115.



CR5110

It's really easy to tell Fisher tape decks from all the others. Compare the features and specs of the CR5110 (priced at \$199.95\*) and the CR5115 (priced at \$249.95\*), and you'll see why they're the best value around. Now at fine audio stores.

Fisher Corporation, 21314 Lassen Street, Chatsworth, Calif. 91311





AmericanRadioHistory Com



Fig. 1—Block diagram of the Sony TAE-5450. Note the separate headphone amplifier.

beneath and to the right is a set of four tone controls—two for each channel. To the right of the tone controls comes a three-position external adapter switch associated with two phone jacks just beneath. A tape copy switch is next in line towards the right, followed by the secondary function selector switch for *Phono 2* and the *AUX* inputs (more about this system later). The final switch in this line is the mono/stereo mode switch with the usual five positions, *Stereo, Reverse, Left, Right,* and *Left Plus Right.* Just beneath this last control is the balance switch, while just above it is the large master volume control and associated lever-type muting switch. Two more lever-type switches are just to the left of the muting switch, the primary function selector switch and the tape monitor switch.

68

Along the bottom, going from left to right, are the headphone jack, low filter turnover button, low filter on/off button, high filter turnover button, high filter on/off button, bass tone control turnover button, treble tone control turnover button, and tone control defeat button. These seven button switches are push-push types.

Sony has had an interesting and somewhat unique approach to the human engineering of the function selection system of their preamps and amps for some years now, and

the TAE-5450 continues that type of system. The primary function switch is a three-position, lever type, with *Tuner* as the bottom position and *Phono 1* as the center, while the upper position, labeled *Phono 2/AUX*, engages whatever has been selected through the secondary function switch. This secondary selector, a four-position rotary switch, handles the *Phono 2, AUX 1, AUX 2,* and *AUX 3* inputs, the last of which is coupled via the phone jack just beneath. Thus, Sony provides selection of the three basic signal sources through the primary lever selector, which will probably cover better than 90 per cent of a user's needs, yet three additional sources can be chosen just by a twist of the secondary knob. A good idea of how the system works can be had from the block diagram, Fig. 1.

On the rear of the unit are some 26 RCA phono jacks for the inputs and outputs, as well as two switched a.c. outlets, one unswitched outlet, and a thumbscrew ground connection. Note, too, that each of the tape recorder inputs has its own level control.

#### **Technical Measurements**

The first tests were for output level versus distortion, and the results are shown in Fig. 2. Maximum output voltage was

## (High Fidelily magazine commenting on the new Ohm C2)

"The sound of the C2 resembles that of a much larger system, in dynamic range as well as bass output... the system does phenomenally well at 80 Hz, reaching 100 dB SPL (Sound Pressure Level) with distortion quite low.

... the low frequency output falls away between 30 and 40 Hz — just where Ohm claims it will.

...Located an a shelf and at least two feet from the corners of the room, the speakers produce a scund that is clear and well detailed — and if you like it that way — loud.

... Surely, all things considered, the design of the Ohm C2 represents a fine achievement... With classical music its performance is adequate with something to spare. And with popular music – wow!"

Ohn





Ohm

FOXIT CLEANING

Check No. 25 on Reader Service Card

For a reprint of the entire Ohm review from **High Fidelity** (November 1976), write: Ohm Acoustics Corporation, 241 Taaffe Place, Brooklyn, N.Y. 11205



Fig. 2-Output versus distortion.





11.5 volts at low impedance, which is much higher than would be needed since most power amplifiers require inputs of only 1 to 2 volts for maximum output. Total harmonic distortion for three volts output was less than 0.005 per cent, increasing to 0.01 per cent at 8 volts output. IM distortion was less than 0.03 per cent at 6 volts output, while for 2 volts output it was 0.015 per cent. With the high frequency filters switched in, maximum output fell to 6.5 volts. While harmonic distortion didn't begin to increase until about 7 volts output, IM distortion had doubled by the 4 volt output level, though it was still quite reasonably low and well within the specified 0.05 per cent.

Switching in the tone controls had no measurable effect on distortion, although a very slight rounding of a 20-kHz square wave could be detected. Figure 3 shows the frequency response and the effects of the filters; note that the upper -3 dB point is well above 100 kHz, but that the 20-kHz filter can reduce the response accordingly—so both the wide and narrow bandwidth schools of design should be satisfied! Note also that the low frequency filters do not begin to at-



Fig. 3—Frequency response and filter characteristics.

tenuate from 100 Hz or below, unlike the case with the simple circuits almost invariably used on less elaborate amps and receivers. The tone control characteristics can be seen in Fig. 4, where the solid lines indicate the maximum and minimum response obtainable with the turnover points at 500 Hz and 2.5 kHz, while the dashed lines indicate the response obtainable with the 250 Hz and 5 kHz "hinges."

The input signal level for 1 volt output was exactly 150 mV for the high level inputs, and the signal-to-noise ratio there was 90 dB. Phono sensitivity was 1.2 mV, and the signal-to-noise ratio was more than 2 dB better than claimed at 72.5 dB (inputs shorted, "A" weighted). The maximum signal handling capacity for the phono input before visual distortion of a wave form on the 'scope was 120 mV. Crosstalk measured 58 dB at 1 kHz and 37 dB at 10 kHz.

## Listening and Use Tests

For the listening and use tests, the Sony TAE-5450 was teamed up with a Phase Linear 400 power amp, a Dynaco AF-6 AM/FM tuner, and a Harman/Kardon (Rabco) ST-7 turntable fitted with a Goldring G900 SE phono cartridge. Loudspeakers used were Infinity's Quantum Line Source One or a dynamic/electrostatic hybrid design by the reviewer. A TEAC A-2300 and an AIWA AD-1800 cassette deck were also pressed into service for some tape dubbing. Program material included the usual variety of items, plus two new direct-to-disc recordings, Direct Disco (CCS 5002), a 45rpm disc from Crystal Clear Records in San Francisco, and Rough Trade-Live (UMB DD1) on the Canadian Umbrella label. (Editor's Note: This last disc is extremely well done and should not be missed by fanciers of top-quality discs, no matter what their taste in music. It is available through Audio-technica phono cartridge dealers in this country.)

### Fig. 4—Tone control characteristics.



## Remember the plug-in-shell? Thorens Isotrack Series Turntables proudly introduce the Plug-In Arm.

Thorens introduces an exciting new tonearm design to complement its highly sophisticated, new manual turntable series. Thorens has eliminated the headshell and its collar connection by incorporating the headshell and tonearm rod in a straight tubular design only 7.5 grams in effective tonearm mass. This reduction in mass (up to 50% that of other tonearms) reduces the inertial forces that affect stylus pressure. Tracking is improved, distortion lowered and stylus and record life are extended. Thorens Isotrack tonearm assures optimum performance with the newest, light weight, high-compliance pick-up cartridges.

## The accent is on quality

-The high-speed stability and silent opera-Check No. 53 on Reader Service Card tion of the belt-driven 16-pole synchronous motor is a tribute to Thorens traditionally advanced engineering. The natural elasticity of the belt filters motor vibrations from reaching the platter, and therefore, the pick-up stylus. In more than twenty years of continuous development, and the manufacture of nearly one-million Thorens turntables, Thorens has brought its beltdrive design to a level of technical perfection not approached by *any other drive system known today*.

Thorens Isotrack turntables featuring the "mini-mass" tonearmnow at your Authorized Thorens Dealer, or for further details write:



Pictured Above: Top Rtght-TD-126C • Lower Right-TD-145C Lower Left-TD-166C • Top Left-TD-160C As far as I could tell during my extended listening test, Sony's TAE-5450 preamp did not affect the sound quality in any way. Signal to noise was excellent, and the tone controls and filters helped a great deal in shaping signal sources which were "off." While the controls did take a while to get used to, primcipally because of their great variety, I must say that this TAE-5450 is one of the most versatile preamps I have Check No. 91 on Reader Service Card

yet tested—particularly with respect to the tape recording facilities and the large number of auxiliary inputs and outputs. Many enthusiasts will find the front panel jacks very convenient—they certainly save a lot of trouble.

As I mentioned earlier, I initially thought the unit was a bargain at \$450.00. After testing it for several weeks, I am still of the same opinion. George W. Tillett





MANUFACTURER'S SPECIFICATIONS Power Output: 256 continuous average watts per channel, both channels driven into 8 ohms from 20 Hz to 20 kHz with 0.05 per cent total harmonic distortion; 350 average watts per channel, with similar conditions except 4-ohm loads with 0.10 per cent total harmonic distortion, and 140 average watts per channel with similar conditions except 16-ohm loads with 0.10 per cent total harmonic distortion. **Intermodulation Distortion:** Less than 0.1 per cent at or below rated power using SMPTE method. **One-Watt Frequency Response:** -3dB at 2 Hz and 120 kHz. **Input Sensitivity:** 2.26 V rms for 256 watts into 8 ohms. **Input Impedance:** 25 kilohms, not affected by gain control setting. **Slew Rate:**  $\pm 15 \text{ V/}\mu\text{ S}$ . **Hum and Noise:** -110 dB below rated output, 8 ohms.

**Damping Factor:** Greater than 100 at 1 kHz, 8-ohm load.

**Phase Shift:** Leading 9 degrees at 20 Hz, lagging 10 degrees at 20 kHz.

**Dimensions:** 15-3/8 in. (39.04 cm) W by 6-1/8 in. (15.55 cm) H by 14 in. (35.56 cm) D.

Weight: 46 lbs. (20.7 kg). Price: \$999.95; Model 510, less meters, \$899.95.

The Model 510 is one of Marantz's newest amplifiers in the medium to high power range, continuing their 500 series, and its styling is typical of recent products from this company. The front panel of the basic model contains two level controls, a power switch, and peak indicators; included in the "M" version we tested are two large, illuminated meters and a meter range switch.

The unit is well made and very compact, with a large encapsulated power transformer, two filter capacitors, and the cooling tunnel occupying the majority of the chassis interior. Inside the tunnel are 16 output transistors, each having a small staggered-fin radiator, across which cooling air is drawn from a temperature-controlled two-speed fan. Mounted on either side of the tunnel are the amplifier boards, which allows the transistor pins to solder directly to the printed conductors, thereby saving both space and considerable chassis wiring. The top cover is perforated and has a foam air filter mounted to its underside to keep dust and other debris from being drawn into the box. Marantz recommends periodic cleaning; this is easily accomplished by vacuuming the top surface of the amplifier.

Mounting and installation of the unit is straightforward, with details in the owner's manual. Several inches should be allowed atop the amplifier installation for it to draw cool air, and an opening is similarly required behind the fan for warm air exhaust. All connections are made to the rear panel. Speaker jacks are the five-way binding post type, and inputs are ¼-in. phone plugs. Provided with the amplifier are adaptors to convert the inputs to the more common RCA jacks.


One fuse on the rear panel interrupts the a.c. line in case of amplifier failure, while external, in-line fuse holders are provided for speaker protection. In the owner's manual are diagrams showing the proper connections and guidelines for fuse selection. The use of these fuses is recommended.

The meters are calibrated to show full scale at +3 dB with sine wave inputs at 256 watts/channel, 8 ohms, and the meter switch in the +20 dB position. Also provided on the meter range switch are: Off, +10 dB, and 0 dB positions, with the latter two changing the full scale readings to 25.6 watts and 2.56 watts respectively. Internal calibration was provided for each meter, and their adjustment was found to be quite accurate after the amplifier warmed up for a few minutes. Worst case error proved to be about 1 dB which should be quite adequate for checking average power levels using musical program materials.

Short duration peaks are captured and held by front panel lamps and their associated circuitry. These were set to trigger at about 63 volt peaks (250 watts/channel at 8 ohms) or if the positive half cycle limiter is engaged. Peak-hold displays are certainly useful, though 510 users would be unnecessarily conservative if they were to always play music "soft" enough to entirely avoid lighting these peak indicators because the 510 doesn't clip or limit before pumping a healthy 347 watts into an 8-ohm load or 536 into 4 ohms, driving both channels at 1 kHz.

(Editor's Note: Marantz tells us their design intent on the peak load indication system was to indicate the approach of clipping on peak transients, rather than an actual clipping situation. Thus, the system should not be considered as indicating an overdrive situation, as the LEDs will light up before actual clipping. The system tracks the power supply voltage so it will always give the same warning margin that clipping is approaching, regardless of the a.c. power line variations. While the circuit turns on in microseconds, the "hold" portion of the circuit keeps the LEDs lit long enough so they can be seen by the eye. The system indicates an actual overload condition by staying on more or less continually. Thus, 510 users should consider occasional flashing of the LEDs as full use of the normal operating range.) On the amp submitted for review, a 3 dB difference was found in channel balance when both controls were set at 50 per cent mechanical rotation. When using these controls at less than maximum gain, it is recommended that the settings be made by the amp's meters or verified with oscillator and voltmeter if you wish precision in balancing.



#### **Circuit Description**

Suitably attenuated input signals are a.c. coupled to the unity gain buffer amplifier, which uses Q301 and Q302 in a circuit often called an amplifier emitter follower. This stage exhibits a high input impedance which minimizes the loading on the gain control and the preamplifier. Minimum input impedance for the 510 is approximately 31 kilohms, so preamp manufacturers' specifications should be checked to ensure compatibility, especially if vacuum tube preamp models are used.

Capacitor C307 couples the buffer amplifier to the noninverting input of the differential amplifier Q304 and Q306, and feedback is applied as usual to the inverting input. Marantz has used an uncommon but simple circuit to combine both phases of output signal from the input stage, while also getting the ability to pull the driver stage hard in either the positive or negative direction. Transistor Q307 is the key to this circuit; it is connected as a common emitter amplifier to get the necessary signal inversion and voltage translocation, but degenerated to a gain slightly less than 1,

## Decca Record Brush:



## **No Side Effects**

Most record cleaners use liquids. They do the job. But not without side effects which reduce the life of your records.

To see why, imagine you are examining a record groove through a microscope while various liquid cleaners are tried. All the cleaners remove a lot of dust, but even the best ones leave some behind. Since liquid was applied, this soft dust dries into hard grit. While the stylus could have pushed a few soft dust particles out of its way, it must now track hard grit particles like they are part of your record. The result: distortion. Not to mention stylus wear caused by the new bumps and grinds it must now traverse.

74

Decca's research into these liquid side effects, resulted in their pioneering of a new, electrically conductive, carbon micro-fiber - the bristles of the Decca Record Brush. Each Decca Record Brush contains one million of these ultrathin conductive bristles - 1000 enter <u>each</u> groove removing dust, dirt - and draining off static for lower surface noise and expanded dynamic range.

Decca Record Brush. No fluids, no side effects. Just keeps your records sounding like the first time.

Decca Record Brush available at quality dealers across the U.S.

Sugg. list \$14.95



160 Ronald Dr., Montreal, Canada H4X 1M8 Phone (514) 489-6841 Check No. 31 on Reader Service Card



AmericanRadioHistory Com

AUDIO . March 1977

in order to match its characteristics to its mate, Q308, connected as an emitter follower. It can be shown that the driving signal at the collectors of Q309 and Q310 will be relatively free of even harmonics by nature, if the transistors are chosen carefully and the resistors involved are properly balanced.

The output stage and its drivers are straightforward, being similar in design to those of other high quality amplifiers currently in production. Eight output transistors are used per channel in a complimentary, series-parallel arrangement. Such a design allows the use of low voltage expitaxial base devices, giving the composite stage a very good safe operating area (especially important with reactive loads such as electrostatic speakers) and good current linearity as well.

V-I limiting is employed for protection, but its action is not instantaneous, so short duration transients will not trigger unnecessary limiting. Capacitors C315 and C316 are used to accomplish this effect. Figure 2 shows the amplifier forced into limiting with 2-ohm,  $2-\mu$ F series R-C network, in parallel with 8 ohms and the amplifier output. Note that limiting action is symmetrical and without spurious glitches or oscillation.

#### Measurements

The 510 was first asked to deliver one-third rated power into four ohms, both channels driven with a 1 kHz sine wave, for an hour, as per FTC requirements. Being close to the maximum internal power dissipation point, the exhaust air quickly heated up and the high speed switch for the fan turned on in less than 30 seconds. The amplifier ran continuously for about 15 minutes, and then the two thermal switches, set to 90° C., opened and closed alternately for the remainder of the test. It took about seven cycles of thermal cut-out and 1 hour, 20 minutes to accumulate a total of one hour running time.

After a very brief cooling-down period, the amplifier was then connected to a suitably large set of 4-ohm noninductive load resistors and a Sound Technology 1700A THD analyzer. The right channel of the amplifier showed more distortion at high frequencies than the left, reaching 0.10 per cent THD at full power into 4 ohms, while the left channel remained at or below 0.03 per cent up to 20 kHz. Figure 3 shows THD for both channels at full power with 4 and 8 ohms as a function of frequency. This rise in distortion with increasing frequency reflects the drop in amplifier openloop gain, thereby reducing the negative feedback available to correct the amplifier's internal non-linearities, and these effects are common to the large majority of tube and transistor power amplifiers. Figure 4 shows a sample of the nulled THD residual and the amplifier output at 10 kHz and 100 watts output into an 8-ohm load.

An attempt to measure IM distortion with respect to power output was made using a Crown IMA. Starting at 256 watts per channel into 8-ohm loads, the figures measured with 0.006 and 0.001 per cent for the left and right channels respectively. As power was decreased in 10-dB steps, both channels fell rapidly into the noise, with no measurable increase in IM products on the way down. No figures are presented for the sum of 5th and 7th harmonics as this amp was unmeasurable with this test and the available equipment, i.e. measurements were at the residual of the test equipment, 0.001 per cent, at or below rated power, both channels driven into 8-ohm loads.

Frequency response, as shown in Fig. 6, is a plot of the measured values with the gain control full up and the signal generator set for an amplifier output of 1 watt at 1 kHz with



Fig. 2—Top, amplifier forced into limiting with a load composed of 8 ohms paralleled with a series R-C network of 2 ohms and 2  $\mu$ F. (Traces: top, 20 V/div. & 20  $\mu$ S/div.; bottom, 2 V/div. & 20  $\mu$ S/div.)



Fig. 3—Frequency vs. THD at full power into 4- and 8-ohm loads.







Fig. 5---One-watt frequency response; note break in frequency scale at 100 Hz/10 kHz.

an 8-ohm load. Measurements above 100 kHz are presented for comparison purposes only, since this range will show considerable variation with changes in load, power output, and gain control setting.

Damping factor is exceptionally high with the 510, over 500 for any frequency below 300 Hz, though falling rapidly at frequencies over 500 Hz. The fall in damping factor in this range is, again, typical of transistor power amplifiers. Decreasing feedback and the series output inductor both contribute to increasing output impedance at higher frequencies. Even at 10 kHz, however, the damping is still greater than 50. The curve shown for damping factor is that of the left channel. The right channel hit 626 at 20 Hz and followed the left's slope with increasing frequency. Although these numbers can be measured in the laboratory, this reviewer doubts they can be directly related to the sonic qualities of amplifiers. With figures this large, damping factor in the system will probably be totally dominated by speaker and wiring losses. Such measurements are of inter-



Fig. 6—Square-wave performance into a reactive load. Top: Amplifier output with 10-kHz square wave (20 V/div.) Bottom: Input 2 V/div. Timebase: 20  $\mu$ S/div.

est, however, in that they provide one more small piece of data on the nature of the electronics for those interested in detailed comparisons of high level audio equipment.

Maximum gain was well matched between the two channels and averaged 26.2 dB; Marantz specified 26.03 dB. This means the preamplifier will be asked for some 2.6 volts rms to drive the amplifier into clipping—easily with the capabilities of current high quality preamp designs.

Figure 6 shows square wave performance with reactive loads, this one being a 2-ohm,  $2-\mu F$  series R-C network. Note the well-damped and symmetrical transitions. Table I shows output noise vs. volume control rotation for two bandwidths. Even the worst case figures reflect excellent performance and should be inaudible under all conditions, even with efficient speakers.

Table I—Output noise vs. volume control rotation for two bandwidths; all measurements in  $\mu V$ .

Control	20—2	20 kHz	400—	-20 kHz
Position	Left	Right	Left	Right
Off	41.8	75.4	17.6	23.7
20%	42.9	77	19.6	24.8
40%	49.6	74.3	23.1	28.1
60%	53.9	67.1	33.0	40.7
80%	54.0	107	37.4	44.0
100%	38.5	114	17.6	33.0

#### **Listening Tests**

While it's conceivable that some users of this amplifier would be bothered by the continuously running cooling fan, the noise level of the 510's fan appears to be lower than most other fans used presently in high power amplifiers. What sound it does produce will be swamped by moderate levels of music and should not be audible for more than a few feet if no music is playing.

After the initial set-up, we sat down to serious listening, which was performed before the technical measurements. The 510 amplifier quickly proved itself in direct A-B comparisons with other high quality units which have been found, by many highly critical listeners and over a period of time, to not only be quite accurate but also very easy to enjoy. Over long stretches, the 510 was judged to be a fine sounding piece of audio gear, and this amplifier could definitely belt out the decibels better than any of those used for comparison. Also, and again much to its credit, there was no report from any listener of edginess or irritation. For some listeners, this amp did not take absolute first place, since in the last fraction of its power range the high end did not have the ultimate in "space" and "openness" and the midrange had a very slight tendency to become "hard" mostly with a strong male vocalist at the same power levels. (Editor's Note: The power levels described here will break down most speakers fairly quickly, if applied continuously, and are usually considered beyond the normal listening range.) Especially appreciated by all listeners was the solid and powerful bass reproduction at tremendous volume levels achieved with this amplifier.

In conclusion, those who require a very powerful amplifier with a first-class sonic rating must audition this unit. They can be assured that its performance and quality of construction are commensurate with its price. *George D. Pontis* 

Check No. 92 on Reader Service Card



If you'd like your own personal copy of the test result, write to ADC at address shown above



In Concert: The Best of Jimmy Cliff: Jimmy Cliff

Warner Brothers MS 2256, stereo, \$6.98.

Only a few weeks ago I saw Jimmy Cliff perform, and it was a major disappointment—he seemed genuinely uninspired, the band sounded crummy, and it seemed as if each song wouldn't end. At that point I hadn't heard the live album, and following the concert my anticipations for the live LP were not particularly high. Perhaps this is why I'm so delighted with it, although I am not quite sure -whatever the reason, In Concert: The Best of Jimmy Cliff is about 47 minutes of the best reggae I've heard all year, far more musical and exciting than anything I got out of the actual concert by Cliff.

Now I believe in giving credit where credit is due, and one Andrew Loog Oldham produced this live album in a way which makes this the first reggae album on which Anglo-American sonic values are utilized by

a Jamaican artist without losing the true reggae perspective. It works to Cliff's advantage. While the bass drum is ridiculous up-front, the subtleties of all the instruments are allowed to emerge rather than remain as clicking rhythmic noises, and a lot of things which aren't usually audible on reggae records are here. Reggae music is extremely conservative, with the instruments usually playing a secondary role to the lead vocal, but here the balance is refreshingly left-wing, and it works. The Oldham technique of hyping up the audience reaction track (made famous by his pal Phil Spector on the Bangla-Desh album but put into use much earlier on The Stones' Got Live If You Want It) boosts the album-I can't decide whether Mr. Oldham merely quadrupled the audience track or took an applause tape he keeps around for these circumstances and transplanted it here, bringing up the clapping and screams at the appropriate moments. Besides all this, there's one thing working in

everybody's favor, and which is that Oldham has captured Cliff and band on a night when they're truly ON. The playing is way above par, and Cliff's singing his arse off. It has been rumored that "Mr. Oldham was brought in to produce this disc because he had access to the best ganja in town, and this is important in bringing out the best in any reggae performer." I don't know how valid this gossip is but whatever the case, this live album truly is the best of Cliff with virtually every track better than the original recording. J.T. Sound: A Performance: A

### The Pretender: Jackson Browne Elektra 7E-1079, stereo, \$6.98.

Within these two album sides lie every fault a solo artist can burden himself with, pitfalls which for the most part have been carefully avoided on previous Jackson Browne records. This reviewer has always found Browne's strongest asset is that his

# If you can see a difference, imagine what you'll hear.



Magnified, you can see record vinyl wearing away.

You're looking at the solution to one of the oldest problems in audio-how to protect records from wear, while at the same time preserving full fidelity.

It's called Sound Guard,\* and it's remarkable.

Guard preservative played

100 times display the same

full amplitude at all frequen-

Independent tests show that discs treated with Sound

Sound

distortion as "mint condition" discs played once.

A by-product of dry lubricants developed for aerospace applications, Sound Guard preservative is so smooth it reduces friction, yet so thin (less than 0.000003'') it leaves even the most fragile groove modulations unaffected.

Len Feldman in Radio Electronics reports "At last! The long awaited record-care product has arrived. It preserves frequency response

Record Preservation Kit

clie le

while reducing distortion and surface noise." It's effective and safe for all discs, from precious old 78's to the newest LP's. Sound Guard preservative,



With same magnification, record vinyl shows no wear.

in a kit complete with a nonaerosol pump sprayer and



Test record played first time.



After 100 plays without Sound Guard.



Identical test record after 100 plays with Sound Guard.

velvet buffing pad, is available in audio and record outlets.

#### cies and the same absence of surface noise and harmonic Sound Guard keeps your good sounds sounding good.

Ball

\*Sound Guard is Ball Corporation's registered trademark for its record preservative. Copyright ©Ball Corporation, 1976.

AmericanRadioHistory Com

# What you don't know about effective tip mass won't hurt you,

## just your records.



You can find out what you don't know by contacting us for our comprehensive cartridge brochure.

## Bang & Olufsen

Bang & Olufsen of America, Inc., Dept. 10F 515 Busse Road, Elk Grove Village 60007

Check No. 5 on Reader Service Card

## and FM DIRECTORY

Get all the newest and latest information on the new McIntosh Solid State equipment in the McIntosh catalog. In addition you will receive an FM station directory that covers all of North America.



#### FM/FM STEREO - AM TUNER AND PREAMPLIFIER

SEND	McIntosh Laboratory, Inc. East Side Station P.O. Box 96 Binghamton, N.Y. 13904 Dept. 1
TODAY!	NAME
	CITYSTATEZIP
If you are in a hurry for you	Ir catalog please send the courses to Malatast

If you are in a hurry for your catalog please send the coupon to McIntosh. For non rush service send the *Reader Service Card* to the magazine. Check No. 22 on Reader Service Card

backup group sounds more like a band than a group of session musicians, and more often than not they sounded like a band with their own musical style, which was a good one. The past two albums Browne's made sound like what Eagles' albums want to sound like-tight arrangements which rock out when needed, with very few concessions to musical fads of the day, and a songwriting talent which consistently comes up with fresh, nonindulgent, and appealing tunes. The Pretender sounds like the first album by an artist who really didn't know a whole lot about what he was doing, what the people he was playing with should be playing, or when to stop wallowing in self-pity.

To say that the songs are Jackson's worst in a long while would be true, but that's not totally where the blame lies, because the arrangements on previous J.B. albums have often rescued material which was less than excellent. It's necessary for people to recognize that Jackson Browne records have depended a great deal upon David Lindley's musical perfection and it was usually he who created the earlier arrangements as much as Jackson, his guitars added the push and pull when needed, and if he wasn't playing Andrew Oldham to Jackson's Mick Jagger, he was at least the Keith Richard of the outfit. Lindley's role on this album is at best as occasional sideman, usually invisible, and often less than memorable. In his stead we find Jackson relying upon the fingers and ears of the member of Little Feat, arrangers David Campbell, Jim Horn, and Arthur Gerst, and the occasional presence of producer Jon Landau. Landau's an old cohort of this writer so I shouldn't be too hard on the brute for old times' sake, but I find the Browne/Landau team such an obvious mismatch that it's hard to avoid. But Landau seems to have stepped aside here when he's most needed, providing true laissezfaire production when a strong hand is what's called for. If this is not true and Landau encouraged the musical direction taken here (which my respect for him leads me to disbelieve), then two giant slaps on the wrist to him; my only hope for Browne is that either he finds individuals who can guide him toward making terrific records and stick by their direction (maybe Lindley should produce the next one) or find the strength within to steer away from making another album like The Pretender. J.T. Sound: C Performance: C

\_\_\_\_\_

## These new Dahlquist products will greatly improve the performance of your speaker system.

We are pleased to offer you four important new products and accessories that will add considerably to your listening enjoyment. Included are a remarkable subwoofer system and two crossover units, electronic and passive. Also available is an attractive stand for our popular Dahlquist DQ-10 loudspeaker, which will improve both performance and appearance. Ask for a demonstration at your Dahlquist dealer. DQ-1W LOW-BASS MODULE. A superior subwoofer design. Adds an octave or more of extremely tight, well defined low response to most speakers. Propagates considerable acoustic output to 20 Hz and below. Its fast rise/ decay times assure excellent coherence with high-definition speakers. Use with either the passive or active Dahlquist crossovers below. High quality 13" driver with heavy cast frame and 12,000 Gauss magnet. Oiled walnut finish with satin aluminum trim.

DQ-MX1 PASSIVE CROSS-OVER. For connecting any 8 ohm center-channel subwoofer without requiring another amplifier. Features: 3-position bass level switch; phase switch; frequency selector for 60 or 80 Hz crossover.



biamplified system. Features: continuously variable crossover settings from 40 to 400 Hz, @ 18dB/octave; bass level adjustments with up to 15dB gain; 0 to + 5dB equalization at 20 Hz; bypass switches silence subwoofer and restore full-range response to main speakers; separate outputs for stereo and mixed-centerchannel subwoofers; A unique combination of active low-pass and passive high-pass sections prevents any degradation of high frequency performance quality.

ST-10 OPTIONAL STANDS. For owners of our Dahlquist DQ-10 speakers. Improve radiation characteristics, especially noticable in the lower-midrange/ upper-bass regions. Packed two to a carton. Assembles with six screws.

81

27 Hanse Ave., Freeport, N.Y. 11520

Check No. 11 on Reader Service Card



#### Small Change: Tom Waits Asylum 7E-1078, stereo, \$6.98.

Tom Waits really *is* like that. Beneath that seedy exterior lies a seedy interior.

**Small Change**, his fourth album is the best encapsulation of studio Waits yet, even more than the nightclub-instudio album **Nighthawks at the Diner**. To do it, producer Bones Howe recorded the album completely live and direct to two-track stereo, string parts and all. That means no overdubs and no remix. What you hear is what you get, and that accounts for the album's remarkable presence.

Waits' compositions are contemporary beat poetry and balladry, rambling and kaleidoscopic, with images tumbling hazily into one another. For the record, the sax-bass-drums combo behind Waits' piano includes Lew Tabackin, Jim Hughart, and Shelley Manne-fast company indeed. Back in the 50s, Jack Kerouac made an album much like this with Steve Allen's jazz combo. Maybe that will make it all clearer. Truth be told, Tom Waits is an acquired taste and not for all. The most accessible entrance to Waits is still the magnificent Heart of Saturday Night, but Small Change is probably the most accurate roadmap to his private world yet. MT Sound: A Performance: A



Kiss

#### Hotel California: The Eagles Asylum 7E-1084, stereo, \$6.98. Rock and Roll Over: Kiss Casablanca NDLP 7037, stereo, \$6.98.

Here we have the two most popular American rock bands, and you better believe that these bands are raking it in. It seemed inevitable that someday Americans would appeal to American audiences the way Englishmen could, but two major changes had to occur: the groups had to find management who could merchandise their music, and they had to find a producer who could make their music sound as good on vinyl as British groups sounded. England doesn't have a whole lot of natural resources, and pop music is one of England's top moneymaking exports, so naturally there's a whole lot more encouragement over there to use the best recording techniques and equipment available.

The beginning of the Seventies seemed to be dominated by British groups, but more and more American groups are making inroads in the pop music market due to a realistic approach to record making and group presentation. Kiss and The Eagles are a product of the new American mentality, where musical innovation is not the key to success but a progression in the application of technology and marketing has thrown these two groups to the top of the charts.

This is not to say that these groups are lacking in musical merits, for 1 can, to a limited degree, grasp some pleasure from these grooves. Kiss is one of

the best-recorded heavy bands around, and though they aren't exactly the Mozarts of Metal nor the virtuosos of the Seventies (and the vocals are occasionally irritating-Greg Ridley must be eating his heart out in jealousy), they make fiery records despite their limitations. Lyrically they don't have anything to offer most of the time, though they can surprise you on a ballad like Hard Luck Woman which could be Son-of-Rod-Stewart's-You Wear It Well and doesn't sound anything like the rest of the album. It's actually quite pretty, an adjective which doesn't apply to the rest of the album which could be an amalgamation of Humble Pie/Rolling Stones riffs but for the vocals. Still, it's well executed and less irritating than their covers; I wonder if Kiss could have made it strictly on their music without benefit of the theatrics and makeup, but I let that question go unanswered because it's time to review my favorite group, The Eaglers.

I shouldn't be too hard on The Eagles, because they embody all that which is California and groovy, and after all they've secured Joe Walsh (one of America's top metal guitarists) in the band now, and they write all those pretty songs. But there are several problems inherent in The Eagles, like Glenn Frey (not only that he is to rock music what Sonny Davis Junior is to R&B, but that he is just plain irritating as both a singer and songwriter), and like the fact that the only person in the group who sings really well is drummer Don Henley (who is practically running the band, singing five of the eight songs here), and like the sheer baloney of their lyrics. The loe

**B2** 

### THE COST/PERFORMANCE EQUATION: HOW MUCH TAPE RECORDER IS ENOUGH?

Essentially, a tape recorder is a machine you can use to capture your talent and faithfully reproduce it. Practically, the more you make demands on a tape recorder, the more demands it can make on you.

Put another way, a tape recorder can be your wings or an anchor. It can work for you or it can work against you.

At \$1,299.95 the investment you make in the Dokorder 1140 gets you a partner instead of a handicap. Compare what it does to what it costs and you won't find a better tape recorder anywhere.

The 1140 lets you concentrate on your music as art. Much of the concern you have about your music as signal is handled for you automatically.

The 1140 has logic circuitry that takes care of getting you in and out of Sync and in and out of Source automatically. It makes knowing where you are in multi-track recording a whole lot easier.

The 1140 also has an automatic cue-up function, called Program Memory. Once it's set up, the Pro-

gram Memory automatically brings you back to the beginning of material and either stops or plays it again, depending on what you tell it.

The transport controls on the 1140 are digital logic-operated so you can go from one mode to another directly except in Record and there is a motion sensing system which lets you go into play from fast forward or rewind when the reels stop.

Bias controls are up-front on the transport and there is a built-in pink noise generator which supplies a test signal to each channel. This unusual device makes biasing simple but extremely accurate.

There is a lot more hardware to the 1140: peak level indicators, discrete playback and record amplifiers, 62-Volt record drive circuit, wide band sync response, etc.

All to make it easier to put music on tape.



Check No. 12 on Reader Service Card

#### THE BEST KEPT SECRET IN THE AUDIO INDUSTRY.

That's the way it's been. But no more. We want the world to know that we make loudspeakers ... probably the very best made anywhere. And the only way we know of convincing you is for you to go to your audio dealer and listen to a Frazier. If your dealer doesn't have Frazier, ask him to get Frazier. Or go somewhere else. Once you hear a Frazier, we're pretty sure you'll buy a Frazier. Frazier. The best kept secret in the audio industry. Until now.



DOMESTIC 1930 Valley View Lane Dallas, Texas 75234 214/241/3441

INTERNATIONAL 2200 Shames Drive/P.O. Box 882 Westbury, L.I., New York 11590 Cable: "Churchin" Westbury, N.Y. Telex: 961474/Telephone: 516/334/3303

Fine loudspeakers from \$60.00 to \$1,200.00. Write or call for the name of your nearest Frazier dealer and for descriptive brochures.

Walsh song on the album is terrible, he doesn't play anything particularly earth-shattering here, as there is already an established Eagles guitar sound which he fails to break out of, Although Walsh's co-composition Life in the Fast Lane is fairly good, it's still an Eagles tune-there is evidence here that a group comprised of Henley and Walsh could be pretty interesting, but here the negative points of the rest of the Eagles continue to bring Joe and Don down in the mire. Without the California laidback/ cowboy mystique, The Eagles would be just another bunch of singer/ songwriters banded together for no apparent purpose. With it, they're a group who make records together for the sheer sake of momentum they don't sound like a band really,

but a bunch of solo artists with very little in common. They sing nicely together, and occasionally write well, but as far as I'm concerned they're less of a band than Kiss, and though at times they may show a slightly greater degree of musical knowledge and melodic gift, in the long run neither is particularly inventive musically and the only battle between the two is in terms of who has the most mundance lyricists. While Kiss may lack subtlety and charm, when it comes to writing banal words, Glenn Frey can take on all comers. I.T.

#### Eagles:

Sound: A-	Performance: B-	
Kiss:		
Sound: B+	Performance: B	



Hejira: Joni Mitchell Asylum 7E-1087, stereo, \$6.98.

Last year's **Hissing of Summer Lawns** was not an easy pill to swallow. A total departure from the phenomenally successful **Court and Spark**, it was a daring, highly idiosyncratic and lavish album that some people did not like at all.

**Hejira** (which refers first to Mohammed's flight from Mecca and generically to the pilgrim's flight from the holy place) is much sparser. The sound, no less personal, is cut lean and to the bone, and is very challenging. Jaco Pastorius is brilliant every

time his bass playing appears. Larry Carlton's guitar leads and Victor Feldman's vibes perform some uncanny tricks. Surprisingly, Joni Mitchell's piano work, which had been strongly emphasized since the **Blue** album, is completely gone. She contents herself with her special guitar rhythms which unite the album sonically, with the effect of a smooth motor in a new car.

This album is completely a road album. It is spent in cars looking up at jets in the sky or strung out on another man. Coyote opens with an encounter on the road near Joni's Canadian hometown. Amelia following it

## A Totally New Kind of Audio Component

#### The Audio/Pulse Model One Digital Time-Delay System

The Audio/Pulse Model One re-creates the feeling of *being there*. It can make a living room sound like a concert hall or cathedral or theater or night club.

It is the first of an entirely new breed of audio equipment and its sophistication goes beyond any other product we know of. It uses the equivalent of 150,000 transistors (in 90 integrated circuits) for highly advanced fully digital processing of audio signals. With conventional solid-state techniques of a few years ago, it would have to be as big as the kitchen in an average home, and if made with tubes it would be as big as the concert hall itself. Yet, despite its advanced technology, the Model One is simple and enjoyable to use -- and *it requires no special program material*.

When you hear what it does, we think you will agree it is the long-awaited major step toward totally realistic sound reproduction.

#### Why Time-Delay?

A live concert, whether by John Denver or the Boston Symphony, is a much more involving experience than listening to a stereo system. One reason is that at a live concert you are actually enveloped in the ambient sound field -- completely surrounded by reflected, delayed, rever-



berant sounds (above left), while even the finest stereo system is limited to reproducing the front-arrival sounds coming from the concert stage (above right).

The Audio/Pulse Model One Digital Time-Delay System restores this missing dimension by electronically duplicating the way in which delayed, reflected, ambient sounds produce the richness and depth of a live listening experience.

Like a concert hall, the Model One produces a highdensity pattern of delayed reflections and reverberant decay.



When the Model One is added to a stereo system, the front-arrival direct sounds continue to be reproduced by your existing stereo speakers; the Model One's delayed, reverberant signals are fed to a separate amplifier and heard over a second set of speakers (which don't have to be big or ultra-wide-range), located to the sides or rear of your listening area. The flexible controls of the Model One let you make anything from a single guitar or singer to a rock band to a full-size symphony orchestra sound as if you are hearing it in its natural setting. It is designed to work with any conventional stereo program source -- record, tape, or broadcast -- and also will come surprisingly close to its full effect with *mono* recordings and broadcasts.

What it really is and does has to be heard.

#### What the Audio Press Is Saying

Hi-Fi Stereo Buyers' Guide, Nov.-Dec. 1976: The Audio/ Pulse Model One Digital Time-Delay System probably ranks next to stereo and stereo-FM as the high-fidelity highlight of the past twenty-five years, for it really can recreate the sound -- and more important the feeling -- of a music hall.

Consumer Electronics, Feb. 1976: The ability of this new product to conjure up the feeling of listening in a live hall is incredible. One simply does not sense the presence of the extra speakers as such -- only the feeling that the listening room has been vastly expanded in size.

High Fidelity, Feb. 1976: The overall effect is astonishingly realistic... We could turn our rather "dead" listening room into a small auditorium, a large concert hall, or even a cave.

The Boston Phoenix, March 1976: The sound of any disc takes on a warmth, body, and dimensionality that just aren't there without delay, and without sounding synthetic.

The Gramophone, May 1976: The unit gives a remarkable "you are there" quality to any stereo source, allowing the user to expand and vary the sense of acoustic space to suit his own taste .... Now enough people have heard digital delay systems to predict that they "will be the hottest thing to hit the hi-fi market in years."



Check No. 3 on Reader Service Card

is triggered by six jets over the desert in "the hexagram of the heavens," with visions of Icarus doomed to fall, she compares the fallen aviatrix and her own state—"I crashed into his arms." The song is another view of *Both Sides Now* fully a decade along, her fear of flying all too alive. *Furry Sings the Blues* takes place at Furry Lewis' place on crumbling old Beale Street in Memphis. The obsolescence of the wonderful old Blues singer is tender and sad. *Hejira* is at the beginning of her second 30 years. It looks directly at the aimless, endless road-

ing and fully acknowledges the alternative—"(I'm) a defector from the pretty wars/until love sucks me back that way."

The Song for Sharon faces the same dilemma through the image of a childhood friend who has her family and farm and still keeps her music for them held against her own checkered romantic history, the bitterness like a lozenge that won't dissolve. The Blue Motel Room is in Savannah, and the encounter there leads inevitably to the Refuge of the Roads. The uncertainty and the ever-altering scene-

## Phase Linear 400: The best selling amplifier in the world.

**Phase Linear** 

The Powerful Difference

Since its introduction, the Phase Linear 400 Power Amplifier has been hailed in ernationally as the undisputed "best buy" and best performer among all the super amps available today. And for good reason.

For some time most serious listeners hav∋ considered a h gh powered amplifier a necessary component in a home stereo system. Most high quality speakers are ineffi-

cient and demand great reserves of power to play recorded music at realistic levels. But un if the intro-

86

But unil the introduction of the 400, this addisonal power was an expensive extra few home stereo owners could enjoy. Advanced technology developed by Phase Linear has resulted in a high quality, high performance power amplifier that, at a suggested retail price of \$499, becomes a practical investment for a stereo component system.

The Phase Linear 400, with its tremendous power reserve, enables your

AmericanRadioHistory Corr

Sound system to deliver reallife listening levels with extremely low distortion levels without clipping...at a very reasonable price. See your dealer for an audition.



Check No. 27 on Reader Service Card

ry are all Mitchell can count on, this "rolling taking refuge in the roads." *Hejira* is another difficult pill to swallow, as open as it is.

The cover gives some clues. It is in striking black & white, black for asphalt, white for freedom, and the birdlady poses are stunning.

Hejira is a challenge to absorb. It is demanding of you, and it's not easy to shake off or forget. If it takes a little getting used to, it is easily worth the effort. M.T.

Sound: A – Performance: A –

#### Blue Moves: Elton John

Rocket 2-11004, stereo, \$6.98.

I'd like to go on record as saying that Elton John hasn't done anything particularly stunning musically since **Goodbye Yellow Brick Road,** and although his subsequent albums initially satisfy, they have no long-lasting musical impact, up until now.

Blue Moves is the album which changes all that, I reckon, because it doesn't satisfy even from the very start, and after several listens, you wonder exactly how many songs Elton has written and how much of this album is actually non-songs produced/played/engineered into masters. His damn predictability never really bothered me because his hook lines were the big surprise. He'd sucker you in with a fairly mundane verse, and then come in and grab you with the chorus on something like Don't Let Your Son Go Down On Me. Even though he hasn't written anything but the most self-indulgent songs recently, I never really found Elton to be quite so unmemorable as not to merit a fourth listen, until his last studio album. But this one, this two-record set, which I wish I could say would make a good single album or at least a decent EP-this is just two pieces of plastic.

He's got all the right names on the album-you find arrangements by the overlooked (and misspelled) Curt Boettcher, Bruce Johnston, and Captain Daryl Dragon, engineering by ex-Sparks guitarist Earl Mankey, and background vocals by Tenille, The Cornerstone Institutional Baptist and Southern California Community Choir, Cindy Bullens, and Crosby & Nash. Production by Gus Dudgeon is the usual "I love treble don't you?" and Bernie Taupin's lyrics border on total worthlessness. I've always thought Elton was trying to achieve something before, but here I'm lost looking for any redeeming value. I.T.

Sound: A –

Songs in the Key of Life: Stevie Wonder

Tamala TI3-340C2, stereo, \$6.98. Stevie Wonder is the state of the art. Aside from his success in terms of mass acceptance, he's the one his fellow musicians point to as the one doing the real stuff. With all the time to build up expectations since Fulfillingness First Finale (itself originally intended as a double album), Songs in the Key of Life could easily have been a disappointment. It isn't. It is amazing as anyone could possibly have imagined.

The album is bursting with ideas, iov and realization throughout the four full sides and the 45-sized bonus disc which adds another 18 minutes to the total, virtually a fifth side. Rather than rhapsodize about favorite tunes -which tend to change at least daily -I'll only note Black Man where a strident didacticism interferes with the grand flow. Weighed against 20 others which are gems, that is quibbling.

Repeated listenings bring out a curious flaw that the brilliance of the performance masks. Stevie has produced fine sound in the highs and lows, but put virtually nothing in the middle. That effect takes an edge off the sound that becomes most notable if you go back and listen in reverse order to this work from Talking Book onwards. Each album has sharper sound than the one that follows it.

Still I can't imagine not experiencing this album. With Bob Marley and the Wailers Live, it is the most essential music of 1976, and I don't expect to have to eat that statement. As I said, Stevie Wonder is the state of the M.T. art Performance: C+ Sound: A+

#### High Voltage: AC/DC Atco SD36-142, stereo, \$6.98.

Coming on aggressively like a more perverted Sensational Alex Harvey Band with the underbelly of a Roxy Music, the American debut of Australian AC/DC is a selection culled from their two Australian albums. They are grotesquely humorous and appropiately sardonic. Their ideas for songs aren't particularly original, with lots of time spent telling how hard it is to actually make it as a rock & roll star (read in all puns), while grabbing all the buns you can along the way. Ergo songs like It's a Long Way to the Top (If You Wanna Rock 'n' Roll), Rock 'N' Roll Star, and She's Got Balls.

They've got lots of energy and good projection as well. Their appeal is young, and they are not at all ashamed of it. AC/DC's album fulfills their own goals. It'll probably either sell very well or vanish without a M.T. trace. Performance: B Sound: B

#### Jesse Come Home: James Gang Atco SD 36-141, stereo, \$6.98.

When heavy rock was in, the James Gang was the loudest American band around with Joe Walsh and/or Tommy Bolin fronting the outfit. With the coming of glitter, the Granny Takes A Trip suits fit them well, but those days are gone. Now The James Gang, led by Dale Peters (bass) and Jimmy Fox (drums), sounds like one of those L.A. country/rock/progressive bands, having fired their last two front men and in their stead have two new ones. They dress up in cowboy shirts and look pretty butch. They also sound like their music was tailor-made, bought just as sure as their suits, and equally dull. I sincerely doubt that they'll be any more successful this time around than they were last time, so what next? The James Gang Goes Disco? Reggae Night in Cleveland? Some people just don't know when to IT auit. Sound: C Performance: D+

87

## What have Quad been up to recently?



## Current Dumping that's what

amplifier circuit developed by QUAD

A current dumping amplifer basically consists of a low power amplifier of very high quality, which controls the loudspeaker at all times and a high powered heavy duty amplifier which provides most of the muscle

The small amplifier is so arranged – it carries an error signal - that provided the heavy duty transistors (the dumpers) stay within the target area of the required output current, it will fill in the remainder accurately and completely.

Current Dumping is the name given to a totally new power amplifier, which because of its low power, can be made very good indeed.

The QUAD 405 is the first amplifier to incorporate current dumping

There are no internal adjustments, so nothing to go out of alignment.

There are no crossover distortion problems and performance is unaffected by thermal tracking.

The QUAD 405 offers impeccable performance, reliably and predictably.

Send postcard for illustrated leaflet to Acoustical Manu-The reproduced quality is solely dependent on the baby facturing Co. Ltd., Huntingdon, Cambs., PE18 7DB, England.

## for the closest approach to the original sound

QUAD is a Registered Trade Mark

Check No. 1 on Reader Service Card

AmericanRadioHistory Com

#### Nakamichi proudly introduces its first all-electronic components, backed by world-famous Nakamichi engineering and manufacture. The 610 Control Preamplifier and the 620 Power Amplifier offer no-compromise performance and flexibility that is clearly Nakamichi. Grouped with the exciting new 600 Cassette Console, they comprise the Recording Director Series - elegantly styled with identical profiles, each is a study in human engineering

The 610 Control Preamplifier is three devices in one. As a stereo preamplifier its performance and color-free sound invite comparison with the finest units available. It also functions as an advanced test center, with builtin test tones, pink noise generator and precision meters - just to name a few. As a studio-qualit mixer, any 5 of 19 different inputs can be selected in many combinations. The creative audiophile will find no end to the 610's capabilities.

88

#### Forward Into The Past, The Best of the **Firesign Theatre**

Columbia PG 34391, stereo, \$7.98. Just wanted to let you know about this handsome two-record collection. The selection of material is amazingly right, with smartly edited extracts, including the complete classic Nick Danger, along with the so-called unreleased single Forward Into The Past/Station Break. The album is great, especially if you've kinda dug these crazy guys but never quite got the albums. This is the best of them and makes a good basic collection. There's only highlights, no clinkers. M.T.

#### Presentation: A

#### The Main Refrain: Wendy Waldman Warner Bros. BS 2977, stereo, \$6.98.

Wendy Waldman's fourth is her finest yet by a full quantum. Song for song, it is one of the year's very best, and a true sleeper.

The first song, The Eagle and the Owl, is such a good one, I am having trouble tracking through the side and not immediately replaying the cut. Once past it, song after song are well developed, both in concept and execution. The title song, Soft and Low, Is

THD: Less than 0.005% Meters: -40 dB to +10 dB range, peak reading: Frequency Response: 5 Hz-150 kHz ±0.75 dB

Phono S/N Ratio (HF-A): Becter than 80 dB (0 dB=1 mV);

He Coming at All, Goodbye Summerwind and Living is Good all have a very real maturity, lacking in pretense.

Yes, I do like The Main Refrain very much. Wendy Waldman has worked hard to earn an audience, and Refrain is more than enough to bring it to her. M.T.

Sound: B+ Performance: A



#### Technical Ecstasy: Black Sabbath Warner Brothers BS 2969, stereo, \$6.98

Clearly

Contrary to rumors, persistence pays off, and Black Sabbath has been persisting long enough that they've finally learned how to play their instruments. In fact, they play them right well and the songs they write have been getting better with each successive album. If only they could sing....

Yet, it is the vocal quality their lead singer Mr. Ozzie Osbourne gets/has that is the most grating and degrading. At best, he sounds like Robert Plant singing through his nose, and more often than not, Osbourne's shrieks and caterwauling resemble nothing so much as a mellotron with tapes tuned in pitch to cats getting their tails stepped on (as opposed to the usual strings or choir). I thought that with time I would get used to Ozzie's voice, that the edges would wear thin, and that with my inevitable loss of hearing, I would mind the sound of Mr. Osbourne less. However, as the Sabs have taken to doing acoustic songs (which aren't half-bad), I find the negative aspects of the vocals to be much more present. And so with this in mind, I do not condemn the music of Black Sabbath—I merely say I

## Nakamichi!

The 620 Power Amplifier boasts harmonic and IM distortions so low they cannot be reliably-measured with the best test instruments. It is unconditionally stable under any load, including a direct short circuit. The power supply packs more punch than units several times its size. A unique biasing circuit cuts idling current by 1/20 and keeps the bold heat sink fins cool to the touch. Peak indicator lamps glow green or red for each channel at presettable power output levels.

> For complete information, write Nakamichi Research (U.S.A.), Inc., 220 Westbury Ave., Carle Place, N.Y. 11514 or see your Nakamichi dealer soon and ask for a demonstration of the 610 and 620 together with the incredible 600 Cassette Console (now also available in matte black finish).

520 Power Output: 100 watts per channel min. RMS, 8 ohms. 5 Hz-20 kHz, with no more than 0.01% THD IM Distortion: Less than 0.002% at 100W/8 ohms (60 Hz: 7 kHz, 4:1); S/N Ratio: Better than 120 dB (IHF-A). Check No. 23 on Reader Service Card

would like it and would probably discover nuances to it which I previously ignored, if I didn't have to listen to Ozzie. I must add that I have met Mr. Osbourne and he is a nice, almost charming gentleman and hold no personal grudges against him, but I don't like the way he sings. J.T. Sound: B+ Performance: B-

Heat Treatment: Graham Parker Mercury SRM-1-1117, stereo, \$6.98.

Graham Parker is a contender, a skinny British kid loaded with loner charisma. Howling Wind, his first album, which is only about six months old, was one of the really important debuts of 1976, and this follow-up gives him a solid one-two combination. With the first record's songs still ringing in my head, especially Don't Ask Me Questions, the new set is almost too much to believe. The grand tradition of rock'n'roll lives in his songs, as in the instant classic Fools' Gold and in Hotel Chambermaid. If goodies like Black Honey, Back Door Love or the others don't reach you, my friend, you just don't like rock'n'roll, it's that simple. Just don't mind if I get my own taste when it's this good.

The supporting band, The Rumour,

backing Graham on both albums and on tour, are one of the bitchinest bands out of Britain. Live, you can't help but believe.

Graham Parker & The Rumour sound like their lives depend on it, and that makes them special. Just like Parker says in Fools' Gold. ..''I've been doing my homework for a long, long time/And everything I look for I know I will someday find.'' I couldn't have put it any better than the kid already has. <u>M.T.</u> Sound: B+ Performance: A-



Snakes and Ladders: The Faces Warner Brothers BS 2897, stereo, \$6.98.

Made In Europe: Deep Purple Warner Brothers PR 2995, stereo, \$6.98.

These two groups continue to put out albums despite their nonexistence thanks to the convenience of "Greatest Hits" and "Recorded Live" packages. The Faces set could have been a whole lot better—as is, there are only two tracks here unavailable on other American albums (Pool Hall Richard and Cindy Incidentally—both fine tracks), while there are still a load of singles (Maybe I'm Amazed/Oh Lord I'm Browned Off for one) plus some unreleased things cut just before they split which could well fit on a posthumous album such as this.

The Purple album makes a lot more sense—five unreleased live tracks from the last tour with Richie Blackmore (thank Heaven, they didn't try to release stuff from the tour with Tommy Bolin) which demonstrates both the weak points (tedious material at times) and the strong factors (Blackmore's playing, and Ian Paice's drums) working in their behalf. Personally, I'd be happier to hear more live stuff with Ian Gillan and Roger Glover (pre-Made In Japan) doing songs like Fireball and Flight of the Rat, but I doubt that anything from that period will be released. J.T. Sound: B+ Performance: B

The End of the Beginning: Richie Havens

#### A&M SP-4598, stereo, \$6.98.

Cosmic Richie's back, and A&M's got him.

His first record in several years is divided a lá Rod Stewart into Fast and Slow sides. The Slow side crawls. 10 cc's *l'm* Not in Love is strictly a mismatch as Richie never touches the ironic underbelly so necessary to the song. James Taylor's You Can Close Your Eyes lacks conviction, while Richie's own I Was Educated by Myself is utterly directionless.

Flipping it over, Van Morrison's terrific Wild Night is given nothing new. Dylan's If Not For You comes closer, and the Steely Dan hit Do It Again is interesting but again it's the song more that the singer. The Doobie Brothers' Long Train Running fares the best because the band finally gives Richie a well needed push.

## How to be an audio architect

Design exactly the hi-fi system you want. Build with Crown components to provide precise control, monitoring and selection for your ultimate listening pleasure. Let us send you the complete specifications.



#### Select 8 inputs. IMD .002%

IC-150A. The new, improved Crown stereo pre-amp. Inputs include front panel jacks. 31-step precision loudness control. Exclusive panorama control. ISO loudness compensation. THD below .05%, S/N down 105 dB, IHF "A" weighting.



#### Select crossover points.

VFX-2. In bi-amp systems, select and change crossover points to fit your speakers and listening area.



#### Meters show clipping level.

**OC-150A.** The Crown stereo output control. Peak-reading or peak-sample-and-hold meters show precise clipping levels. Switch three pairs of speakers with front panel push-buttons. Two headphone jacks.

## Fast playback coupon

Send directly to Crown for specs A-12 on control centers.

When listening becomes an art,



The album's problem is lack of focus. Producer David Kershenbaum, who reactivated Joan Baez with his work on **Diamonds and Rust**, doesn't connect with Richie Havens to create a team. They don't work at cross-purposes, they just lack a meeting place to take off from. M.T. Sound: C – Performance: C –

#### Let the Rough Side Drag: Jesse Winchester

#### Bearsville BR 6964, stereo, \$6.98.

The years of exile since fleeing the draft have brought serenity and honesty to the foreground of Jesse Winchester's music. With the last album, **Learn to Love It**, it was implicit in the album title as well. The new one is an extraordinarily mellow album. It doesn't jar you, it seduces you. What may seem slight at first insinuates itself into you and draws you to it.

The songs are an inspired bunch. Damned if You Do, How About You, and the title song show Jesse's gritty faith in people in spite of themselves. Everybody Knows but Me is an instant classic to my ears, maybe the song to bring Jesse to more than a few. It's a downright funny song with hooks that won't quit. His gospel roots account for the fine version of It Takes More than a Hammer and Nails to Make a House a Home.

If Let the Rough Side Drag sounds a bit soft at times, it's only because of the musician's own inner calm. Jesse Winchester's charm pervades his music abundantly. <u>M.T.</u> Sound: B Performance: A-

#### Deep Cuts: Strawbs

Oyster/Polydor OY-1-1603, stereo, \$6.98.

With **Deep Cuts** the Strawbs, who have never exactly lacked pretension, take three giant steps toward the middle of the road in their never-ending search for mass acceptance. Toward that end, they have moved to a new label and used the Rupert Holmes and Jeffrey Lesser production team fresh from their Streisand project. Simultaneously leader Dave Cousins writing with member Chas. Cronk has grown into full-scale collaboration.

If only the Strawbs could have retained their own personality, it might have worked, but alas where the production is full-bodied and willing, the songs are stiff. They lack character. **Deep Cuts** is a cold, impersonal album, utterly lacking magic. M.T. Sound: B— Performance: C—





Beethoven: Symphony No. 4; Grosse Fuge, Op. 133: Academy of St. Martinin-the-Fields, Marriner.

Philips 9500 033, stereo, \$7.95.

Every so often an unobtrusive record comes along like this one and, to my astonishment, simply bowls me over. I was so stunned by this music that it took me an evening to recover.

The Fourth Symphony, one of the "even numbered" symphonies which the 19th century felt were inferior works (the "odds" were the Great Symphonies), nevertheless has always been a favorite of mine and quite unique in Beethoven, though it is seldom heard and not easy to project successfully. Over the years I have had numerous indifferent recordings, even as far back as one of those early RCA Long Play transcriptions of c. 1933-I can still hear the distorted loud segments of that one. As for the Grosse Fuge, it is the enormous string quartet movement detached from one of the last Quartets, composed when Beethoven was stone deaf, a

lone, jagged monument of quartet writing—which occasionally gets a misguided performance for string orchestra, the players sounding like a bunch of drunken bagpipers on a spree. As ensemble music, the work is almost unplayable.

So here comes the Fourth, and such a clear, precise, lovely, warm performance I have never heard before! A labour of love, to use the British spelling, perfectly shaped and phrased, also beautifully and impressively recorded as well-what a splendid symphony! As for the Grosse Fuge, it is simply stunning, overwhelming. One of the finest performances of that incredibly difficult work I ever hope to hear-and for orchestra (though a small one)! Why, these players are more accurate and less frantically squeaky, in the difficult ensemble format, than nine-tenths of the pure string quartet performances on disc! And such control-the final pages of the work left me so moved, I could not speak. A very great performance in a most improbable form, the sort that makes life worth living for those of us who are musical.

#### **Constance Keene Plays Mendelssohn**: Constance Keene, piano.

Laurel-Protone 12, stereo, \$6.98.

The solo recital disc is always best when both the instrument and the music itself are of interest, and here is a splendid example, a piano "recital" devoted entirely to the music of Mendelssohn—including some unusual works, played with astonishing Romantic conviction where, all too often, Mendelssohn sounds merely old fashioned.

Keene is a pianistic powerhouse—such energy! She has bushels of technique and hands of steelspring strength, but it is her intensity, her passion, that you hear first. This, it seems to me, is the way Mendelssohn *must* have sounded to listeners in his own day, a young, modern composer writing an exciting, even disturbing new style, tempestuous, and wild as well as fabulously virtuoso. Very few pianists now have the imagination to see it this way. Two big pieces, the rarely heard *Fantasy in F Sharp* and the more familiar Variations Serieuses, are surrounded here by shorter *Etudes*, and Songs Without Words, plus the marvelously sprightly Adagio and Capriccio, out of the youthful Midsummer Night's Dream period— Mendelssohn was 18. Never a lag in interest, straight through, though to be sure the composer does write an awful lot of fast notes, almost never ceasing.

The notes say Keene tried 36 Stein-

ways before she chose this one-how curious! It is astonishingly bangy and unevenly voiced (perhaps because of her super-strong fingers?) but, after a very short time, turns out to be an excellent instrument for the early 19th century music, sounding as Mendelssohn's own pianos might have sounded in the days before rigid steel frames, when strings broke and parts cracked. I liked the effect, and the recording too, a bit distant with a good resonance. (RCA New York Studio B, plus added large-room reverb at A & M-how's that for an early 19th century sound!)



#### You've probably heard our name.

We build the two best power amplifiers in the world; the 3B with 100 watts per channel, and the 4B with 200 watts per channel. Each will distort a musical signal less than any other amplifier we know of. Each has a slewing rate over 60 volts per microsecond. Both will deliver full power from below 1 Hz to beyond 100kHz into any known speaker load.

Write us, we'll tell you more about the amplifiers, and where you can hear them.





Check No. 41 on Reader Service Card

**Concert of the Century.** Recorded live at Carnegie Hall, May 18, 1976: Bernstein, Fischer-Dieskau, Horowitz, Menuhin, Rostropovitch, Stern, Oratorio Soc., N.Y. Philharmonic.

**Columbia M2X 34256,** 2 discs, SQ stereo/quadraphonic, \$13.96.

#### **The Heifetz-Piatigorsky Concerts:** (Dvorak, Stravinsky, Gliére, Handel-Halvorsen.) With Leonard Pennario, piano-forte.

#### Columbia M 33447, stereo, \$6.98.

Here from Columbia are the best and worst aspects of live concert recording. Stay away from Carnegie! (Unless you want to give to the Carnegie endowment fund, which is fine.) But listen to Heifetz and his friend Piatigorsky, who make really modest and splendid music in the famed concert series of the early 1960s.

The monster Carnegie concert made a million dollars or so, thanks to free performances by the galaxy of stars, and presumably everyone who paid came forth pleased as punch for it was a great success. Better to leave things as they were-but no! Columbia has to try for one more Legend. Ugh. It's awful. A combination of everything that can make the recording of a concert come through disastrously-both performance and recording. With so many superstars on hand, the atmosphere was something like one of those Oscar shows, triumphant, but all tension. This taut quality comes through far too strongly even though it leads to some powerful, if erratic music making. Notes out of tune. strains and stresses, shaky ensemble, all are too faithfully recorded at ultraclose range, grossly exaggerated by the nearness of the microphones; the performers, aiming at the thousands of listeners out in the hall, tend to shout or to play extremely loudly-quite OK if you are a proper distance, but deadly at close range. The "chamber" works, for solo performers, duet, trio, are much the best offerings and the big surprise is Horowitz, who turns out to be a model piano accompanist as well as a powerful solo virtuoso. A very unkept movement from the Bach Concerto for Two Violins (Stern and Menuhin) and the Beethoven Leonore No. 3 feature the Philharmonic, not at its best, and the Oratorio Society sings mightily, and flat, in Tchaikovsky, joining everybody and his brother for the Handel Hallelujah Chorus. Fischer-Dieskau's Schumann Dichterliebe is heartfelt and strangled-a bad night for him.

No-this recording will never make it into legend.

But Heifetz and Piatigorsky are legend already. Their performances, with Leonard Pennario at the piano, are astonishingly smooth and well balanced, minus any undue tension plus remarkably free of bloopers. Even the recording is very good. It can be done, live concert recording! But not at gala monster events.

George Gershwin Plays Rhapsody in Blue; An American in Paris: Columbia Jazz Band, N.Y. Philharmonic, Michael Tilson Thomas.

**Columbia M 34205,** SQ stereo/ guadraphonic, \$6.98.

What a laugh! This new recording is made using the "legendary" 1925 Gershwin piano roll of the *Rhapsody*, with a jazz band added to the player piano—the whole in modern stereo/quadraphonic sound. A nice stunt, but even more tricky in detail than you might imagine.

The original piano roll (which has been reissued in an LP performance) has all the music on it—the piano solo part and the instrumental accompaniment, the whole thing played by the accomplished Gershwin. Therefore, to begin with, somebody had to go through the entire piano roll and cover up about a hundred million holes representing the orchestra part (after having laboriously figured out which ones to cover!), so that only the notes of the piano solo would play. Some job. But that's only the half.

If his piano rolls are accurate, Gershwin was always a pretty fast player and did his own music at breakneck speed. Moreover, a piano reduction of any orchestral music is almost certain to go faster than the more heavyweight orchestral version. So, you can believe it, this Rhapsody really rips along. And what happens to the added jazz band (the original orchestration of the work)? By golly, it has to rip along too at a most unseemly pace! The whole thing is a riot and lots of fun. ('Course you'd think they could have slowed down the piano roll a bit...)

The second side offers a complementary American in Paris with the New York Philharmonic and no piano roll to complicate matters. Too symphonic for my taste, this version, although the musicians try hard. It isn't jazzy/blatty, as it ought to be; it doesn't sound like the 1920s. It sounds like the Philharmonic. Couldn't be helped, I guess.

## If your cartridge is more than three years old, don't replace your stylus!

Don't get us wrong. There is nothing worse than playing your records with a worn stylus. And no better way to restore your old unit to its original glory than a new diamond.

But frankly there have been significant strides made recently in the phono cartridge field. And the new cartridges of today stand head and shoulders above even the finest of a few short years ago.

Here's the choice: Get fresh—but outdated performance with a replacement stylus of enjoy a/ the benefits of modern cartridge research and development for just a few dollars more. You'll find that you can upcate your system for far less than you might imagine. It's probably the most diamatic single improvement you can make.

For instance, Audio-Technica offers Universal<sup>16</sup> cart-idges equipped with a genuine Shibata stylus and our uniquely effective Dua Magnet<sup>17</sup> system beginning at just \$75.00 list. Or you can replace your present cartridge with a fresh new Audic-Technica cartridge with highly-bo shed elliptical tip for as little as \$45.00 list.



Are these new models worth the difference? Absolutely. You'll be amazed at what you hear from today's generation of phone cartildges. Improved trequency response. Lower distortion. Better separation. Less record wear. Trul, tetter sound.

A new ALCID-Technica cartridge. Your best value in hi-fi.

idio-technica

NOVATION D PRECISION D INTEGRITY





PAIA's PYGMY Amp, already one of the best practice amplifiers is now an even more spectacular bargain!

Every PYGMY Amplifier kit sold during the month's of February & March of 1977 will include our new...

#### Articulator attachment (a \$5.00 value at no additional cost)

Now you can use the PYGMY for

Frampton effects in addition to stage monitor, practice amp, spontaneous jams, etc.....

PYGMYAMPKIT still only \$39.95 Plus \$2.50\* postage & handling + Continental U. S. MORE Great Kits at righteous prices



in our FREE CATALOG

ELECTRONICS, DEPT 3- A 1020 W. WILSHIRE BLVD OKLAHOMA CITY, OK 73116 Check No. 26 on Reader Service Card



#### Starring Fred Astaire

**Columbia** (2 discs) SG32472, mono, \$6.98.

Part of the parade of releases for nostalgiamaniacs, this two-record mono set of Fred Astaire songs (and dances: those amazing sounds have been crisply preserved) consists of the 1935-38 Brunswick recordings and 19 songs from Astaire films not previously released. They're by Irving Berlin, Dorothy Fields and Jerome Kern, and George and Ira Gershwin, and represent 6 films: Top Hat, Follow the Fleet, Swing Time, Shall We Dance, A Damsel in Distress and Carefree.

These are best heard in small doses. Even given the various orchestras—Johnny Green, Ray Noble, and Leo Reisman—and the enduring tunes (Cheek to Cheek, A Fine Romance, They All Laughed, Let's Call the Whole Thing Off, and A Foggy Day), there is a sameness to the rhythms, phrasing and mood created. All are light love songs, or, more accurately, songs of affection that don't take themselves very seriously, and none come remotely close to even dignified passion or credible pathos.

Astaire's singing was all in the throat; there were no real chest tones. But vocal criticism is really out of place: his approach to song was as unique as it was to dance. He was more than a diseur but less than a crooner, and he sang in a manner that was unaffectedly innocent, almost palpably callow. Yet he could be a countertenor, as in the end phrasings of Cheek to Cheek. For all this, Astaire was a baritone manque. What is most interesting is the clarity of his enunciation, his ability to sing/talk rapidly. And those feet, moving right into your living room!

That there is little difference between his approach to Top Hat, White Tie and Tails and They Can't Take That Away From Me may be due less to his style with them than to the fact that these 30s songs used only two or three tempi, favored simple harmonies and avoided syncopation or the kinds of novelty that inject substance into a melody. But Astaire is inimitable in everything he did (has anyone ever dared to parody him?). His very lack of subtlety had an earnest appeal in comparison with the easy leers of later "romantic" singers. And for all his boyishness—believably retained up to his most recent performances—he still sounds more responsible than the whiners of the 50s or the screamers of the 60s. (Now my real prejudices are showing.)

Perhaps more than anyone else in our tradition, Fred Astaire represented the beau ideal of the American performer: the honest, cheery lad whom every Yankee father wished his daughter would marry, and every mother wished she had. The young Frank Sinatra had that quality, too. But he never recorded and danced to Let's Face the Music and Dance or The Way You Look Tonight. In the final analysis Fred Astaire can be compared only to himself.

**Citizen Kane and Others:** The Classic Film Scores of Bernard Herrmann. Charles Gerhardt cond. National Philharmonic Orch. Kiri Te Kanawa, soprano; Joaquin Achucarro, pianist. **RCA ARD 1-0707**, stereo, \$6.98.

Bernard Herrmann is not really a film composer, but a composer who has written for films. I think he may be the finest, the most versatile, and the least stereotyped artist in this medium, for the volume and breadth of his



AUDIO • March 1977

94

compositions are staggering. Continuing the Classic Film Scores series, RCA has recorded suites from five Herrmann scores: from Citizen Kane (1941) to White Witch Doctor (1953). Herrmann's best work - the eight scores for Hitchcock from 1956 to 1964 - is not represented, perhaps because selections are available now under the composer's baton on London's Music from the Great Movie Thrillers. This album is interesting (who else could compose with such freshness for a clinker like Beneath the 12-Mile Reef?). But there are other omissions also (what happened to his music for The Day the Earth Stood Still?).

**On Dangerous Ground** (1951) is represented here briefly. Listen to it and hear the hunt scene from Hitchcock's Marnie (1964), right down to that staccato in the brass. The Xanadu episode in Citizen Kane foreshadows Herrmann's greatest, most Wagnerian score, that for Hitchcock's Vertigo (1958), arguably the finest American film and the grandest film score. Kiri Te Kanawa, the soprano from New Zealand, negotiates the devilishly difficult music Herrmann wrote for the opera sequence in Kane, and her final high D is really striking. This makes one hope for recordings of Herrmann's own full-length operas and cantatas, Wuthering Heights, Moby Dick, and A Christmas Carol. How about it, RCA?

The Concerto Macabre Herrmann wrote for piano and orchestra for Hangover Square (1945) is a darkly fearsome undertow of a piece, Lisztian in spirit, starkly effective - the piano is alone for the final 28 measures! — and memorable where the film is not. White Witch Doctor, inexplicably the longest cut on the disc, has two moments worth attention, an obsolete medieval metal "serpent," which produces a really terrifying sound for the Tarantula sequence; and the sublime Nocturne, with its rhapsodic melody in the strings and aching counterpoint for solo clarinet.

Bernard Herrmann once remarked, "A composer's first job is to get inside the drama. If he can't do that, he shouldn't be writing the music at all." He has himself consistently got "inside the drama," as those who know his Hitchcock scores attest. This recording is welcome, but it is hardly definitive. The production is about as smooth as you'll find today. RCA's ultra-thin Red Seal series is admirably free of whoosh or warp.

Sound: A	Performance: A

Are you looking for speakers to torture your dog, or for a better deal in the sound you can hear?



Relax. We're not accusing you of cruelty to animals. But we do think it's

high time to get up-front on speaker specs. Separating the ones that make a difference to the human ear, from the ones that soak you just to drive poor Rover mad.

Years ago we realized what most of you really want: great sound reproduction, more reasonably priced. And being an up-front, coast-to-coast loudspeaker company, we could take it from there.

By cutting out the gimmicks, the inaudible esoterics, we could concentrate all our resources on perfecting the sound values your own hearing could appreciate.

Building in enough power-

handling for top-line electronics, without running up the tab on specs that serve no practical purpose.

And what this approach saves is passed on to you. In such terrific sound systems, so terrifically packaged, we're not afraid to encourage one-onone auditions against any comparably-priced speakers.

In side-by-side comparisons of our total price/performance/

Ultrakmear is a trademark of Ultrahmear Loudspeakers, a division of Solar Audio Products. Inc

packaging, it's *that* apparent that Ultralinear gives you more bang for the buck. Dollar for dollar. Sound for sound.

And since no two ears are alike (or bank accounts either), we put a broad selection of Ultralinear speakers up-front. In bookshelf, floor-standing or tower systems—



pick your own price and configuration. With a choice of sleek cabinet finishes and grilles. With plenty of technical goodies, like blowout-proof circuit breakers—built in.

No wonder audio sales personnel are quick to recommend our up-front



concept in loudspeaker development. They know value...and their experience confirms what

you've always suspected: too many expensive speaker specs are for the dogs.

For the full-color line brochure from the up-front, coast-tocoast loudspeaker company, write to

Ultralinear, 3228 East 50th Street, Los Angeles, California 90058. A list of your local Ultralinear dealers will be included.

#### Ultralinear

AUDIO • March 1977





#### The Complete Artie Shaw, Vol. 1 Bluebird AXM2-5517, mono, \$7.98. Artie Shaw - Melody and Madness, Vols. 1 & 2 Jazz Guild 1001 & 1002, mono, 5.98 ea.

It was the very late 30s, and a million pulsating, throbbing radio sets in prewar America kept time to Artie Shaw's music. By 1937 Benny Goodman was "King of Swing," and fellow clarinetist Shaw cast envious eyes on the crown. In 1936, Shaw, always an individualist and experimenter, had tried to break in with a string/swing combination-(a string quartet plus trumpet, tenor sax and standard rhythm section). This interesting band, trying to buck the trend of loud, brassy, swinging ensembles, was a financial flop. In 1938, with conventional swing band instrumentation-four saxes, three trumpets, two trombones, and four rhythm, and a hit recording of Begin the Beguine—the Shaw orchestra crashed the King of Swing's court and very nearly usurped the throne.

In less than a year, Shaw's success was such that on one trip to Boston, he had a crowd of close to 20,000 kids jitterbugging under the stately elms of the Boston Common.

While the Shaw band was a blatant imitation of Benny Goodman's instrumentation (as were most of the swing bands that sprung up in the late 30s), it had a lilt, a beat, and a thrust all its own. It's lively debut music has been assembled for us in the RCA Bluebird doubleset, and is also reflected in the Jazz Guild **Melody and Madness** volumes which are 1938-39 airchecks from Shaw's Old Gold sponsored radio program.

Burt Korall, in his excellent liner notes for the Bluebird collection, quotes Shaw as saying that he wanted his scores to have "crystal-clear transparency so that the lay listener could hear every instrument...see all the way to the bottom, as when you looked into a clear pool of water and see sand at the very bottom of the pool."

Indeed, the Shaw band, recording on the RCA Bluebird label in 1938, projects that quality right from the start, certainly on the multi-million seller Begin the Beguine, the skillful arrangements and crisp, taut section work is readily apparent on such performances as Yesterdays, It Had to Be You, What Is This Thing Called Love, Softly as a Morning Sunrise, and You're a Sweet Little Headache. Helen Forrest, the guintessential band vocalist, sings tastefully, with flawless intonation and with a buoyant lilt that blended into the swing band style. But Forrest's vocals make a striking contrast with Billie Holiday's one recording with Shaw-Any Old Timewhich appears on the first side of the Bluebird set. Holiday is the guintessential *jazz* singer. The acerbic quality of her unique voice gives Any Old Time a commanding presence that makes Forrest's singing sound frail. Holiday's sense of time and perception are in full command as she alters notes and accents and changes rhythmic contours. (In 1938 RCA withdrew the Holiday/Shaw version of *Any Old Time* because it was too "far out," and forced Shaw to re-record it with Forrest!)

A biting jazz quality is precisely what is lacking on most of the 1938 Shaw Bluebird sides. Listening to those early studio recordings today, Shaw's group comes across as a polite swing band. The 1938 airchecks of tunes like Non Stop Flight, Shoot The Rhythm to Me John Boy, Back Bay Shuffle, What Is This Thing Called Love, and It Had to Be You, paralleling the studio recordings, sound more volatile than the commercial discs, no doubt due to the chemistry between the band and its live audience. On the 1938 airshot, Shaw plays vigorously, tenor Tony Pastor blows with warmth and feeling, tenor sax man Georgie Auld takes some hefty jazz breaks, and there are pungent hot solos by trumpeters John Best and Bernie Privin

But it took a great drummer to make Shaw's a truly exciting band. The hiring of 17 year-old Buddy Rich turned the Artie Shaw Orchestra into one of the major swing forces of 1939. Rich joined Shaw in January of that year, and, as documented on the last five cuts in the Bluebird collection, and in Vol. 2 of the Melody and Madness airchecks, the precocious percussionist took charge immediately. Suddenly the Shaw band had a swinging, propulsive drive. The band plays with remarkable fervor on numbers like Time Out, Serenade to a Savage, Diga Diga Doo and At Sundown. Shaw's hot soloists, particularly Auld and Privin, who never set the world on fire, now seem to catch fire as Rich swings them relentlessly, underlining every nuance of the arrangements, pushing and driving the soloists, squeezing every ounce of talent from them. I particularly liked the Count Basie chart Time Out, a collectors item because Shaw never recorded the tune commercially; the marvelous sax section takes on an aggressively gutty quality, and the whole band plays with tremendous drive and conviction. The same feeling comes across on an exhilirating version of Begin the Beguine, (far better than the Bluebird performance)...this kind of swing is obviously what "sent" the "cats" on Boston Common.

RCA does its usual fine monaural sound transfer job on the Bluebird set. The Jazz Guild airchecks vary in sonic quality as Vol. 1 is somewhat fuzzy and boxy, but Vol. 2's Shaw broadcasts come through sharp and clearly detailed. John Lissner Complete Artie Shaw:

Sound: B+	Performance: B+	
Artie Shaw-Melody & Madness:		
Sound: B+	Performance: A+	

#### Bobby Hackett Live At The Roosevelt Grille, Vol. 2: Bobby Hackett Chiariscuro CR-138, stereo, \$5.95.

I wish I could wax enthusiastic about this album because over the years I have admired most of the musicians. The Hackett band-with the leader on cornet; Vic Dickensen on trombone; Dave McKenna, piano; Jack Lesberg or Milt Hinton, bass, and Cliff Leeman, drums-was brought into New York's Roosevelt Grille by millionaire jazz patron Dick Gibson, who marketed the Water Pic, and whose World's Greatest Jazz Band has been a factor on the jazz scene for almost a decade. The Grille, long the lair of Guy Lombardo, went dark in the late 60s. In 1969 Gibson reopened the room with the World's Greatest Jazz Band, and in the spring of 1970, signed Hackett to alternate with the WGJB.

I heard Hackett's group at the time and don't remember it sounding this dull. The music, caught on these particular tapings, is flabby and uninspiring. The placid side of Hackett's playing, which has endeared him to Jackie Gleason and the Muzak people (he is one of Muzak's most recorded musicians), has gotten the upper hand. A listlessness seems to have infected all of the musicians with the exception of pianist McKenna, who, rollicking along with unabashedly swinging solos, doesn't seem to realize that everyone else is sleepwalking. 1. L. Performance: C-Sound: B+

#### Max Morath Plays Ragtime Vanguard VSD 83/84, two discs, stereo, \$6.98.

Long before Scott Joplin's The Entertainer achieved Hit Parade status and classicial pianist Joshua Rifkin's Nonesuch rag recordings became runaway successes, a small group of dedicated musicians and scholars had kept ragtime alive; they published newsletters, tracked down first editions of the music, recorded on obscure labels, and met sporadically for ragtime bashes.

In jazz circles, the classic ragtime style was played authoritatively by Wally Rose, of the Yerba Buena Jazz Band, and by Ralph Sutton, the pianist with the World's Greatest Jazz Band, In 1963, Max Morath emerged on the scene, publishing his collection of Over 100 Classics of Ragtime, an excellent cross section which included 26 numbers by Scott Joplin, 19 by James Scott, and 11 by Joseph Lamb. While there is great respect for Morath as a scholar and aficionado, he leaves much to be desired as a pianist. His playing on this Vanguard double set is stodgy and stilted, only on the fast rags like Scott's Frog's Leg Rag or Joplin's Maple Leaf Rag is there a hint of the exhilaration and definitive syncopation that a Rose or Sutton convey in their recreations. 1. L. Performance: C Sound: B+

#### The French Market Jazz Band Flying Dutchman BDL1-1239, stereo, \$5.98.

The French Market Jazz Band, "direct from New Orleans," ought to go back to the Crescent City and spend at least two years woodshedding before it has the gall to make another record. Despite the puffy liner notes written by critic Nat Hentoff, most of the playing on these nine cuts is so poor that I'm surprised producer Bob Thiele released the album.

The French Market Jazz Band is one of those young groups that plays traditional jazz on the streets of New Orleans and San Francisco. Thiele and his wife, Teresa Brewer, caught this particular band in the French Quarter some months ago, flew them to New York, recorded them over a period of two days. The band then roamed the city, ending up in Washington Square playing an informal concert, after which they passed the hat which came back with \$110.00 in it.

It may be that the over-generous and musically naive urchins that hang out in Washington Square were exhilerated by such traditional jazz tunes as Tin Roof Blues and That's a Plenty tunes new to them, but a seasoned jazz listener is not going to put up with the supine, soggy rhythms and clumsy ensembles that make this Flying Dutchman collection one of the dullest records I have ever reviewed for Audio. The unprofessionalism of the French Market Jazz Band must have been apparent to producer Thiele, or else he wouldn't have added veteran clarinetist Johnny Mintz to bolster this hopeless session. Mintz makes an attempt to sound like a swinging jazz man but he is overwhelmed by the ineptness of the whole proceedings. John Lissner Performance: D Sound: B+

## Classified

#### FOR SALE

ANTI-SKATING for AR TURNTABLES!! Proven counterweight design of nickel steel & aluminum construction. Install yourself in minutes \$7.00 postpaid. (Dealer inquiries invited.) AUDIO INNOVATIONAL PRODUCTS, P.O. Box 1607. Portsmouth, N.H. 03801.

SUPEX — ORTOFON — DENON — DTHER MOVING COIL CARTRIDGE OWNERS: Send for free literature on our Micro Preamp Superb performance at \$99.95. Huntington Electronics, Box 2009A, Huntington, Conn. 06484

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF MIAMI, 1756 S W 8th STREET. # 201. MIAMI, FLORIDA 33135

LOWEST DISCOUNT PRICES ANYWHERE on audio equipment. All major brands discounted. Write for quotes. K&L Sound Services 75 N. Beacon St., Watertown, Mass. 02172

DIAMOND NEEDLES and Stereo Cartridges at Discount prices for Shure, Pickering, Stanton, Empire, Grado and ADC Send for free catalog, LYLE CARTRIDGES, Dept. A. Box 69 Kensington Station, Brooklyn, New York 11218

GRAPHIC EQUALIZER PLANS: Novel circuit very effective/inexpensive, requires no inductors. Ten knobs (octave bands) compensate your Hi-Fi/Tape providing better listen ing. Complete plans rushed only S3.49 GREEN BANK SCIEN TIFIC, Box 100C, Green Bank, WVa 24944.

ESS AMT-3 "Rock Monitors" with Heil tweeters. New (lifetime) warranty. Good condition. \$525. pr. (212) 228-8140

#### NATURAL SOUND

salutes those audio manufacturers who have raised the art of sound reproduction to new levels of excellence.

NATURAL SOUND cordially invites you to hear the new line of FULTON speakers which are unparalleled for their naturalness and quickness of response. BRAVURA and GREAT AMERICAN SOUND(Thaedra/Thoebe, Ampzilla II/Son of Ampzilla electronics which set new standards for the audio art.

Hear a properly set up V15III-G cartridge in a GRACE arm and see if you don't agree with us that it, too, is unexcelled for its naturalness. Hear the rich and exciting sound of the FIDELITY RESEARCH in a KMAL arm. Hear the best of the moving coil and magnetic cartridges and make your own choice. Hear the audible superiority of the LINN SDNDEK over expensive direct drive turntables.

Hear the best of the British speakers: LENTEK, KEF, B & W, IMF INTERNATIONAL, QUAD. Hear the new and exciting equipment: the BRAVURA and LEVINSON Class A amplifiers, the new PAOLI tube amps, the PARAGON and DB SYSTEMS preamps, the SLEEPING BEAUTY, FOR-MULA 4 arm, and a best buy, the new CONNOISSEUR BDI turntable.

If you are interested in audio, you will want to receive our newsletter and a catalog of audiophile records available from us: ARK, AUDIO LABS, LEVINSON...

PREOWNED: ARC SP3a-1, D-100, Tympani IIIa, IC, WA panels. IMF International Monitors, Audio General, Stax and DB Systems preamps, Ampzilla, Quad 303 and 405 amplifiers, Armstrong receiver, Sony TA-5650, Thorens TD125 MKII with Decca and SME arms, Transcriptors skeleton and ERA turntables, Stax SR-5s... Write or call for our newsletter for a more complete listing.

NATURAL SDUND, 315 South 11th Street, Lincoln, Nebraska 68508, (402) 475-3325.

#### FOR SALE

FAIRFIELD AND WESTCHESTER COUNTY AUDI-OPHILES TAKE NOTE! THE AUDIOPHILE, 231 BEOFORD STREET, STAMFORD, CONN. specializes in equipment for the connoisseur G.A.S., Koss Model One, ADC, Crown, Dahlquist, Dyna, Epicure, Infinity, Philips, SAE, SME, Stax, TEAC, Technics, Thorens, Soundcraftsmen, Denon, Sonus and many more (203) 348-3551 (Closed Mondays).

DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHDUSE OF FT WALTON BEACH 652-D BEAL PKWY, N.W., FT WALTON BEACH, FL 32548

BUY DIRECT from England's Hi-Fi mail order specialists! Save on B&O. Celestion, Tandberg, Revox, Transcriptors, Jordan-Watts, Lowther, KEF, Rogers, SME, Ariston, HPD, Sugden, Radford, Neal, Technics, Sony, Alwa, Yamaha, Pioneer, etc. Shipping list free or send S3 bills to include literature Goodwins, 7 The Broadway, WoodGreen, London,N22 Phone 888 0077. Visitors welcome.

CANADIANS — DYNACO COMPONENTS AT TREMEN-DOUS DISCOUNTS Write En-Jay Sales, Hornepayne, Ontario.

#### INNOVATIVE AUDIO

The major reasons for YOU to participate in the "Innovative Experience:" 1) We don't look at our watches while demonstrating 2) We try to gently guide you in your selection by offering you information that is honest & concise.

3) We are NOT SNOBS.
4) We offer a wide range of super-quality equipment in all price categories.

5) We give service that most everyone else promises. We LEND units while yours is being serviced.

<ol><li>We are nice people.</li></ol>	
Mark Levinson	Sequerra
Accuphase	Dunlap-Clarke
Quintessance	Audire
DB Systems	Audio-General
SAE	BGW
STAX	Innotech
Klipsch	ADS
0HM	IMF International
Spendor	Gale
Celestion	Micro Seiki
Linn-Sondek	Thorens
Technics	ADL
Ortofon	Denon
Supex	Satin
Grace	SME
KMAL	SAEC
Revox	Bever
TEAC	DBX
Ater reading this weird but "Innovative"	ad, we seriously
hope you'll come by and "Experience" us.	
129 Degraw Street	
Brooklyn, New York 1123	1
(212) 596-0888	

CAMPUS REPS! CONSUMERS! DEALERS! Most medium and many high end lines available at lowest wholesale. Make 10%/40% Repping/Demonstrating high quality loudspeaker line. Prices, info. S1 (refundable w/order) + SASE (812) 332.4252. AUDIO 1010 S. Dunn, Bloomington, Indiana 47401

ELECTRONIC CROSSOVERS—ALL TYPES. Updated defini tive booklet describes applications, how to improve speaker systems; \$5.00 postpaid, credited to first purchase Huntington Electronics. Box 2009-A. Huntington. Conn. 06484

#### FOR SALE

CYBERACOUSTIC LABORATORY is a research and development center combined with the most scientifically advanced audio acoustics lab Exciting new product lines for 76-77 including: Audio Pulse Home Digital Delay Line, Acoustat Direct Tube Drive Electrostatic Spkr., Crown's New High Definition Series of Amps and Preamps, Fulton Systems, Infinity's New Quantum Spkr. Series, Luxman Ultra-High Fidelity Solid State & Tubes, IMF International Spkrs., RTR Point Source Direct Drive Electrostatic Spkrs., IM Fried Models H, M, D, R II, L, Q, & S Spkrs., Denon Blk. & Wht. Carts., Stax Electrostatic Spkrs., Nakamichi's Recording Director Series of Electronics, Source Engineering's New Noise Reduction System, EMT Moving Coil Cartridges, Transcriptors TT, Sonus Carts., Otari Decks, KEF Spkrs., Spendor Spkrs., For mula 4 Tonearms, Polk Spkrs., Fons TT AND MUCH MORE!!!! 233 E. Lancaster Ave., Wynewood, PA 19096; 215-667-3048

DENON DL103C and AU320. New \$195. PPD. J. Fong, 1238 Green St., San Francisco, CA 94109.

UNE STUP for all your professional audio requirements Bottom line oriented FTC Brewer Company, P.O. Box B057, Pensacola, Florida 32505

DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF MOBILE 1770 BELTLINE HIGHWAY, MOBILE, ALABAMA 36609

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF ATLANTA # 6. BELVEDERE PLAZA SHOPPING CENTER. 1203 COLUMBIA DRIVE, DECATUR, GA 30032

#### CLASSIFIED ADVERTISING RATES

BUSINESS ADS - For Sale, Help Wanted, Services, Business Opportunities, Shortwave, Tape Recordings, etc. etc. 60c per word (minimum charge for eight words per line, \$4.80 per line), First line set In bold face type at no extra charge Extra lines set in bold face type: \$1.20 per word (minimum charge for eight words per line, \$9.60 per line), One point ruled box, extra charge \$8.00. Full payment must accompany order.

NON BUSINESS ADS - Situations Wanted, used equipment for sale by private individuals: 35e per word (minimum charge for eight words per line, \$2.80 per line). First line set in bold face type at no extra charge. Extra lines set in bold face type: 70c per word (minimum charge for eight words per line, \$5.60 per line). Full payment must accompany order.

FREQUENCY DISCOUNT - 3 times, less 10%. 6 times, less 15%. 12 times, less 20%.

BLIND ADS - Box numbers may be used at \$2.00 extra for handling and postage.

DISPLAY CLASS	IFIED RATE
1 col x 1"	\$85
1 col x 2"	\$125
1 col x 3"	\$175
2 col x 1"	\$125
2 col x 2"	\$225

Advertiser must supply complete film negative ready for printing for mail order and display ads.

> AUDIO Magazine 401 North Broad Street Philadelphia, Penna 19108

#### MILWAUKEE & WISCONSIN'S ONLY TRUE AUIDOPHILE DEALER

Specialists in components by Audio Research, Dahlquist, Transcriptors, SAE, Nakamichi, Bozak, SME, DBX, Revox, Infinity, RTR, Phase-Linear, Tandberg, G.A.S., London-Decca, Stax, Sonus and over 50 others. Wisconsin's ONLY Audio Research dealer with their new product line on demonstration. Plus one of the truly largest displays of tape decks & accessories in the entire country. Over 130 machines on display. WACK ELECTRONICS, INC. 5722 W. NORTH AVE. MIL-WAUKEE, WI. 53208

**DDN'T PAY THE HIGH MAIL ORDER PRICES**. THIEVES WAREHOUSE OF ATLANTA NO 7, 215 COPELAND ROAD. ATLANTA, GEORGIA 30342

KLH MODEL SCX-3A speaker mint condition, \$625.00. Call 1 (3D1) 742-5939

BACK ISSUE MAGAZINES. Over 200 titles, 1890 to 1976. Send Stamped Envelope. Free List. Everybody's Bookshop Dept AU, 317 West 6th. Los Angeles, Calif. 90014.

QUAD 405. Current dumping amplifier \$320 or best offer. 206-778-1904.

#### NORTHERN OHIO AUDIOPHILES-

Akron's GOLDEN GRAMOPHONE (owned by audio systems) — Audio Research, Nakamichi, Magnepan, Great American Sound, Linn Sondek, ADS, Advent, SAE, Grace, Denon, Stax, Sonus, Grado Signature I, Vestigal, and many other fine audio components. 2858 W. Market St., Akron, Dhio 44313. 216-864-4411.

McINTOSH MR-78 tuner (\$585) mint (614) 297-1753

#### FOR SALE

#### BRITISH COLUMBIA, CANADA

THE SOUND ROOM IS an organization dedicated to provide discerning audiophiles with the finest matched components to reproduce the most accurate sound available. We currently recommend the following products:

Audio Research	Dayton-Wright Mark Levinson
FMI (Fulton)	
Magneplanar	Dunlap-Clarke
Rogers (BBC Monitors)	Lux (Luxman)
mqvuad	Phase Linear
BGW	Bose
Dahlquist	Infinity
KEF ('Super C' & 'Reference' series)	Thorens
Stax	Ariston Audio
Bozak	Linn Sondek
AR (Advanced Development Division)	Grace
Soundcraftsmen	SME
Micro-Acoustics	Goldring
KMAL (Keith Monks)	Denon

FEATURE OF THE MONTH: New Audio Research SP-4 solid state preamplifier now in stock and available for in-home demonstration.

THE SOUND ROOM 2BD3 West Broadway Vancouver, British Columbia Canada V6K 2G6 (604) 736-7771

CLASSICAL recordings old/current list, ARS Musica, 13 Dante St., Larchmont, N.Y. 10538.

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF MOBILE # 2, 301 SOUTH CRAFT HIGHWAY, CHICKASAW, ALABAMA 36105

#### FOR SALE

DDN'T PAY THE HIGH MAIL DRDER PRICES THIEVES WAREHOUSE OF TAMPA 1531 SOUTH DALE MABRY, TAMPA, FLORIDA 33609

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF PLANTATION, 231 SOUTH STATE ROAD 7. PLANTATION, FLORIDA 33317

BIGGEST DISCOUNTS on audio - high-end components. Over 125 brands. Audio Unlimited, 466 Hawthorn, Sunnyvale, CA 94086 408/737-0828 evenings

DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF FAIR LAWN, 34-09 BROADWAY, FAIR LAWN, NEW JERSEY 07410

#### DISAPPOINTED WITH THE MEDIOCRITY AND LIMITED WISDOM OF YDUR NEIGHBORHOOD STEREO STORE?

Some of our most satisfied customers have travelled an EXTRA DISTANCE to buy the BEST SOUNDING AUDIO EQUIPMENT in the world!

WITH PRODUCTS SUCH AS: AUDIO RESEARCH, MAG-NEPLANAR, JANIS, LUXMAN, FORMULA FOUR, DECCA, just to name a few, you can *finally* begin to hear what **REAL MUSIC** sounds like. The reproduction of REAL MUSIC is our goal at:

#### DKL SDUND LAB 804 BURLINGTDN AVE. SILVER SPRING, MD. 20910 (301) 588-6257

The ONLY AUDIO SPECIALTY SHOP for the NORTHERN VIRGINIA, MARYLAND and WASHINGTON, D.C. areas.





## Audio Classified Ads

Want to buy, trade or sell components? Want to offer or buy a service? Want a job in the audio field? Your ad belongs in Audio. Rates are low—results high.

RATES: Commercial, 60¢ per word; situation wanted or noncommercial, 35¢ per word. We reserve the right to determine classification as commercial or non-commercial. **Payment must accompany all orders.** 

Place your ad today!

Send copy to: Audio Magazine 401 N. Broad Street, Philadelphia, PA 19108 Attn: Classified Dept.



DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF SARASOTA 6564 GATEWAY AVENUE, SARASOTA, FLORIDA 33581

BUILD YOUR OWN SPEAKERS AND SAVE UP TO 50%. You can assemble your own high quality, multi-element stereo speakers in a few hours and save up to half the cost of comparable speakers. Send for our free 32-page catalog of speaker kits, raw speakers and accessories SPEAKERLAB, Dept A2, 5500--35th NE, Seattle, WA 98105

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF FT MEYERS, 3081 CLEVELAND AVENUE, FT MYERS, FLORIDA 33901

#### PDLK AUDIO MONITOR SERIES

AUDIO BREAKTHROUGHS now has on demonstration the remarkable new Polk loudspeakers. Compare them to the finest loudspeakers in the world. Both the Seven (S129.95 ea.) and the Ten (S199.95 ea.) utilize high definition polymer laminate bass-midrange drivers, wide dispersion soft dome tweeters and fluid coupled sub-bass radiators. They are capable of reproducing a highly defined phase accurate three dimensional sonic image which rivals the thousand dollar super speakers. They sound great with a small receiver, yet reveal the fine subtleties of state of the art electronics like Levinson and GAS. Shipped free in U.S. Send for free brochures on Polk or our other fine lines. AUDIO BREAK-THROUGHS, 1681. Northern Bivd. Manhasset LI. N.Y. 11030 516-627-7333

#### DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF BIRMINGHAM. 23 RDERIJCK PLAZA DR. RIRMINGHAM, ALA 35206

123 RDEBUCK PLAZA DR., BIRMINGHAM, ALA 35206

#### TACOMA, WASHINGTON AUDIO-TECH ELECTRONICS

STATE-OF-THE-ART SPEAKER KITS	
\$65.00 to \$700.00. Plans, Raw Drivers, Complete	e Lab Facil-
ity. \$50,000 in Test Equipment.	
ADC	Philips
Dyna-Mk-8	Pioneer
mhvervic	Sonus
Marantz T	ranscriptor
McIntosh	
Special: Marantz Receivers 25% off if purchased	d with any
pair of speaker kits.	
3863 Steilacoom Blvd, S.W.	
Tacoma, Washington 98499	
206-584-0332	

**RABCO SL-8E OWNERS** - Newsletter 3 describes many modifications you can make to your arm, color photos and details. \$2. AUIDDETC, Box 55, Lansing, Iowa 52151

#### FOR SALE

STERED CARTRIDGES AND STYLUS REPLACEMENTS FOR: ADC, Audio Technica, B&O, Grado, Empire, Micro/Acoustics Pickering, Ortofon, Shure, Stanton, Supex, Write for free catalog, NEEDLE IN A HAYSTACK, Dept. MA, PO. Box 17436, Washington, D.C. 20041.

PROTECT YDUR LPs. Poly sleeves for jackets & cround bottom inner sleeves 7c Poly lined paper sleeves 15c White jackets 35c Postage \$1.50 House of Records. Hillburn, New York 10931

ATTENTION CANADIANS Over 100 top brands, stereo components. Write for quote ADCO Sales, Box 13359, Kanata, Dintario K2K 1X5.

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF BIRMINGHAM # 3, 203 South 18th STREET, BIRMINGHAM, ALABAMA 35233

McINTOSH—XR7, A5 King \$1500 pr. M0101 \$175, C28 \$400, MR74 \$500, MC33 \$1000. Call Collect After 3 PM weekdays. (N.Y.) 516-221-0511 J. Redmond.

CITATION 16 power amp. Multi Voltage. Almost New. Mint. \$650 or best offer. 315-474-6790 after 6 PM (NY).

CM Labs RR805 monitoring recur. \$365. Pr. IMF Super Compact spkrs. \$275. B&O 3000 t'table \$200. All mint. Shipped pre-paid insured. M. Fader P.O. Box 291, R.D. 1 Hockessin De. 19707 (302) 239-7689

Professional Hi-Fi Home Study Course—Instructors include Len Feldman, Julian Hirsch, Larry Klein and Larry Zide. Send S2.00 for full color AUDIO PRIMER and information on joining (SAC) Society Audio Consultants, Oept. A. NY, NY 10016

AUDIO RESEARCH D-76 amplifier and SP-3a-4 pre-amp (latest update by AR), under warranty, orig. cartons, excellent condition, both \$1250. Will sell separately. (212) 376-4842.

#### CONN. AND WESTERN MASS.'S LARGEST STERED DEALER

Accuphase Audio Technica Epicure Dahlquist ● B&W ● dB Systems ● Crown ● Quatre ● Phase Linear • SAE • ESS • Soundcraftsmen • Magnepan Magneplanar Mayware Grace Tandberg
 Merchnics
 SME
 Ortofon
 Revox
 OTEAC
 OBX ●Beyer ●Stax ●AKG ●Nakamichi ●Sequerra ● FRED LOCKE STEREO New Haven Avon Fast Hartford 203-678-1797 203-289-3231 203-787-3469 Newington Waterbury Огалде 203-666-0555 203-757-9296 203-795-5757 Springfield, MA. **Professional Products Division** 413-782-7111 203-828-1124

LDW MASS NYLON CARTRIDGE mounting hardware. 14 piece set. \$2.50 ppd. Component Systems, 5556 Personality Ct., Indianapolis, Indiana 46227

ACCURATE SOUND NOW OFFERS seven high accuracy speaker kits, including an exceptional car or van speaker and ultimate transmission line with ribbon tweeter top end. Prices range from \$115.00/pair to \$785.00/pair. Kits include drivers (KEF, Coles, & Decca), crossovers using film capacitors, air core inductors, and high quality L-pads, back plate with binding posts and fuse holder, and cabinet plans. Drivers and crossovers available separately. Domestic and exotic wood veneers available. For more information. Accurate Sound, 1213 "M" Street, Lincoln, Nebraska 68508 (402) 489-1218.

DEMD SPECIALS: Ohm F \$700./pair; Dahlquist DO-10 \$650./pair; Transcriptor skeleton \$300 w/vestigal arm Mint used equipment: Thorens TD 125 w/nondetachable SME \$295; ADS L700 \$220./pair Audio Reproduction. 217 College Ave., Blacksburg, Va. 24060, (703) 552-6850

#### FOR SALE

 $10\,\%''$  Recorder Specialists: Fresh Scotch L/N 3600 ft. on new 4'' NAB metal reels five for \$35.00. New low noise, high output Ampex tape on  $10\,\%''$  metal reel, six for \$35.00 Reconditioned NAB metal  $10\,\%''$  reels, \$24.00 per dozen. 10% on above for postage. Other tapes also on special, write for catalog. Sound, POB 88338, Atlanta, GA 30338

THDUSANDS OF LIKE NEW LP's and prerecorded tapes Catalogue - \$1.50. House of Records, Hillburn, New York 10931.

#### AUDIO'S HI-FI HANDBOOK

Complete reference guide to over 1.000 components, including prices and specs. All arranged in tabular form for easy comparison. Plus over 30 outstanding articles on audio topics, trends and advances. State-of-the-art reading for audiophiles. Only a limited quantity available. Over 200 pages Send \$4.50 (includes shipping and handling) to: Jean Davis, Audio Hi-Fi Handbook, 401 N. Broad St., Phila., Pa. 19108.

NAME BRAND RECORDING TAPE, custom loaded. Available in cassettes, reels, and cartridges. Huge savings direct from manufacturer. New catalogue now available, MJS, 516 Brooks, San Jose, Calif. 95125 (408) 998-2693.

THE NEW MODEL 12 PARAGON PREAMPLIFIER. Improvement of the Model 10 highly acclaimed recently in an audiophile magazine is now available at Paragon of Sound. You are invited to call 301-229-2676 (Bethesda, Md) for an appointment to hear the difference.

HI-FI ENTHUSIASTS WANTED!! Earn more than just spare money in your spare time. We need campus representatives to sell name brand stereo components at discount prices in your area. High commission, no investment required. Serious inquiries only, please. Contact. Alan Weisberg, K&L Sound Services Co. 75 N. Beacon St., Watertown, Mass. 02172.

#### AMPEX TAPES

Ampex Audio Studio Mastering Tapes, 631-641, 406-407, and "GRAND MASTER" in stock for immediate shipment 14", 12", 11" & 2" Factor fresh Best Prices TECHNIARTS, 8555 Fenton St. Silver Spring, MD 20910 (301) 585-1118

#### DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF PENSACDLA

3731 NAVY BOULEVARD, PENSACOLA, FLORIDA 32507

#### OON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF ORLANDO. 1915 EAST COLONIAL DRIVE, ORLANDO, FL 32803

CANADIANS: Best Hi-Fi discounts on over 96 feading Hi-Fi brands. Many exclusive factory closeout and special deals Quotations via return mail. Nationwide mailorder service FREE catalogs jam packed with bargains in Hi-Fi equipment, tape and recording accessories, calculators telephones and accessories, kits, parts, etc. Hundreds of factory and government surplus specials tool. American inquiries welcome. Rush free catalog request to ETCO. Dept. AUA. Box 741, Montreal H3C 2V2.

SMALL RECORDING STUDIO Crown 800 & 700 series tape decks, Tascam Model 10 Board Master Room Reverberation unit AKG Mikes one year old. Bob Swan — 704-982-4726, Albemarle, N.C.

ESS AMT-1 towers, \$395. pair, Levinson JC-1AC, \$190. 201-531-8618, Allenhurst, NJ

MXR's 10 Band equalizer, Discwasher Systems, Maxell Tape Discounted, N.A.B. Audio, Box 7 Ottawa, 1L 61350

ODN'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF BOCA RATON, 499 N.E. 20th STREET. BOCA RATON, FLORIDA 33431

100

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF PENSACOLA # 2, 3820 NORTH 9TH AVENUE, PENSACOLA, FLORIOA 32503

TECHNICS, SP-10 with SME like new, \$400. ADC-XLM/II. never used, \$30. Toulme, 2527 Hydraulic 35. Charlottesville, Va. 22901. (804) 977-4618 after midnite.

DON'T PAY THE HIGH MAIL DRDER PRICES THIEVES WAREHOUSE OF ATLANTA, 4162 JONESBORO RO., ZAYRE CENTER, FOREST PARK, GA. 30050

COLORADO'S AUDIO ALTERNATIVE — Boulder Sound Gallery. Ltd. — Purveyors of unusually fine audio systems and service to meet the needs of all serious music lovers. Our product selection includes the Acoustat X ESL. Allison. B & O. B & W. Oahlquist, dbx, Fidelity Research, Fons, Luxman, Magneplanar. Mark Levinson, M & K Sound, Quad Acoustical, Quatre, Sound Concepts, Stax, Supex/Sumiko, Yamaha, and Ultraphase.

1200 Pearl, Boulder, Colorado 80302: 1-303-444-2626

EVERYTHING ON OPEN REEL! Classical. Popular Dolby. Quadraphonic. Latest releases. For "Reel News," send \$1.00 Barclay-Crocker. Room 857 A, 11 Broadway, New York 10004.

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF NORTH TAMPA, 1441 EAST FLETCHER AV-ENUE, TAMPA, FLORIDA 33612

DECOURSEY ACTIVE ELECTRONIC CROSSOVERS Model 110 dividing network; complete with regulated power supply, for bi-amp, tri-amp, or quad-amp, Custom assembled to meet your specifications. Monaural, stereo or with derived third channel. Plug-in Butterworth (maximally flat) filters; 6. 12, or 18 db. per octave at any desired audio frequency. DP-TIONS. Summer for single woofer systems, VLF hi-pass filters for elimination of subsonic noise, derived third channel. FOR OEM OR HOME ASSEMBLERS. Model 500 or 600 dual filters. Regulated power supplies. Write for new brochure DECOURSEY ENGINEERING LABORATORY. 11828 Jefferson Blvd., Culver City, CA 90230. Ph. (213) 397-9668

OON'T PAY THE HIGH MAIL OROER PRICES THIEVES WAREHOUSE OF ATLANTA 3164 PEACHTREE RD., N.E. ATLANTA, GEORGIA 30303

DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF ATLANTA 2769 LAKEWOOD AVE. S.W. ATLANTA. GEORGIA 30315

DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF ATLANTA 4166 BUFORD HIGHWAY, N.E., ATLANTA, GEORGIA 30345

\* Looking for the finest new & used audio components?

\* Want the inside info on the latest stereo projects?

\* Got a gripe, an idea, or something important to say?

\* Want audiophile opinion from across the country?

THE AUDIO FORUM

is for YOU! In our first issue:

\* The nation's finest audio dealers select: "The Worlds Best (Ungradeable) \$1000 Music System"!

\* David Fletcher (Grace, Supex) on: "Tonearm-Cartridge Compatibility".

\* John Iverson (Electro-Research) on: The Force Field Loudspeaker". (With ND moving parts!)

\* E. M. Long (Sonex) on: "Time Alignment Techniques".

\* Mark Deneen (Paragon) on: "Wide Band Tube Design".

\* John Curl (Levinson) on "Ultra low noise design"

\* Plus: "Reviewing the Reviewers"; The "Womens Viewpoint"; Reader reviews; Free subscriber classified ads; and much, much more! Send S15 for six bimonthly issues to: AUDIO FORUM, BOX 578, Fairfax CA 94930 415-453-9530

#### FOR SALE

DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHDUSE OF ST PETERSBURG. 9151 Park Boulevard, North Largo, Florida

ESOTERIC PRODUCTS—ARC, Magnaplanar. Nakamichi, GAS, IM Fried, Luxman, Quatre, others. STEREO(phile) SHOP, 107 Third Ave. SE, Cedar Rapids, Iowa 52401/Village Shopping Center, Oavenport, Iowa 52806.

IN CONNECTICUT AUDIO RESEARCH is available at FRED LOCKE STEREO Hear the *incompatable new* D 100, SP 4 and Tympani I-D in acoustically designed rooms! FRED LOCKE STERED, 216 W. Main St., Avon (203-678-1797), and 1533 State St., New Haven (203-787-3469)

> NOEL CROSS AUDIO "For the finest sound in the world" SAN FRANCISCO, CA (415) 861-6277

FUTTERMAN CAPACITOR-COUPLED output transformerless vacuum tube amplifiers; we're manufacturers-patentees; esoteric audio dealers sought. Golden Ear's Reference Loudspeaker system using KEF drivers, professionally assembled or kit. Promethean rare "Silk Purse" cartridge, exceptional clarity. S95.00.Lux #3045 tubed amplifiers, new pair \$885. Crown#824 tapedeck, mint \$900. Esoteric recordings, free list. Demo/used equipment, request list. WANTED: Used Marantz-McIntosh tubed equipment. GOLDEN EAR, Box 2189, Riverview, Michigan 48192. (313) 479-1234.

#### AUDIO DEN LTD

After careful auditioning we are proud to add to our already fine line of audio products, the BRAVURA preamp

**ROGERS** speakers

YAMAHA and CM

We also carry Fulton (60, 80, 100 in stock), Dahlquist, RTR, Polk, Avid, Magneplanar, Quad (ESL and electronics), Lux, Onkyo, B&O, Revox, Crown, Sonus, Grado Signature, Denon, Grace Formula Four and Sheffield Labs.

FREE INSTALLATIONS IN N.Y. AREA. NO CHARGE FOR SHIP-PING.

AUDIO DEN LTD 1320-34 Stony Brook Road Stony Brook, New York 11790 516-751-3350

#### NORTHWEST AUDIOPHILES

The finest in Audio Components — Audio Research. Beveridge, Celestion, db systems, Dahlquist, Dayton Wright, Decca, Denon, Dunlap Clarke, Dynaco, ERA, Fidelity Research, Fulton, Formula 4, Grace, Hartley, Linn Sondek, Luxman, Magnepan, Mark Levinson, Nakamichi, Quad, Quatre, Sonex, Soundcraftsmen, Shure, Spendor, Stax, Supex, Tandberg, Technics, Yamaha and more

THE TIN EAR STERED CENTER 704 Symons Richland, Wa. 99352 (509) 946-4459

INFINITY SERVO Statik I with Dyna Stereo 70 \$1100 404-241-2519

IMPROVE YOUR SOUND SYSTEM AMTECH LOUDSPEAK-ER ATTENTUATOR — new, unique loudspeaker volume control can dramatically improve quality of your sound system. Controls remote speakers. Equalizes levels of two pairs of speakers in same listening area with differing efficiencies. Improves headphone listening. Write for free brochure. AM-TECH, 2505 E. 7th Ave., N. St. Paul, Minn. 55109.

DON'T PAY THE HIGH MAIL DRDER PRICES THIEVES WAREHOUSE OF ATLANTA 1030-3 CHEROKEE ROAD, SMYRNA, GEORGIA 30080

#### DIRECT DRIVE ELECTROSTATICS

The Best of both worlds. Tubes and Solid State! RTR's DR-1 Point Source and Acoustat's Full Range System combined with the individually hand tuned Cyberacoustan Sub-woofer!!! Available exclusively at Barclay Recording & Electronics, 233 E Lancaster Ave., Wynewood, PA 19096. For Appointment Call: (215) 667-3048

AmericanRadioHistory Com





OON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF BETHESOA. P.O. Box 34251, WEST BETH-ESDA. MO 20034

AMPEX TAPE — NEW 1800° on 7° reel 12 for S18 POST PAIO, 1200° 12 for S13 POSTPAIO — free list — WIDE RE SPONSE, 6114A SANTA MDNICA BLVD. HOLLYWOOD, CA 90038

#### DON'T PAY THE HIGH MAIL ORDER PRICES.

THIEVES WAREHOUSE OF TALLAHASSEE. 1119 APALACHEE PARKWAY. PARKWAY SHOPPING CENTER. TALLAHASSE. FLORIDA 32301

DDN'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF DAYTONA, 1769 SOUTH RIOGEWOOD, SOUTH DAYTONA, FLORIDA 32019

#### ENGLISH HI FI

RADFORD, "AEL LS3/5A Mini Monitors for £110.00 pair." Export Monitors, B&W, Rola Celestion, Monitor Audio, SME, Decca, Mk V, Tannoy, Garrard and very famous Transmission line speakers, other continental products also available. Please write or telex, your quote will be by returned Air Mail Southern Audio Services Ltd. 43 High Street, Kingston, Surrey, UK. Tel 01-549-3194 Telex 929679 AEL G

101

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF AURORA, 10218 EAST COLEFAX, AURORA, COLORADO 80010

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF PENSACOLA # 3, TDWN & COUNTRY PLAZA, PENSACOLA, FLORIDA 32505

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF MOBILE/VILLAGE SQUARE, 301 SOUTH CRAFT HIGHWAY, MOBILE, ALABAMA

ST. LOUIS
SPRINGFIELD
DECATUR
QUAD CITIES

We are pleased to offer listeners in this area the opportunity to experience the rewards of the fine high fidelity components.

Audio Research, Fulton J Modular, FMI, Great American Sound including Ampzilla and Son of Ampzilla, Grace, ERA, Stax, Connoisseur, Bravura, Formula 4, Linn Sondek, modified Dyna Vaccuum Tube Amplifiers, and others.

We are the EXCLUSIVE FULTON-FMI DEALERS in this area and extend to you the invitation to hear the celebrated Fulton J Modular loudspeakers at their best.

We will also be happy to set up your equipment with you in your listening room to assure its best performance.

PRO MUSICA HIGH FIDELITY FOR SERIOUS LISTENERS 603A WEST CALIFORNIA URBANA, ILLINDIS 61801 (217) 384-5415

#### BUILD YOUR OWN SPEAKERS AND SAVE UP TO 50%.

Send for our free fact oacked 40 page catalog manual and team how to assemble your own multi-element spreed speakers from szarath or trom hist. Sun catalog includes chapters on design construction n overs enclosures mid-anges wooters, tweeters and hornis. Write us today SPEAKERLAB Oppi AD, 5500 351h N E Sattle, Washington 68105



DDN'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF JACKSONVILLE. 6078 OLD ST AUGUSTINE ROAD. JACKSONVILLE. FLORIDA 32217

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF KNOXVILLE, 5710 KINGSTON PIKE, KNOXVILLE, TN 37919

NEW GENERATION Crown Amplifiers, Cleanest, Smoothest sound ever produced - Crown 01200/HP1200, on demo only at Barclay Recordings, 233 E. Lancaster Ave., Wynewood, PA 19096; (215) 667-3048.

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF JACKSONVILLE. 1239 ARLINGTON ROAD & LONE STAR JACKSONVILLE. FLORIDA. 32211

HEATHKITS, DYNAKIT, assembled, factory-tested, full warranties. Kit price plus shipping. Dynaco Stereo-300, Heathkits AP-1615 Preamplifier, AD-1305 Equalizer, AA-1506 Power Amplifier. Request details. Box A71-2 Audio.

FANTASTIC SOUNO IMPROVEMENT on your present system without additional investment. Instructions \$5.00. Unconditional guarantee. L. Matan, 615 R. Cherry St., Scranton, Pa. 18505

#### WESTERN NEW YORK AUDIOPHILES

#### THE STEREO EMPORIUM

Visit our new, expanded facilities and experience the finest in audio components with the same personalized, honest service we have always maintained

AUDIO RESEARCH	MARK LEVINSON
AMPZILLA-G.A.S.	DUNLAP CLARKE
QUATRE	MAGNEPLANAR
MAGNEPAN	DAHLOUIST
QUAD	FIDELITY RESEARCH
YAMAHA	FMT
DENON	FORMULA FOUR
GRADO SIGNATURE	HADCOCK ARM
BANG & DLUFSEN	WIN LABS
GRACE	IMF
STAX	M&K SOUND
BOWERS & WILKENS	DNKYD
RTR	LINN SONDEK
SONUS	
	KMAL
WIN LABS	CONNESSIEUR
TECHNICS	TRANSCRIPTORS

CALL, WRITE, OR VISIT US TODAY.

THE STEREO EMPORIUM 3407 Delaware Ave. Buffalo, N.Y. 14217 716-874-3372

MARANTZ 10B TUNER. Excellent unit, beautiful sound. Owners manual. \$525.00 (815) 624-4902

SP4 — SP4 — SP4 New analog module preamp from Audio Research with their new D100 amp, more need not be said! Barclay Rec. & Electronics, 233 E. Lancaster Ave., Wynwood, Pa. 215-677-

3048

AUDIO RESEARCH SP-3A-1 \$450; Citation 16 \$425. Quad 303 \$175. 206-522-5330

PIONEER TX-9500 TUNER. Like new, walnut cabinet, \$250. Keep trying (804) 977-4618.



ADVERTISER	PAGE
Acoustic Research	
Loudspeaker Systems	
Check No. 4 on Reader Service Card	
Acoustical Mfg.	07
Hi-Fi Components	
Check No. 1 on Reader Service Card	
100	
ADC Hi-Fi Components	
Write Direct to Advertiser	
Advent.	
Hi-Fi Components Write Direct to Advertiser	
Whe Direct to Advertiser	
Allison Acoustics	60
Loudspeaker Systems	
Check No. 2 on Reader Service Card	
The Audio Critic	18
Publication	
Write Direct to Advertiser	
Audio Pulse	0.5
Hi-Fi Components	85
Check No. 3 on Reader Service Card	
Audio-technica Phono Cartridge	
Write Direct to Advertiser	
Ball Corp.	
Record Preserver Write Direct to Advertiser	
Bang & Olufsen	
Phono Cartridge Check No. 5 on Reader Service Card	
check no. 5 on Reader Service Caro	
BGW	
Hi-Fi Components	
Check No. 6 on Reader Service Card	
B.I.C	
Turntable	
Check No. 7 on Reader Service Card	
Bolivar	
Loudspeaker Systems	
Write Direct to Advertiser	
Bryston Mfg	92
Amplifiers	
Write Direct to Advertiser	
Celestion	65
Loudspeaker Systems	
Write Direct to Advertiser	
Crown International	00
Hi-Fi Components	
Check No. 10 on Reader Service Card	
Custom Stereo	
Custom Stereo	
Write Direct to Advertiser	

Dahlquist.... Loudspeaker Systems Check No. 11 on Reader Service Card

ADVERTISER	PAGE
Designatron	
Audio Store	
Write Direct to Advertiser	
Discount Music	
Record Club	
Write Direct to Advertiser	
Discwasher	
Hi-Fi Components Write Direct to Advertiser	
Dekarder	
Dokorder Tape Deck	
Check No. 12 on Reader Service Card	
Dolby FM	
Write Direct to Advertiser	
Dual (United Audio)	
Tonearm	
Check No. 46 on Reader Service Card	
Dynamic Specialties	111
Audio Store	
Write Direct to Advertiser	
Elpa	
Turntable	
Check No. 53 on Reader Service Card	
Empire	
Phono Cartridge	
Check No. 13 on Reader Service Card	
Fantasy Sound	
Audio Store	
Write Direct to Advertiser	
Fisher	
Cassette Decks	
Write Direct to Advertiser	
Frazier	
Loudspeaker System	
Check No. 14 on Reader Service Card	
Garland Audio	
Audio Store	
Write Direct to Advertiser	
JVC	
Hi-Fi Components Check No. 16 on Reader Service Card	
KEF	
Loudspeaker Systems Check No. 17 on Reader Service Card	
Loudspeaker Systems	
Check No. 18 on Reader Service Card	
Kenwood	41
Turntable	71
Check No. 19 on Reader Service Card	
Lake Shore Drive Hotel	
Hotel Write Direct to Advertiser	
THE DIEL ID ADVELIGE	

Write Direct to Advertiser

.81

AUDIO • March 1977



ADVERTISER	PAGE
Marantz Loudspeaker Systems Write Direct to Advertiser	
Maxell Magnetic Tape Check No. 20 on Reader Service Card	
Magnetic Tape Check No. 21 on Reader Service Card	
McIntosh Labs Catalog Check No. 22 on Reader Service Card	80
Micro-Acoustics Phono Cartridge Write Direct to Advertiser	19
Nakamichi Preamp, Amp Check No. 23 on Reader Service Card	
Natural Sound Audio Store Write Direct to Advertiser	
Nikko	
Amplifier Check No. 24 on Reader Service Card	
Ohm Loudspeaker Systems Check No. 25 on Reader Service Caud	77
PAIA Articulator Check No. 26 on Reader Service Card	94
Phase Linear Amp <b>Check No. 27 on Reader Service Card</b>	86
Pioneer Hi-Fi Components Check No. 28 on Reader Service Card	. Cov. II, Pg. 1
Precision Electronics "G" Lines Check No. 29 on Reader Service Card	
Quam Nichols Loudspeaker Systems <b>Check No. 30 on Reader Service Card</b>	
Rhoades Teledapter T.V. Sound Tuner Write Direct to Advertiser	
Rocelco Record Brush Check No. 31 on Reader Service Card	
SAE Hi-Fi Components Check No. 32 on Reader Service Card	53

ADVERTISER	PAGE
Sansui Hi-Fi Components Check No. 33 on Reader Service Card	5
Sharp Electronics Cassette Deck Check No. 34 on Reader Service Card	21, 23, 25
Tuners & Amps Check No. 35 on Reader Service Card	
Turntables Check No. 36 on Reader Service Card	
Shure Brothers Phono Cartridge Check No. 37 on Reader Service Card	61
SME Tonearm Check No. 38 on Reader Service Card	6
Sonic Research Phono Cartridge Write Direct to Advertiser	22
Sony Corp Hi-Fi Components Check No. 39 on Reader Service Card	
Soundcraftsmen Amplifiers Check No. 50 on Reader Service Card	11
Speakerlab Speaker Kits Write Direct to Advertiser	
Stanton Hi-Fi Components Check No. 40 on Reader Service Card	3
Sumiko Tonearm <b>Check No. 41 on Reader Service Card</b>	92
TDK Magnetic Tape Check No. 42 on Reader Service Card	
Teac Hi-Fi Components <b>Write Direct to Adværtiser</b>	Cov. IV
Technics43, 5 Turntable Check No. 43 on Reader Service Card	5, 56, 57, 58
CHECK NO. 45 OH KEAUER SERVICE CARD	

Loudspeaker Systems Write Direct to Advertiser Ultralinear

Loudspeaker Systems Write Direct to Advertiser

AmericanRadioHistory Com

Yamaha.... Loudspeaker Systems Check No. 45 on Reader Service Card



CROWN SX tape recorder electronics, good condition, works. Make offer. Tom Szerencse, Box 89, Wakarusa, Ind. 46573.

SHOP AROUND — Listen to every speaker available then come to Cyberacoustic Laboratory and hear RTR's New Direct Drive Electrostatic DR-1 speaker system at Philadelphia's exclusive distributor — by appointment — 233 E. Lancaster Ave., Wynewood, PA 19096; (215) 667-3048.

SOUND ADVICE MAGAZINE - IN ITS THIRD ISSUE OF FERS A CLASSICALLY SIMPLE MODIFICATION THAT ANY AUDIOPHILE CAN MAKE TO NOTICEABLY IMPROVE THE SOUND QUALITY OF ANY STEREO SYSTEM, WE'LL ALSO EX-AMINE THE HIGHLY TOUTED AUDIO RESEARCH D-150 AM PLIFIER THE PRESTIGIOUS MOINTOSH MC2205 AND THE THRESHOLO-A NEW, SUPERB SOUNDING 300 WATT PER CHANNEL CLASS & AMPLIFIER AUDIOPHILES WILL ALSO BE STUNNED BY A NEW MODIFICATION KIT FOR THE DY-NACO PAS-3X THAT SWAMPS EVERY OTHER PRE AMP WE HAVE HEARD. FOR COMPARISON, WE LOOK AT THE PER-FORMANCE CHARACTERISTICS OF THE DB SYSTEMS, AU-010 GENERAL, STAX, NAKAMICHI 610 ANO ACE AUOIO. CARTRIOGE BUFFS WILL BE INTERESTED IN OUR COM-MENTS ON THE EMT XSO-15, JVC X-1, SUPEX 900 SUPER, NAKAMICHI MC1000, FIOELITY RESEARCH FR-1, MKIII, SONUS BLUE AND RED AND GRADO G-1+. FOR THOSE MOVING COILS, YOU'LL NEED A STEP-UP DEVICE AND WE EVALUATE AND COMPARE 3 OF THE BEST: MEL SCHILL-ING'S MAS-1, QUATRE GAIN CELL DG-1 ANO HUNTINGTON MICRO, WITH, WITH OUR FAVORITE THE DENON TRANS-FORMER. THERE'S ALSO THE LUXMAN PD-121 TURNTABLE AND A COMPARISON OF THE DAMPEO GRACE G-940 WITH THE UNDAMPED G-707. FINALLY, THERE'S A THOROUGH EVALUATION OF THE MAGNEPLANAR TYMPANIE 1-C LOUD-SPEAKER, SOUND ADVICE-FOUR ISSUES FOR \$12 (\$15 FIRST CLASS; \$18.00 FOREIGN-SENT AIRMAIL) SOUND AD-VICE 225 KEARNY STREET SUITE 200M, SAN FRANCISCO CALIFORNIA 94108

"Two Crown DC - 300-A's. Strapped, 600 Watts rms per channel, 1975 vintage, mounted in single Crown walnut enclosure. \$1100 FOB Corpus Christi, Texas. Feferman 512/884-1961, 854/3445"

The objective: THE BEST SDUND FOR YOUR DOLLARS "State of the Art" systems: \$895 to \$3449, AUOIO HDUSE, 5232 Sagamore Dr., Swartz Creek, Mich. 48473

WE HAVE FRAZIER SPEAKERS! Models for every system in stock. Custom Sound, 1480 Wharton Way, Concord California 94521, 415-687-5660.

INCREDIBLE FRAZIER 11 LOUDSPEAKER!!!! 16Hz -40Khz flat! 103Db SPL for one watt! \$2,400 pair. Other Fraziers on display from \$99.00. Northern California dealer. RTV, 7512 Elphick Road, Sebastipol California 95472. (707) 823-3701

BRAUN TG-1000/4-Tape machine. Good condition needs record head. Best offer. John Evans, 214-886-7357

TOP RATED HEATH RECEIVERS AR-15 \$275, AR-1500A \$375. Mint Condition.

RS

.95

17

98 Saddlewood Or. Hillsdale, NJ 07642

Receiver and Integrated Amp Owners. Our phono amp sounds better than yours. Play your records thru our phono pre-amp into your aux. input for a phenomenal improvement. If not amazed, return in ten days. Introductory price \$59.95 Calif. residents add 6% sales tax. Write to us at PS Audio to order or ask for details. 2734 Industrial Way, Santa Maria, Ca 93454.



#### DYNAMIC SPECIALTIES IS A WEST COAST STORE DEALING PRIMARILY IN USED AUDIO EQUIPMENT

 We sell and offer service for vintage tube equipment Marantz, McIntosh, Citation, Quad, Scott, Fisher, Revox, Ampex, etc. Also Audio Research, Futterman.

2. We carry a wide range of used components, vintage and current

3. We also sell and demonstrate certain new equipment: Fulton, Grace, Supex, F.R., Dahlguist, M&K Subwoofers, Connoisseur, PARAGON AUDIO, ERA.

4. We stock Telefunken, Mullard, Amperex, Genelux, G.E. Sylvania vacuum tubes.

5 We are the exclusive dealer for PARAGON AUDID vacuum tube electronics. Audition the new Model 1D High-Gain Wide Band tube preamplifier at out store. Phone for appointment

We Buy Sell Trade DYNAMIC SPECIALTIES 2261 Spring Street Redwood City, CA 94063 415-364-6634

OON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF BILOXI, 441 PORTER AVENUE, BILOXI, MISSISSIPPI 39530

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF CLEARWATER, 1502A GULF TO BAY BOULEVARD, CLEARWATER, FLORIDA 33515

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF BIRMINGHAM # 2, 203 SOUTH 18TH STREET, BIRMINGHAM, ALABAMA 35233

CONTROL 1 - Signal Activated automatic power shut-off for Component Systems. \$49.95. Electromedia Design. Inc., Box 26. Livingston, N.J. 07039.

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF JACKSONVILLE NO 3. CEDAR HILLS SHOP-PING CENTER. 3716 BLANOING BLVD., JACKSONVILLE. FLORIDA 32210

MICHIGAN AREA AUDIOPHILES: Perfectionist Stereo now on display at the EQUINOX STUDIO. Fulton FMI, Magneplanar Magnepan, Rogers Monitors, Great American Sound GAS, Ampzilla, Paoli, DB Systems, Linn Sondek, KMAL, Grace, Win Labs, Denon, Fidelity Research, Promethean and more. 2763B, 44th St. S.E., Wyoming, Mi. 4950B; 616-531-4530, 313-482-4801.

GARRAD Z2000B w/Stanton 681EEE, 20 hours, \$150. Babcock, 504 N.E. 35, Pendleton, Ore. 97801

#### FOR SALE

DYNAKITS, DYNASPEAKERS, SHURE, SME—lowest prices. FRIED LOUDSPEAKERS (not discounted). Perfectionist modifications. Underground HiFi Sales, 324c Broadwater Road, Arnold, Md. 21012. (301) 647-0919.

> CHICAGD CHICAGO CHICAGO

State-Of-The-Art has finally come to the windy city. Stereo Emporium of Buffalo, N.Y. and Paul Heath Audio of Rochester, N.Y., have joined together to form

#### PAUL HEATH AUDIO, LTD.

One of the most complete audio salons in the country. Acoustically designed demonstration facilities, instant A-B comparisons, experienced personnel, and honest money back policies all combine to make this THE place to audition the finest in audio.

> WE HAVE, ON DEMONSTRATION: SPEAKERS

Magneplanar T IIIA, tri amped Magneplanar T-IC (BI or single amped) Dahlmuist DO-10 Magnepans-single and double Acoustat X Dayton Wright XG8III series II Beveridge cylindrical IMF Monitor IV, TLS80, TLS50 Fried Model "H", R" **Rogers BBC** Koss Model 2 B&O M-70 Gale 4014 Spendor BCI Quad ESL M&K subwoofer-single and double-(set up to be bi-amped with Magnepans, (1 or 2 pair); Dahlquists, Dayton Wrights, Quads, or Magneplanar T-IIIA-TM)

PRE-AMPS Mark Levinson LN Audio Research Thaedra Thoebe Dayton Wright DB Systems Quatre Quad Stax TURNTABLES	IP-2, JC-2 Cartridges	AMPLIFIERS Audio Research Ampzilla Son of Ampzilla Dunlap Clarke Mark Levinson Dayton Wright Quatre Quad Yamaha ARMS
Linn Sondex	EMT	Formula Four
Technics	Grado Signature	Grace
Lux	Denon	Stax
Bank & Olufsen	Fidelity Research	SME
Connessieur	Sonus	KMAL
Fons	Satin	N/IAC
10115	ADC	
	B&0	
T <b>APE DECKS</b> Revox	RECEIVERS	<b>TUNERS</b> Sequerra
Bang & Olufsen	Onkyo	Yamaha
	Yamaha	Onkyo
	Bang & Olufsen	Quad

WE OFFER A FULL 5 YEARS PARTS AND LABOR WAR-RANTY ON EVERYTHING WE SELL, A 30 DAY REFUND POLICY, AND PRE-PAID FREIGHT IN THE CONTINEN-TAL U.S. PLEASE CALL OR WRITE FOR MORE INFOR-MATION.

Ovnaco

PAUL HEATH AUDIO, LTD. 2036 Ň. Clark Chicago, III. 60614

SAVE ON SACRED COWS-Bose, SAE, JBL, Thorens, Philips. Over 50 top brands. Write for quotes. SOUTHBOUND SOUND, P.O. Box 52508. Atlanta. Georgia 30355.

IMF SPEAKERS: Model R/II, perfect condition. Call after 2 pm, 216-792-2161 Ohio

#### FOR SALE

J. E. SUGDEN A48 integrated stereo amplifier \$360. P51 mono/stereo power amplifier \$300. C51 control unit \$225. In factory sealed cartons, complete array of printed boards and spares for Quad 33 & 303. R. Benavides, 630 Sun Valley Ct., Indianapolis, Indiana 46217.

IN PURSUIT DF EXCELLENCE WE OFFER: Luxman, Dayton-Wright, Nakamichi, I. M. Fried, ADS, Stax, BGW, Revox, Philips, Ortofon, SAE Beyer, DBX, McIntosh, JBL, Klipsch, Harman Kardon, Oecca, SME, Dahlquist, Yamaha, Soundcraftsmen, Teac and more....Also custom room equalization, individually damped Altec and JBL Monitors and an ongoing equipment evaluation program. THE HOUSE OF SOUND, 821 Kent Avenue, Baltimore, Maryland, 21228, Tel; 301-747-5260

THE SENSIBLE SOUND: ONLY audio equipment testing publication with a "best sound for the money" philosophy. Subscribe. \$10, \$11 Canada, \$16 Foreign. 403 Darwin, Snyder, NY 14226

THE WAREHDUSE — LOWEST PRICES ON TYPEWRITERS, MANUAL AND ELECTRIC. All brand new, factory sealed, and fully warranted. Free catalog and prices. YOU CAN'T BUY IT ANYWHERE FOR LESS! Fast service. THE WAREHOUSE, Dept 18, 187 North Main Street. Milltown, New Jersey 08850

AMPEX AG 500 TRANSPORT  $\frac{1}{2}$  playback only electronics \$260. Lee Marpet 212-531-7296 eves.

**RECONDITIONEO 16**" Gates turntable on floor base, Shure, SME Model 3012 arm, Shure M91ED cartridge. Spare motor mounts and idler wheel, \$275. Call (614) 291-6207 after 5:00 week nights.

**BEOGRAM 4002.** one year old, excellent condition, \$500. John Emery, 2 Filson Place, Cincinnati, Ohio 45202 (513) 579-9575

FORMULA 4 model PLS4/D the best sounding universal tone arm available at U.S. audio dealers. Literature \$1 bill. Mayware Ltd. 15 Heather Walk, Edgware, Middlesex, HA8 9TS England.

**ELIMINATE DISTORTION!** Bypass unused portions of your preamp, integrated amp or receiver with an inexpensive accessory. Plans. \$3.00. Regan Design Services, P.O. Box 34045, Washington, D.C. 20034.

LEACH LNF-1: 100 Watt/Channel Stereo Power Amp Low TIM (Transient Intermodulation Distortion) Amplifier Available from your local dealer or from Electronics Onc, Inc., P.O. Box 13835, Atlanta, Georgia 30324

SONY 4950 VFET PREAMP \$800; Phase Linear 2000 preamp \$200; Phase Linear 700B \$550; Ampzilla \$600; pair Allison 1 speakers \$600; pair AR LST speakers \$750. Dr. Sachs, Box 1719, Ann Arbor, Michigan. 313-665-9388

DYNA PAT-5, factory assembled, like new. \$150. ADC XLMII cartridge, extra styli, \$30. BSR 4800 changer for teen system, ceramic cartridge, new, \$25. Audio Box a-2.

TANDBERG TR 2075, mint used, \$700; Son of Ampzilla, mint used,\$350; 2 Tannoy Devon, new with warranty, \$450, 2 Dahlquist DO-10, new with warranty, \$650. All prices negotiable. C. Allen Durham, {703} 552-5568 Evenings.

ARP SYNTHESIZERS. Lowest prices in the country. Dan Keen, RD 1 Box #21, Cape May Court House, N.J. 08210, Write for quotes.

TURNTABLE REK-O-KUT DELUXE, 16" Empire arm, Stanton Cartridge, S100. David Fonseca, 555 Notre Dame Ave., Chattanooga, Tenn. 37412

#### PALO ALTO, CALIFORNIA

An important new store for Bay Area audiophiles—THE AU-DIBLE DIFFERENCE—is currently recommending: KOSS MODEL ONE and MODEL TWD electrostatic loud

speakers. Excellent bass. High power handling. Model Dne, \$1075 ea. Model Two, \$650 ea. DUNLAP CLARKE Dreadnaught power amplifiers. Stable, conservatively designed amps of extraordinary performance.

Dreadnaught 500, \$980. Dreadnaught 1000. \$1500. SONEX TWO. Patented time-aligned design by Ed Long. Exceptional midrange clarity and high-frequency definition. A

perfectionist loudspeaker. \$550. ARISTON and LINN SONDEK turntables. Belt drive. Superi-

or suspension systems. \$250 and \$360. FR MK III. Fidelity Research's deluxe moving coil cartridge,

now available. \$200. FRT-4 transformer, \$250. ROGERS LS3/5A. Legendary BBC mini-monitor. As good as

its reputation. \$215 ea. OECCA GOLD. The Decca has been tamed. Life-like sound,

reasonable tracking. \$150. DECCA TONEARM. New version of this classic damped

arm. Now mounts easily on more turntables. \$139. GRACE 9 series cartridges, from \$80. Grace 707 low mass tonearm, \$129. Grace 940 oil-damped, uni-pivot arm, \$149.

**DECCA BRUSH.** One million conductive bristles eliminate need for liquids and reduce static, \$15. We also feature selected products from Celestion, Audionics,

Supex, Lux, Sony, Yamaha and others. Coming soon: Dunlap Clarke preamp with built-in moving coil amp.

#### Prepaid/insured shipment in U.S. and Canada. THE AUDIBLE DIFFERENCE

435 Tasso, Palo Alto, California 94301 (415) 328-1081

#### AUDIO BREAKTHROUGHS

Long Island's finest audio dealer offers you the world's most advanced and audio components.

**ELECTRONICS**, Levinson JC-2 Preamp & LNC-2 Electronic Crossover G.A.S. (Ampzilla, son of Ampzilla, Thaedra & Thoebe) Paragon model 12 Preamp, Yamaha, AGI, D-B systems, preamp, sound concepts, Luxman, Marantz prof.

SPEAKERS, Koss model one, Magneplanar, Dahlquist, Fulton Model J. Spendor, B&W (DM-6) Polk, Janis woofer, M&K woofer, Kef drivers, AR pi, B&O. Epicure, Yamaha.

TURNTABLES & CARTRIOGES, Linn Sondek, Lux, Formula 4 am, Technics, B&D, Transcriptors, Satin, A.D.C., Grado J.G. signature series, Denon, Supex, Stax, Grace, SME, Rabco.

AUDIDPHILE RECORDS, Sheffield, M&K, Fulton, Audio Lab, Levinson, AR, B&O.

Free delivery and installation in Long Island and New York City

AUDIO BREAKTHROUGHS, 1681 Northern Blvd., Manhasset, New York 11030, (516) 627-7333; AUDIO BREAK-THROUGHS Huntington 129 Route 110, 516-423-7755

#### WESTCHESTER, FAIRFIELD COUNTY THE LISTENING ROOM INC. 590 Central Park Avenue Scarsdale, N.Y. 10583 (914) 472-4558

Cordially invites you to audition	our fine line of equipment.
DAHLQUIST	YAMAHA
AMPZILLA	LUX
SON OF AMPZILLA	B & 0
THAEDRA	KEF
SOUNDCRAFTSMAN	ESS
M & K	PHASE LINEAR
THORENS	DENON
ADS BRAUN	TANDBERG
STAX	NAKAMICH
DUNLAP CLARK	DAYTON WRIGHT
QUAD E.L.S.	JANIS
BOZAK	GRACE
AUDIO PULSE DIGITA	L DELAY SYSTEM
AUDITION FOR TH	HE FIRST TIME
LUX TUBE-TYPE MONAURAL	POWER AMP & PRE-AMP

#### FOR SALE

DDN'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF PANAMA CITY, 5220 W HWY 98. SUITE D, PANAMA CITY, FLA 32401.

DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF MONTGOMERY 3386 NDRMAN BRIDGE RD. MONTGDMERY ALA 36105

THE AUDIDPHILE, home of the renowned DB preamp, the little black boxes everyone has heard about and nobody's seen, is happy to help with your search for musical excellence - offering products which, even if not the most widely known, provide musical honesty. Dayton Wright loudspeaker, CM Labs amplifier, Dunlop-Clark, Fulton J ERA. 1.M. Fried, Power Research loudspeaker, Paoli, Quad - including the exciting new 405 amplifier. AlO. Oenon (expensive but excellent). Win Labs, KMAL, Revox, ADS, and

the Feature of the Month

the Promethean cartridge, obscure but offering exceptional clarity at only S95 Sales and service, 582 N. Frederick Ave., Gaithersburg, Md. 20760 (301) 948-2999. Ask for Gene, Bob, or Albert

SIEMENS, TELEFUNKEN, and other top quality audio tubes available at very competitive prices. Contact Jim Wallace at 201 McMasters Drive, Monroeville, Penna. 15146 or (412) 373-2602.

HARMAN-KARDON Citation 14 FM Tuner w/Dolby. B&K Model 280 Digital Multimeter, \$75 new with case. (919) 967-4781.

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF NORTH MIAMI BEACH. 1807 N E 164TH STREET. MIAMI BEACH. FLORIDA 33162

ELECTRO-VDICE speaker components; AKG, E-V microphones; Crown amplifiers, Tapco mixers, DBX, Otari, White, Sony-Superscope All new, priced right. Gold, P.O. Box 141A, Englewood, Colo. 80110.

BURWEN 1200 Dynamic noise filter-\$150. (419) 542-8971

QUAD 33/303 \$275 for the pair; Dynaco FM-5 walnut, \$150, Rogers LS 3/5A monitors, teak, \$250 pr. All units perfect with little use. Original cartons. Any reasonable offer. Shipped prepaid, insured. Greg Trimble Kirkwood, Pa. 17536, 717-529-2497

STEREOPUS, The new quarterly equipment review journal begins volume 2 soon. We will soon be reviewing Ampzilla II, Audio Research D-100 and SP-4, Luxman Tube Components. Satin Pickups, Fidelity Research Mark III, Micro Acoustics 2002e, Dyna Mk VI (tube) amplifier; B&W DM-6, Audioanalyst Anthem Array, IMF Intl TLS 50 II, Sonex, and Fried H loudspeakers, and much much more. Limited quantities of issues#1 through #4 (vol 1) still available. Volume 2 will consist of two bound issues and three newsletters. S10.00, \$12.50 first class, Canada, and overseas, \$16.00 overseas air. PD. Bax 509, Shalimar, Florida 32579

"RAW LOUDSPEAKERS — we specialize in supplying the industry with quality high wattage loudspeakers. If your current supplier cannot deliver fast enough call us. We stock what we build, sales geared for low or high volume users. LTL Electronics, 525 N. Central St., Kent, WA 98031 (206) 852-3671

#### LOW \$\$'s

Ampex 4408 (2), Scully 280-2 14 in., T.T.'s ORK(2) + SP 1300 (2), Marti limiter CLA -40H (3), Sparta MIXER AS-308, Belar SCM-1, & MORE!! Contact "MEDIA", G.C.S. Box 2776, N.Y.C. 10017 or 212-661-4664

CRDWN DC-300-A; one year old-\$575. S.A.E. MK 2700 equalizer, new with warranty-\$400. Phase Linear autocorrelater/noise reduction unit; mint-\$250. (804) 296-5305 E.S.T.

CORNER HORN SPEAKER ENCLOSURE KITS. Send for free brochure. Kneller Audio Cabinets, Dept. "A", 6428 W. 27th Pl. Berwyn, Illinois 60402

#### FOR SALE



#### TECHNIARTS

Professional Audio Equipment, Ampex, AKG, DBX, Crown International, Malatchi, Orban Parasound, Sescom, in stock for immediate delivery. 8555 Fenton Street, Silver Spring MD 20910. 301-585-1118.

#### ATTENTION!

AUDIOPHILE ITEMS DIV. (Division of Dynamic Specialties) Announces its new exclusive sound room specializing in vacuum tube and current solid state equipment. We are dealers for:

PARAGON AUDIO ELECTRONICS, Futterman, Dahlquist, Fulton (FMI), RTR, M&K subwoofers and Rabco mod., ERA, Connoisseur, Grace 9L, Promethean, etc. Fidelity Research. Supex, Dynaco, Soundcraftsman, Stax, Telefunken, Amperex, Valvo, Genelex, GE, Sylvania vacuum tubes.

Also quality used gear sales and service: Marantz, McIntosh, Audio Research, Quad, Magneplanar, Dynaco, Citation, etc.

We Buy—Sell—Trade AUDIOPHILE ITEMS DIV. (Division of Oynamic Specialties) 2269 Spring Street Redwood City, Calif. 94063 U.S.A. 415-364-2494 415-364-6634

SAVE NOW on PROMINENCE the piezo-electric add-on tweeter. Most speakers do not have flat response above 10 KHz, but with PROMINENCE the response can be extended to beyond 25KHz. Supplied in simulated walnut cabinet. Hook-up in seconds. Was \$75/pr., now \$45/pr. FSC, 7033 Benjamin St., McClean Va. 22101

CABINETS FOR DYNACO preamps, tuners. Quadaptor, Stereo 120, Literature, Geometrix, Box 612, Mexico, MO 65265

AMBIENCE DECODER FOR REAR CHANNELS, \$149.95. Free literature. Huntington Electronics, Box 2009-A, Huntington, Conn. 06484.

SAE IB \$475, Pioneer TX9100 \$200; VI5TIII \$35, Dyna St80 \$90, 404-241-2519

AUDIO RESEARCH SP-3A-IN w/case, warranty transfer, \$500; Futterman H-3AA (new), \$475; Marantz 10B, case, \$500; Hartley 220 MSG 10" (New), \$200 pr.; Dynaco Steren 400 w/meters (New), \$325; Decca International Arm w/lift, \$85; RTR Exp-8, \$100 pr.; Stax SR-3, SRD-5, \$65; ARC PC-1, \$45; Universal Tigers, \$50 pr.; AR Turntable (New), \$75; B&W ESL Panels \$200. More. All Excellent. 404-872-0626

LOUDSPEAKER OESIGN COOKBOOK — A technicians approach to designing Air Suspension, Vented, Tol. and Passive Radiator. Covers Acoustic and Electrical Xover, calculating and manipulating driver, Box "O", Low Cost Test Procedures, plus construction and cosmetic technique. Practical application for builders, profusely referenced for theory freaks. \$5.95 to Speaker Research Associates (SRA), 3959 S.E. Hawthorne Blvd., Portland, Ore. 97214.

#### FOR SALE



DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF HOLLYWOOD, 5719 HOLLYWOOD BOULE-VARD. HOLLYWOOD. FLORIDA 33021

FAIRFIELD AND WESTCHESTER COUNTY AUDI-OPHILES TAKE NOTE: THE AUDIOPHILE, 231 BEOFORD STREET, STAMFORO, CONN. specializes in equipment for the connoisseur. 6 A.S., Koss Model Dne, ADC, Crown, Dahlquist. Dyna, Epicure. Infinity, Philips, SAE, SME, Stax, TEAC, Technics, Thorens, Soundcraftsmen, Denon, Sonus and many more. (203) 348-3551 (Closed Mondays).

TOURING SOUND SYSTEMS, 2, 4, and 8 Track Studius, Disco Sound, Cerwin Vega BGW, Altec, Shure, AKG, Tapco, Dyna, Revox, EV, Beyer, Cetec, etc. K & L Sound Service, 75 North Beacon, At, Watertown, Mass. 02172, (617) 787-4072-Att: Ken Berger

PERFECTIONISTS PREFER DYNAKITS Before Purchase You Owe Yourself Our Quote Mainline 11a 971 Fronheiser, Johnstown, PA 15902

ATTENTION DYNA OWNERS: Our Dyna Double 400 modification with 16 output transistors, front end bypass, and 80,000 mfd power supply is twice as fast and twice as strong as a stock ST-400. Our Super PAT-5 has lightning fast ICs and improved high gain phono section. With a Denon DL103S straight in, these Super Dynakits show you just how great our Fulton Js and Magneplanars will play. JENSENS STEREO SHOP, where State of the Art is affordable. 2202 River Hills Drive, Burnsville, Minnesota, 55337. 612-890-3517.

#### SEATTLE, WASHINGTON

-Seriously Pursuing The State of the Art-

Audio Research	Magneplanar
G.A.S./Ampzilla	Fulton/FMI
Quatre	Quad ESL
Mark Levinson	Beveridge
Bravura	Yamaha
Dynaco (MODIFIED)	Nakamichi
Connoisseur	AKG
Linn Sondek	ERA Mk6
Formula 4	Grace
Denon	Shure IIIG
DEFINITIVE AUD	
3414 NE 55th	
Seattle, Washingt	on
(206) 524-6633	
Tuesday-Saturday	

LEVINSON LNP-2 PRE-AMP Marantz 500 Amp (2) Sequerra Tuner, Crown VFX-2 Xover, Crown SX-824-P4C, Akai GX400DSS, JBL S-8 Custom Mod. Systems. 3101 Telegraph Ave., Berkeley, CA 94705; 415/841-6668.

#### AUDIOPHILES AUDIOPHILES AUDIOPHILES

We are dedicated to offering you, the audiophile and music lover, the most sonically accurate components in every price range. All products are tested and include free shipping and insurance. Now is the time to write, call or visit Audio One. We recommend the following:

SPEAKERS IM Fried "H"/"M"/"R"/"Q" **Beveridge Electrostatic** BBC LS 3/5A Audionics Sonex 88W AMPLIFIERS. Quatre "gain cell" C/M Labs 912a/914 Electro Research Audionics Paoli .Paragon Model 12 PRE AMPS Trevor Lees DB Systems C/M Labs Schilling Quatre Technics SP-10 MKII TURNTABLES. Transcriptors Connoisseur Rabco Era TONEARMS Formula 4 Stax CARTRIDGES Promethean Win Labs Депол Supex Sonus Also Ace, BGW, Dynaco, Grace, H-K/Citation, Hitachi, KEF, Philips, Quintessence, RTR Electrostatics and more AUDIO ONE AUDIO ONF AUDIO ONE

"Where it all began in Michigan" Box 1001 Birmingham, Michigan 48012 (313) 646-6666

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF HIALEAH, 6741 WEST 4TH AVE NUE, HIALEAH, FLORIDA 33012

MAKING HIS MOVE — Mel Schilling, formerly of Willow Grove, Pa., has taken his knowledge of music and sound to California, where he will continue to serve a select nationwide clientele devoted to ultra state-of-the-art stereo. All shipments prepaid and insured. Write or call — 20929 Ventura Blvd., Woodland Hills, Calif. (213) 348-4600.

#### FOR SALE

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF FT LAUDERDALE 3347 NORTH FEDERAL HIGHWAY, FT LAUDERDALE, FLORIDA 33306

DYNA STEREO 70 MOD KIT. Tighter bass, improved transient response, higher definition Complete instructions, schematics, parts list. S5 00. With parts kit, including all new tubes, S58 00 all postpaid. Audio Designers. Box 122, Led yard, Conn. 06339.

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF WESTMINSTER, 2969 WEST 72ND AVE-NUE, WESTMINSTER, COLORADO 80030

DON'T PAY THE HIGH MAIL ORDER PRICES. THIEVES WAREHOUSE OF MACON. 1564 EISENHOWER PARKWAY, MACON, GEORGIA 31206

GALE MAXIMUM FIOELITY RECORDS. Gale turntable and speakers, now available at the Audio Cage, 3329 Balmoral Drive, Sacramento, Calif. 95821. 916-482-8346

OUR TA-1 TOMEARM IMPROVES RECORD SOUND with low effective mass (<2.5 grams with most cartridges) and pivot friction (all pivots jeweled), optimum silicone damping, vertical pivots at record level, anti-skate bias, damped cueing, and low capacitance cables. Money-back guarantee. S149.00 postpaid. JML Company, 39,000 Highway 128, Cloverdale, CA 95425

AUDIO PULSE DIGITAL DELAY SYSTEM: quantum step closer to the live experience AUDIDCOM, Old Grennwich, Ct. 06870, (203) 637-3621

#### MR. AUDIO'S BIMONTHLY

NOT another always-late subjective equipment review quarterly, reveals the history, design concepts, circuit diagram and pitfalls to avoid in building the already-legendary Trevor Lees vacuum-tube battery-powered pre-preamp. The first issue also has the real scoop on Dyna PAS preamp mods—who has done what, which is the best and why—as well as info on the Parabolic stylus, a test for detecting interaction distortion, an in-depth interview with Arnold Nudell of Infinity, a totally new microphone technique developed by Ed Long, an easy modification to dramatically improve the Phase Linear 400, the true story of a terminal-case audio junkie, and other amusing surprises. Don't miss out: charter subscribers receive a free classified ad! \$12 for six issues (\$15 overseas) to MR. AUDIO'S BIMONTHLY, Box 77225X, San Francisco, Ca. 94107.

THE ABSOLUTE SOUND<sup>TM</sup>, in its upcoming issue(#9), will be reviewing a new generation of audio components. For instance, the first solid-state units from Audio Research, the SP-4 pre-amp, and the Dual 100 basic amp. For instance, Bob Carver's ultra-sophisticated Phase Linear III, a full-range speaker system. For instance, the long-awaited Ampzilla II from G.A.S. and James Bongiorno. Infinity has produced an ultra low-mass tone arm, the Black Widow, as well as an all FET pre-amp. Joe Grado has designed a \$275 cartridge, the Signature And we'll have much more to say about the Acoustat-X, a full-range electrostatic. If that doesn't whet your appetite, then consider some of the other components that will be reviewed: the Fulton J. Modular speaker system; the AGI pre-amplifier; the Paragon Model 12 pre-amp; the Audio Dimensions tube-type pre-amp; the Dyna Mk VI basic tube amp; the AKG cartridge; the Goldring 900 SE cartridge; the Elac 555-E; the Stax tone arm; a new pre-amp from Rappaport; the Dahlquist electronic crossover and sub-woofer system; a \$300 moving coil cartridge from Satin, as well as the 117 series of high-output moving coil units. That is far from the complete list. We'll also be telling you how to get Imported records; what the most musical and most sonically spectacular new discs are. We'll also continue our comprehensive coverage of behind-the-scenes politics in the audio industry. So why put off subscribing: It's \$12 for four issues (USA) \$13, Canada. Add \$2 for first class mail. Outside North America, \$16 (air mail). The Absolute Sound, Box 5, Northport New York, 11768. Attn: Helen Stites. (Back issues 1-8, \$3 each.)

AUOIO RESEARCH SP-2C preamp mint, Crown IC150, Marantz 8A and 8B. 517-351-3475.

#### M&K ANNOUNCES 2 NEW ADUIOPHILE BASS EXTENDERS

The famous M&K BOTTOM END is now available in two improved models: The BE-1A and the DBE-1 A. We believe they are the finest available sub-woofers, particularly for detailed, tight bass. A speaker that produces high Sound Power Levels for long sustained organ notes is easy to manufacture and the M&K BOTTOM ENDs are excellent in this regard, but for the discriminating Audiophile, they also have:

- Super detail on drum skin sounds and the ability to distinguish between various bass instruments.
- Solid feel of floor shock on Flamenco.
- Exceptionally smooth transition to your audiophile quality Mangneplanars, Magnepans, Dahlquists,
- mllacoustats or Quad ESLS (or other fine speakers) and careful avoidance of coloration to the already excellent mid-bass of these great performers.

Other great products:

- A newly improved line of matrixing crossover networks, to avoid the need for bi-amping, developed after extensive research and listening tests to provide the properties described above.
- And now, totally new. The M&K "BASS RAMP" to allow BOTTOM ENDs to be used with speakers having efficiencies up to 15db. or more higher than the ones named above. It is passive, low-level and allows the full power of your amplifier to be available to all speakers for the peaks.

The BE-1A retails for \$235. (Slightly higher east of California). The double speaker, DBE-1A has 6db. more bass at twice the efficiency for super audiophile installations. (\$445 on the west coast). Join the world of the sub-woofer. It will increase your overall pleasure far more than the same dollars spent almost any other way on an already good system.

Send for literature and dealer list for a dealer near you. Miller and Kreisel Sound, Incorporated 8719 Wilshire Boulevard Beverly Hills, California 90211 (213) - 652-8318

OON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF RIDGEWOOD, 25 GOOWIN AVENUE RIDGE WOOD, NEW JERSEY 07450

#### WISCONSIN AND THE MIDWEST

AUDIOPHILE'S SOUND STUDIO IS AN ESTABLISHED DEALER IN SOPHISTICATED COMPONENTS FOR THE SERIOUS MU-SIC LISTENER. WE OFFER FIVE INDEPENDENT AND FULLY-EQUIPPED LISTENING ROOMS, AND A TECHNICALLY COM-PETENT STAFF WHO ARE WILLING TO APPRAISE HON-ESTLY ANY AND ALL EQUIPMENT. ALL OUR PRODUCTS ARE BACKED BY OUR SUPERB, PROFESSIONALLY EQUIPPED, AND STAFFED SERVICE DEPARTMENT.

We are exclusive Wisconsin Dealers for: Mark Levinson \* Great American Sound Co. \* Bower & Wilkins \* Dayton Wright \* Quad.

Our carefully selected product lines also include: Denon \* I.M. Fried \* Fulton \* Lux Audio \* B&O \* Dahlquist \* Magnepan \* and many more outstanding products.

ALL OUR EQUIPMENT IS PRETESTED AND GUARANTEED TO MEET SPECIFICATIONS. WE ALSO SHIP PREPAID AND IN-SURED WITHIN THE CONTINENTAL U.S.

AUOIOPHILE'S SOUND STUDIO 7459 Elmwood Avenue Middleton, Wisconsin 53562 Phone 608-836-3807

INFINITY QUANTUM LINE source Two's \$960; Janis Woofer never used \$400, ARC 3 \$490, SAE 2400 \$590, ESS M500 Late model, case, \$340. Need prepreamps. Offers 415-851-1202

CHARLESTON, SOUTH CAROLINA: SUNLOFT AUDIO has Fulton J Modular and E Modular, Luxman, G.A.S., Nakamichi, Infinity, Epicure, Stax, B&O, Fidelity Research, Technics, Otari, dbx, Nexus Bravura, etc. SUNLOFT AUDIO, 825 Savannah Highway, Charleston, SC 29407 803-556-8623

CITATION"A", \$150 — DYNA 120, \$150. — Empire 398 with 999VE, \$150 — Cayer — 813-481-3246

#### FOR SALE

~ SANFRANCISCO BAY AREA ~DYNAMIC SPECIALTIES ~AUDIOPHILE ITEMS DIV.~ PARAGON, ANALOG ENG, LEES, AUDIONICS, SOUNDCRAFTSMEN, FUTTERMAN, DYNACO, DAHLQUIST, FMI, M&K, RTR, HARTLEY, ERA, FR, GRACE, SUPEX, PROMETHEAN, SHURE, ALSO QUALITY USED EQUIPMENT VINTAGE & CURRENT: MARANTZ, QUAD, AUDIO RESEARCH, CITATION, MC (NTOSH ETC. VACUUM TUBES: TELEFUNKEN, AMPEREX, MULLARD, VALVO, SIEMENS, GENELEX ETC.) BANKAMERICARD ~ BUY~ SELL ~ TRADE ~ MASTERCHARGE 2261 SPRING ST, REDWOOD CITY, CA 94063 415-364-6634 364-2494

5% OVER COST - Any new AKAI; DYNACO; MARANTZ; SANSUI stereo components. Free Catalogs: Audio Discount World, P.O. Box 99147, San Francisco, California 94109

THE TREVOR LEES tube preamp kit for the Dynaco PAS reviewed in *Sound Advice* has dynamic range surpassing solid state units and openness heard only from tubes. A completely new circuit requiring one hour for construction, kit \$175, faceplate \$25. Foreign \$185 and \$30. CA. residents add sales tax. MR. AUDIO, P.O. Box 4489, Berkeley, CA 94704

CONNECTICUT: ADC-Accutrac, Advent, Audio Pulse, B&O, B.I.C., Citation, Epicure, Harman/Kardon, J.B.L., McIntosh, Nakamichi, Ortofon, Phase Linear, Sony, Stax, Tandberg, Yamaha. Will ship prepaid. Sounds Incredible, 226 White St., Danbury, Conn., 06810. (203) 748-3889 - phone quotes only.

#### IF YOU ANSWER YES TO ANY OF THE FOLLOWING QUESTIONS YDU MAY NEED OUR HELP:

1. Does your local dealer think that a **DECCA PLUM** is an exotic fruit?

2. Does he believe that a FORUMLA FOUR is some kind of new men's hair tonic?

3. If you ask about the JANIS SUB-WDOFER does he refer

you to the U.S. Navy Department?

4. Do you get the feeling that to him low mass is something done on Sundays?

5. Does he advise against "CURRENT DUMPING" unless you get a license?

Seriously folks, there are audio stores and then again there are AUDIO SPECIALTY stores. We at the THE DKL SOUND LAB can offer the finest in audio components

shipped quickly and efficiently to wherever you live. For years we have solved the problems of LONG DISTANCE and SAFE DELIVERY of valuable equipment.

Our TELEPHONE NUMBER in Silver Spring, Maryland is (301) 588-6257 and our HOURS OF OPERATION are 12 until 8 PM weekdays and 10 AM until 6 PM on Saturday. Our MAILING ADDRESS is:

#### DKL SOUND LAB 804 BURLINGTON AVE. SILVER SPRING, MD. 20910

AKG, AMIPZILLA, BEYER, CROWN, DB Systems, DAHL-QUIST, DBX, DECCA, DENON, INFINITY, KLH 9s, Koss, Nakamichi, Ortofon, PHASE LINEAR, PMI, REVDX, SAE, SAEC, Sennheiser, Sequerra, Sony, Stanton, Stax, Supex, TASCAM, Technics, Thorens, etc.

HI-FI HAVEN

28 Easton Ave

New Brunswick, N.J. 08901 201-249-5130

MCINTOSH ML 1C SPEAKERS, four, excellent condition. Original cartons. \$250 each. Consider selling pairs. Call Charles 904-362-2400 after 9 PM (Florida).

SAVE UP TO 69% ON OVER 100 TOP BRANO AUDIO COM-PONENTS FROM CARSTON STUDIOS. NEW ENGLANO'S AU-DIO SUPERMARKET. ONE OF THE OLDEST MAIL ORDER FIRMS (EST 1952) AND CERTAINLY ONE OF THE MOST RE-LIABLE ALL ORDERS SHIPPED FROM STOCKEO WARE-HOUSE SENO FOR PRICE QUOTE AND PRICE LIST CARSTON STUDIOS. OLD BRODKFIELD ROAD. QANBURY. CONN 06810 MARK LEVINSON DAYTON WRIGHT KEITH MONKS LINN SONDEK OAHLOUIST MAGNEPAN AMPZILLA THAEDRA POLK STAX FR MK

FOR SALE

ABSOLUTE SOUND ABSOLUTE SOUND ABSOLUTE SOUND

ESS SAF AVID GALE RABCO GRACE DENON REVOX 111XM AN LESCON TANOBERG KOSS ESL **OUNLAP CLARK** SONY V-FET SOUNDCRAFTSMAN HARMAN KAROON

ABSOLUTE SOUND - HIGH ACCURACY AUDIO COM-PONENTS

(313) 527-2244 12400 Morang Detroit. Mich. 48224 (313) 549-7550 4354 N. Woodward Rd. Mich. 48072 (313) 662-2026 312 S. State St. Ann Arbor 48104

#### RECTILINEAR Xa — one pair 4 ohm three way speaker systems. \$175. Days 212-472-8238; Evenings 212-336-1294

111

#### AMPZILLA-THAEDRA SON OF AMPZILLA

Sound Advice 536 State Road, Emmaus. Pa 18049. Hours: Mon., Tues., Thur., Fri., 12-9:30. Wed. 6-9:30. Sat. 10-6 (215) 967-4418

DON'T PAY THE HIGH MAIL ORDER PRICES THIEVES WAREHOUSE OF GAINESVILLE 434 N W 13th STREET GAINESVILLE, FLORIDA 32601

DON'T PAY THE HIGH MAIL ORDER PRICES, THIEVES WAREHOUSE OF DUMONT, 78 WASHINGTON AVENUE. OU MONT, NEW JERSEY 07628

	RGEST STEREO DEALEF	
		SME
ACCUPHASE		SUPEX
AUDID TECHNICA		ORTOFON
EPICURE	FIDE	LITY RESEARCH
DAHLQUIST		REVOX
AUDIONICS		• B&O
db systems		TEAC
CROWN	T	RANSCRIPTORS
QUATRE		OBX
PHASE LINEAR		BEYER
SAE		STAX
CITATION		AKG
MARK LEVINSON		NAKAMICHI
SOUNOCRAFTSM/	AN	SEQUERRA
ESS		BURWEN
MAGNEPLANAR	* * HAF	TLEY WOOFERS
MAGNEPAN		OUAD
THORENS		···LUX
TECHNICS		& MORE
	FRED LOCKE STEREO	
Newington	Professional Products	Greenwich
203-667-2277	Division	203-637-5439
New Haven*	203-828-1124 Orange	* Avon
203-787-0183	203-795-0701	203-678-1797
Waterbury	Springfield, Mass.	• • Fairfield
203-757-9296	413-782-7111	203-366-5246
	East Hartford	New Landon
Stratford	203-528-9479	203-443-1835
203-377-1771	103-310-3413	T03-443-1933



#### STEREO ONE

FAIRFIELD, CDNN. For the exceptional listener who demands purity and fidelity of sound, we have carefully evaluated and offer:

MARK LEVINSON	STEREOTECH
MCINTOSH	ROTEL
BOZAK	DAHLQUIST
NAKAMICHI	LINN SONDEK
ADS/BRAUN	AKG
YAMAHA	STAX
BANG & OLUFSEN	TDK
DENON	MAXELL
SUPEX-GRACE	PHASE LINEAR
ORTOFON	M-K BOTTOM END
AGI	AUDIO PULSE
We pay freight	

#### STEREO ONE INC.

112

1229 PDST RD. FAIRFIELD, CDNN. 06430 PHONE 203-255-5939

STERED REPRESENTATIVES NEEDED!!! Sell 100 brands!! Lowest Possible Prices!! Krasco - 623 Campbell Ave West Haven, Connecticut 06516

ATTENTION DYNACO PAT 5 OWNERS! Our Pat 5 phono board update kit provides better definition, cleaner highs, tighter bass. Parts list and instructions-\$5.00. Complete Kit \$55.00 postpaid. Musical Sound Lab, Box 5503, Preston King Station, Arlington, Virginia 22205

#### REMEMBER MY NAME!

By air parcel post in a short time you'll be able to get at a lower price, audio components and cords, kits of digital frequency display and multi-tester, etc. K. SOEDA, No. 5-9-503 Toshima 5-chome, Kita-ku, Tokyo 114, Japan

HIGHEST QUALITY STATE-OF-THE-ART audio components from one of the oldest esoteric dealers in the country. We carry ... Audio Research, B&O, Dahlquist, Gale, Mitsubishi, Dayton-Wright, Threshold, Denon, Supex, Micro-Acoustics, Formula 4, Audio-Craft, Grace, Audio Pulse, ERA, Advent, Magnepan, ADS, etc.

THE GRAM OPHONE LTD. 50 Penn Place, Oklahoma City, OK 73118 405-840-1559 757 Asp St., Norman OK 73069 405-364-9477 6568b E. 51st St., Tulsa, OK 74145 918-663-1511

#### HELP WANTED

OVERSEAS JOBS — All Occupations now hiring. High pay, transportation. Computerized Reports, \$2.00. TRANSWORLD, International Airport, Box 90802-AA, Los Angeles, Calif. 90009.

#### MUSICAL INSTRUMENTS

UP TO 60% DISCOUNT. Name brand instruments. Catalog Freeport Music, 114R Mahan St., W. Babylon, N.Y. 11704

#### SERVICES

#### STEREO SOUND LABS

Factory specs or better by 10% on all repairs on major brands. Warranty 90 days parts and labor. Ship us your gear properly packed and insured. 4419 John Marr Drive, Annandale, Virginia 22003 (703) 941-5707.

#### **CROWN INTERNATIONAL**

Complete repair, overhaul, and rebuilding service for current and early model Crown tape recorders and amplifiers. New Crown recorders in stock for immediate delivery. Excellent selection of reconditioned Crown recorders for sale. Used Crown recorders purchased and accepted for trade in. TECH-NIARTS 8555 Fenton Street, Silver Spring, MD 20910 301-585-1118

STC (COLES) TWEETERS repaired for modest charge. New Tweeters 4001K (8 ohms) or G (15 ohms) available. Linear Research, 4500 South 56th Street, Lincoln, Nebr. 68516 (402) 488-4569

DYNACD, A-R, TRANSISTORS, REPAIRS BOARDS & units. speaker service. Send for prices & details: BEAR ELEC-TRONICS, 177-A Hillcrest Road. Mt. Vernon, N.Y. 10552

ALL HI-FI SPEAKERS REPAIRED. Technical expertise has been acquired by servicing our customers four decades. AU-DIO SPEAKER TECHNICS, 281 CHURCH ST., NEW YORK, NY 10013 (212) 226-7781.

TAPE RECORDER HEADS re-lapped \$1500 ea Removed from machine or stack. One day service. E. Maher, 5 Evans Place, Orinda, Calif. 94563

CUSTOM RECORDING SERVICE. Tapes, discs, and cassettes. Stereo and mono. Live and copies. Editing. Masters and pressings. High quality at reasonable rates. Joseph Giovanetli, Audio-Tech Laboratories, 2819. Newkirk Ave. Brooklyn, N.Y. IN9-7134.

STERED MASTERS, RECORDS AND ALBUMS. Check our prices. Newest type high level cutting equipment featuring: Neumann VMS 70 Computer control lathe. Parametric Equalization. Dolby, DBX, and the new SX74 Cutting System by Neumann. Special package prices on pure vinyl album and single record production. 1000 45 RPM stereo singles S19900 including mastering. 100 LP albums S32500 including printed jackets. Write or call for brochure. A & R Record Manufacturing Corp. 902 N. Industrial Bivd., Dallas, Texas 75207. Toll Free 1-800-527-3260.

NASHVILLE RECORD PRODUCTIONS WILL PRESS HIGH OUALITY PURE VINYL RECORDS FROM YOUR TAPES. SEND FOR SAMPLE RECORD AND PRICE LIST. ALSO FINEST DISC MASTERING. 469 Chestnut St., NASHVILLE TENNESSEE 37203.

TAPE DUPLICATING. Professional standards. Half Track, Quarter Track Reel, Cassettes. Low Prices. Write for rates. Moonlight Recording, P.O. Box 22635, San Francisco, Ca. 94122.

NEW BAND FROM NORTH LITTLE ROCK, Arkansas, looking for studio work. Can handle any type of music. Willing to relocate. We have six pieces. Drums, Lead Guitar, Rhythm Guitar, Bass Piano (Elec.) Organ. All are vocalists. Box No. A3-1.

BROADCAST TECHNICIAN wishing to break into professional recording industry. Would like to learn mixing, dubbing, disc-cutting, etc. 4 ½ years experience in maintenance and operation of various equipments — audio, video, transmitter. No prior professional recording experience. Would prefer western U.S. area if possible. Bob Carr, 480 E. 26th Place, Yuma, Arizona 85364. (602) 726-8929.

#### TAPE & TAPE RECORDERS

SCOTCH RECORDING TAPE, lowest prices TAPE CENTER Box 4305B, Washington, D.C. 20012.

EVERYTHING ON OPEN REEL! Classical. Popular. Oolby. Quadraphonic. Latest releases. For "Reel News." send \$1.00. Barclay-Crocker, Room 857 A. 11 Broadway, New York 10004.

#### TAPE & TAPE RECORDERS

RECORDING TAPE—OUTSTANDING VALUES Write to: MAGNE HOUSE, 2271 Union # 4, San Francisco, CA. 94123

TDK, MAXELL, MEMOREX, BASF, cassettes, reels 8-tracks Lowest prices. New. Guaranteed FREE CATALOG S & S Audio, P O. Box 56039, Harwood Hts. IL 60656

CUSTOMIZED TAPES. Jazz. Big-Band Select standard tracks or available artists. Free catalog: 80 minute reel cas sette or 8-track. S8:00. Tapes Unlimited. Box: 163. Ports mouth. R.I. 02871.

#### WANTED TO BUY OR TRADE

E

WANTED TO BUY, Altec Lansing 415-A biflex speaker. Write, Chappie Anderson, Box 546, Hollandale, Miss. 38748.

MCINTOSH MC-3500 power amplifiers. Charles Kappesser, 101 Earl Avenue, Syracuse, NY. 13211, 315-455-1563.

CASH FOR your unwanted LPs & reel to reel tapes. Records. Box 323, Hillburn, New York 10931

QUAD electrostatic speakers (any condition), electronics (including Model II). Mention I)west price. OMS, 1360 Lake Shore, No. 2202, Chicago, IL 60610.

MARANTZ 7C and 2. J. Fong, 1238 Green St., San Francisco, CA 94109.

WANTED: TASCAM 4 OR 8-TRACK ½" recorder with 501 or 701 electronics (and model 10 consoles & modules.) Wanted: Revox ½ track ¼" recorder, 15 IPS, SEL sync. V. Bond, Box 2159.,Winnipeg, Manitoba, Canada R3C 3R2 (204) 888-6099

WANTED: SONY ECM 22 P MICROPHONES IN GOOD CON-DITION, ANY QUANTITY. STATE PRICE FIRST LETTER. STARTRIP, 2809 EDGEWATER DRIVE, ORLANDO, FLA. 32804

RABCO SL-8E need not be in working condition. Dean Slindee Box 55, Lansing, Iowa 52151

WANTED: JBL SIGNATURE C 34 Folded Horn-Enclosure. Also the component group (130A, N1200, LE 175 HL 87) needed to complete stereo. Rev. Burger, 28 W. Ash St., Three Oaks, Mi. 49128.

WANTED: TEAC 7030 tape machine. Transport must work well. Electronics unimportant. Will pay fair price. Mel Hodes, Box J. Pleasant Gap, Penna. 16823 or (814) 359-2742.

REMOTE CONTROL for series "90D" Heathkit television. 301 Pine Hill La., York, Pa. 17403 717-845-4003

BLACK HAWK COLLEGE, MOLINE, IL has an immediate opening for a Television Maintenance Engineer. Should have 1st phone, three to five years experience in television maintenance. Excellent fringe benefits. Send resume stating qualifications and experience to: Acie B. Earl, Director of Personnel, Black Hawk College, 6600 34th Ave., Moline, IL 61265. We are an equal opportunity employer.

WANTED: Complete service manual with alignment notes for Marantz 10B. Kantar, Box 4011, Madison, TN 37115

#### RECORDS

SOUNDTRACK RECORD ALBUMS — Mail Auction — Free List. Whalon, 2321A Hill, Redondo Beach, Calif 90278

OLDIES — 45 RPM Original hits Catalog 50c C&S Record Sales. Box 197. Wampsville, NY 13163

SHOW ALBUMS—Rare. Out of Print LP's. 52 page list 50c Broadway/Hollywood Recordings Georgetown, Conn. 06829.

IMPORTEO, DDMESTIC HARD-TO-FIND Soundtracks, Shows, Nostalgic Personalities. Catalog \$1.00 (Refundable). LIST COMMUNICATIONS, P.O. BOX 916-h, NYC 10023

#### RECORDS

JAZZ, BLUES, ROCK. Out of Print LP's, 45's. Free Lists. Crazy Rhythms, 4 Newman Ave., Verona. N.J. 07044

CATALOGS. Broadcasts, soundtracks Personalities of Thirties, Forties Box 225, New York, N.Y. 10028

WHILE YOU WERE LOOKING for out-of print records, you should've been looking for us. DISContinued, 444 S. Victory Blvd., Burbank, Ca. 915D2

QUASI-RATIONAL PRODUCTS has everything in record protection. Liners- covers- Discwasher- Watts. Also Maxell, TDK tape - Pioneer auto stered - Jensen car speakers - Royce CB's, etcetera. Reasonable, Swift, Reliable. Free catalog. QUASI-RATIONAL PRODUCTS, P.O. Box 171, Prospect Heights, III. 60070.

QUADRAPHONIC RECORDS AND TAPES - World's largest selection - all labels, over 1000 titles - at discount prices! For your free illustrated quad catalog, write: SOUND CUNCEPTS, Box 654-C, Peoria, Illinois 61601.

DISCOUNTS ON LP's, Tapes, Cutouts, Imports. Huge Catalogs. One Dollar. Record Finder Services NERT. Box 268, Lawrence, Mass. 01842

SOUNDTRACKS, CASTS, personalities! Free newsletter! RTSA, 3700 Plaza, F211, Santa Ana, Calif. 92704.

COLLECTORS RECORDS - 50,000 LPs - Sold @ Auction -International Service Since 1971 - Specify category or artists - Lists From: Ray Macknic (or) Theo's, P.O. Box 7511, Van Nuys, Calif. 91406, U.S.A.

78 RPM RECORD LISTS. (1) Popular & Jazz. (2) Americana. (3) Classical. (4) Country-Western. State category. AUCTION ONLY. Write, S.A. Langkammerer, RECORD LISTS, 3238 Stoddard, San Bernardino, Ca. 92405

SOUNDTRACKS — JAZZ — POP. Vincent, Box 5202, Long Island City, N.Y. 11105.

#### HIGH FIDELITY

IN ILLINOIS, the DB Systems preamp and Allison speakers are available at AUDIO Ltd. 115 N. Walnut, Champaign. 217-359-3774.

#### SPEAKERS

B&W

Now the incomparable quality of B&W Loudspeakers from England is available in the Western U.S. Send name and address for information and the name of your nearest dealer.

CORINTHIAN MARKETING P.O. Box 5948 Incline Village, NV 89450 (702) 831-3174

CUSTOM SPEAKER ENCLOSURES, systems, kits, foam grills, crossovers. Raw speakers. Best prices. Info-15c. CSS, Algonac, Mich. 48001.

RECORDING TAPE SPECIALIST OFFERS LOW PRICES, FAST SERVICE, WIDE VARIETY OF BRANOS, UNUSUAL CAT-ALDG. SAXITONE TAPE SHOP, 1776 COLUMBIA ROAD, N.W. WASHINGTON, O.C. 20009.

> HIGH FIDELITY SPEAKERS REPAIRED AMPRITE SPEAKERS SERVICE 655 Sixth Avenue. New York, NY 10010 212-CH3-4812

ELECTRO-VOICE SENTRY PRODUCTS. In stock: Sentry IV-B, Sentry III, and Sentry V monitor loudspeaker systems for professional monitoring and sound reinforcement. Immediate air freight shipment to any N. American destination. National Sound Company, Ft. Lauderdale, Florida. (305) 462-6862.

YDUR = 1 SOURCE for custom speaker systems, kits, enclosures, foam grills, crossovers, raw speakers, veneers, vinyl. Warehouse prices. Surprising info - 13c. CSS. Algonac, Mich. 480D1

#### BOOKS

HOW TO INSTALL CAR STEREDS Send \$2.50 for booklet STEREO SOUND, 4419 John Marr Drive, Annandale, Virginia 22003 (703) 941-5707.

SHOPPERS' GUIDE TO ASUDIO MAIL ORDER DISTRIB-UTORS — \$3.95 Hundreds of audio distributors worldwide surveyed! Box 94-A, Colmar, PA 18915.

#### PHOTOGRAPHY

TAPE-SLIDE SYNCHRONIZER, lap-dissolve plans, \$5.50. With mixer, compressor, preamp schematics, \$8.50. The Millers, 1896 Maywood, S. Euclid, DH 44121.

#### AUTO ACCESSORIES

FUZZBUSTER POLICE RADAR DETECTORS. Latest Model. big discount. Hughes Electronics, 45 Dunn Street, Asheville, N.C. 28806

## INSTRUCTION & EDUCATION

GET INTO BROADCASTING! Become a DJ, earn big money! Start your own station! Free details, Broadcasting, Box 5516-N3, Walnut Creek, CA 94596

**DEGREES**, experience/credits: EMI, Inc. Box 4277, Inglewood, CA. 90309

GET INTO BROADCASTING! Become a OJ, earn big money! Start your own station! Free details, Broadcasting, Box 5516-N3, Walnut Creek, CA 94596

#### EQUIPMENT WANTED

TANNOY 15 inch monitor gold unit. JBLSG-520E. SE-400S, SE-460 F-22. Marantz 7C#9S pair. Kazuo Takashimadaira 2 chome. Itabashi-ku, Tokyo 175 Japan

TWO JENSEN recone kits No. SA-1810-4 for ERPI TA4181A (Jensen L-18-DC) 18 inch speakers. McClain 4133 Maple Rd. Morningside, Md. 20023

JEEPS, TRUCKS, Typically from \$52.40 ... Automobiles, Boats, Motorcylces, Airplanes, Cameras, Tools, Clothing, Sports, Camping, Photographic, Electronics Equipment ... 200,000 Bid Bargains Direct from Government Nationwide

... Low as 2c on Dollar! Surplus Catalog and Sales Directory \$1.00 (refundable). National Surplus Center, 240 Eastcass-

AUD, Joliet, III. 60432.

#### MISCELLANEOUS

THE SUCCESSFUL DISCO-SHOW. Complete descriptions, \$1.00. "Uno" 24 Church, Lubec. Maine 04652.

**SELF-HYPNOSIS** cassette by Counseling Psychologist, 2828 Chestnut Street, Montgomery, Alabama 36107. \$5.95 check or money order.

GARDEN EQUIPMENT & SUPPLIES

Strawberry Barrel Decorative built for pennies local materials, useful, fun, profitable, yards, gardens, patio's. Illustrated booklet send \$2.00, SASE Strawbar, 930 Vista, Lewiston, Idaho 83501

#### BUSINESS OPPORTUNITIES

MAKE TOP QUALITY blank tape cassettes and sell them to us. Details: Amcob Ind. Co. 65 Titmus Dr., Mastic, N.Y. 11950

YDU CAN GET IT! NEW ways to make a fortune! Home and business. Write for exciting FREE details! D.M.H. Enterprises Ltd., Box 3974, Regina, Sask., S4P 3R9, Dept. 15, Canada.

#### BUSINESS OPPORTUNITIES

OUR PORTABLE DISCO SYSTEMS could make you rich Earn \$150 night and more, playing records for parties, bars, weddings Get in on one of the fastest growing best paying jobs Free information American Audio

103 Ohio Ave

Fremont, Dhio 43420 419-334-3326

**S500 WEEKLY** Mailing Circulars - Foolproof Program - Start Immediately! Write: FORTUNITY (1P4), 46 Cardwell, Drangeville, Dntario L9W 2V6

"EARN \$30.00 per hundred, stuffing envelopes. Immediate earnings. Send \$2.50 for beginners kit. Don, P.D. Box 10033, Houston, Texas 77206."

**CAMPUS REPRESENTATIVES** - Double your profits! Contact TOKYO AUDIO LTD., Box 3241, Los Angeles, Ca. 90028

#### TAPE RECORDINGS

OLDIES TAPES ON OPEN REEL TAPE. Rock n' Roll songs by their year of release. Over 100 songs per year. Free brochure. Rock N' Reel Rental, Dept. C, 4 Prescott Ave., Dix Hills, NY 11746.

WE WILL BEAT any price sheet in America. Featuring TDK, Maxell, BASF, and Ampex. Tape World International, 220 Spring Street, Butler, PA. 16001

OLD RADIO PROGRAMS ON CASSETTE. 1-HOUR ONLY \$1.10 EACH. BIG LIST FREE.

NOSTALGIA SOUNDS

BDX 3584 SIMI VALLEY, CALIF, 93063

SIMI VALLEY, CALIF. 93063

CASSETTES, REEL TAPES, bottom prices, name brands and custom loaded with BASF or SCOTCH. Super mastering computer cassettes loaded with AGFA-GAVAERT. Prepaid shipments, Free catalog. STANFORO INTERNATIONAL, Box 609A, San Carlos, CA 94070

#### RADIO PROGRAMS

OLD RADIO ON TAPE AND CASSETTES. THOUSANDS AVAILABLE, 6 HOURS \$8.00 Immediate Service Catalogue 50c Nostalgic Radio, Box 29K, Peoria, IL 61601

OLD RADIO SHOWS! Top sound quality Cassette or reel catalog. Virgo House, Box 1060-A, Des Moines, Iowa 50311

1930-1962 RADIO PROGRAMS, Reels, \$1.00 hour! Cas settes: \$1.00 show! Mammoth catalog \$1.25 AM TREA-SURES: Box 192 AU Babylon, New York 11702

GOLDEN AGE RADIO - your best source for radio tapes Box 25215-D. Portland, Oregon 97225

YESTERDAY'S RADIO PROGRAMS ON TAPE. Reels, Cassettes, Fast-Reliable Service Catalog \$1.00 - refundable with first order ADVENTURES, Box 4822-A, Inglewood, California 90302

RENT RADIO SHOWS Make your own copies or just listen Great way to build your collection reasonably Catalog S1 re fundable. OTR Rental, Box 1146, Livermore, Ca. 94550

#### **PLANS & KITS**

BUILD YOUR OWN klipschorns. Complete plans. Send \$5.00 to JJB 4907 P½ Galveston, Texas 77550.

LINEAR AMPLIFIER, 2 — 30 MHz, 140 watt mobile: Construction plans, \$3.00. IGOR, Box 5516-N2, Walnut Creek, CA 94596

BUILD YOUR OWN state of the art systems, enclosures, & devices. Complete plans. Send one dollar (redemmable) for complete information. SLATER DESIGNS, P.O. Box 14466, Long Beach, CA 90814

## "Marantz offers-in one speakerboth air suspension and ported design. It's the ultimate in flexibility-and quality."

February, 1976: Marantz engineers invited audio experts to comment on the new Marantz High Definition Speaker Systems. The following remarks were taken from that taped discussion:

<sup>44</sup>It's one thing to design an acoustic air suspension system that will have low distortion. And it's another to design a ported system for high efficiency. But here, in one unit, Marantz offers the audiophile the best of both worlds.<sup>99</sup>

<sup>44</sup>It's incredible. Marantz calls it **Vari-Q**<sup>\*</sup>. Pull out the high density acoustic foam plug and the system becomes a tuned port reflex. Push it back in and the port is absolutely sealed and the speaker becomes air suspension.<sup>99</sup>

<sup>44</sup> It doesn't matter what kind of music the listener is into, either. Air suspension with the plug in is great for full orchestra, because it damps better and doesn't peak the lower frequencies. But when you listen to rock, pull the plug and you increase the low end efficiency. It pumps up the lows at about 75 Hz and really delivers that low end oomph.<sup>99</sup>

\*Patent Pending. \*\*Manufacturer's suggested list price. Actual selling price at dealer's discretion. (The enclosures for the HD-88, HD-77 and HD-66 are constructed of particle board, finished in genuine walnut veneer. The enclosures for the HD-55 and HD-44 are finished in walnut grain vinyl.)

HD-88



Linear Polyester Film Dome Tweeter

<sup>66</sup>Another tremendous feature is the **linear polyester film domes** on the tweeters. The dome shape disperses high frequencies over a much wider area. And because the polyester film is so lightweight, it's more efficient.

It takes less power to do the same job. And they're practically indestructible. And higher efficiency means greater distortion-free accuracy in reproducing high-frequency transients?

We call them High Definition Speaker Systems. You'll call them the ultimate in flexibility and listening excitement. Five models in all (three with Vari-Q) ranging from the bookshelf-sized HD-44 with frequency response from 45 Hz to  $18 \,\mathrm{kHz} \,(\pm 3 \,\mathrm{dB} - \mathrm{all \, controls \, set \, flat})$ and power handling capacity of 60 Watts - to the super-powerful HD-88 with frequency response from 25 Hz to 25 kHz ( $\pm 3 \text{ dB}$  – all controls set flat) and power handling capacity of 300 Watts. Marantz High Definition Speaker Systems start as low as \$89.95.\*\* Experience the profession-



©1976 Marantz Co., Inc., a subsidiary of Superscope, Inc., 20525 Nordhoff St., Chatsworth, CA 91311. In Europe: Superscope Europe, S.A., Brussels, Belgium. In Canada: Super scope Canada, Ltd., Ontario. In the Far East: Marantz Far East, Tokyo, Japan. Prices and models subject to change without notice.

# The A-400.

## "It should start designers at other companies rethinking many of the truisms of their craft."\*

We went to a front-loading design for the A-400 not to make it pretty, but to make it more functional. *High Fidelity* Magazine called it "...the most thoroughly satisfactory front-loading well design we have yet tested: practical, easy to use, unencumbered by 'extra' mechanisms that are potential troublemakers."\*

Proven reliability. And typically TEAC performance. Whether you want the twang of a country guitar or the smoothness of a slap bass, the mellow sound of a ballad or the thrilling power of an opera, audition the A-400. You'll agree with the critics. It *is* something to think about.

\**High Fidelity* Magazine, May 1976. Reprinted by permission.



The leader. Always has been. TEAC Corporation of America, 7733 Telegraph Road, Montebello, CA. 90640 ©TEAC 1976 In Canada TEAC is distributed by White Electronic Development Corporation (1966) Ltd.



icanRadioHistory Com

"Dolby" is a trademark of Dolby Laboratories, Inc.