

The Authoritative Magazine About High Fidelity

**CANBY  
WHYTE  
FREED**  
*and more...*

# AUDIO

APRIL  
1970

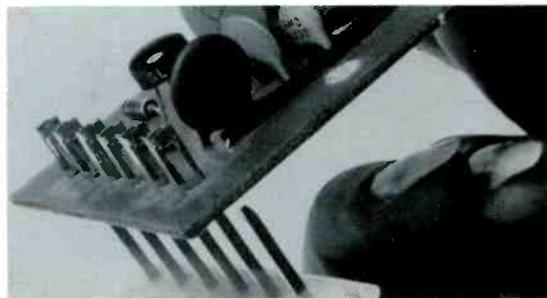
60¢

**Tape Recorder Maintenance** ■ **The Listening Room**  
■ **Getting Hooked on Chamber Music** ■ **Audioclinic** ■  
**Behind the Scenes** ■ **Equipment/Record/Tape Reviews**



# Scott's New Modutron Circuit Board Exchange Policy

**If any printed circuit board  
on any Scott Modutron  
component needs service,  
we'll exchange it  
for only \$10!**



Let's face it . . . electronic devices are becoming progressively more complex and are therefore more difficult and costly to repair.

Scott engineers have solved this problem two ways. First, they minimized the need for service through careful selection of parts, then they went on to simplify servicing through the use of replaceable Modutron circuit boards.

All major electronic circuits are modularized on separate printed circuit boards . . . and each of these boards plugs into place on the chassis. This means that a failure in any major circuit can be repaired instantly by plugging in a replacement board.

Our new service policy allows replacement of any printed circuit board at deliberately low cost no matter how long you've owned your unit!

## **HOW SCOTT'S MODUTRON EXCHANGE POLICY WORKS**

Should your Modutron unit ever need servicing here's all you do:

Take or ship your component to a Scott Warranty Service Station.

Your unit will be electronically tested and the problem isolated. (Experience shows that 95% of problems can be repaired by plugging in a replacement board.)

The warranty station will then exchange the defective board for a perfect one right from stock, or contact Scott for air shipment.

This means service is faster than ever before and that you pay only for troubleshooting costs, any required alignment and the \$10\* exchange cost of a perfect factory-rebuilt Modutron circuit board. Exchange price applies only if board is not physically damaged.

\*or the equivalent 1970 purchasing power.

## **WHAT UNITS ARE COVERED**

Most of Scott's new receivers utilize Modutron construction. Included are the 342C FM stereo receiver, the 382C AM/FM stereo receiver, the 386 AM/FM stereo receiver and Scott's 2506 compact stereo systems.

## **ADDITIONAL PROTECTION FOR YOU**

Scott's regular Two-Year Warranty remains fully in effect. During the first two years there is no charge for either parts or labor costs. This new Modutron circuit board exchange policy is additional protection . . . it assures you of minimal service cost no matter how long you keep your Scott component.

## **SCOTT AUDIO COMPONENT WARRANTY**

All H.H. Scott professional quality tuners, amplifiers, receivers, compact stereo music systems, and loudspeaker systems are warranted against defects in material and workmanship for two years from the date of sale to the consumer. The unit must be delivered to and picked up from either an authorized Scott warranty service station or the Customer Service Department, H.H. Scott, Inc.

This warranty covers repair and/or replacement of any part found by the manufacturer, or his agent, to be defective, including any associated labor cost.

The above warranty does not apply to (1) accessory parts explicitly covered by the field warranty of an original manufacturer (2) units subjected to accidental damage or misuse in violation of instructions; (3) normal wear and tear; (4) units repaired or altered by other than authorized service agencies; and (5) units with removed or defaced serial number.

The 1970 CONSUMER GUIDE published by BUYERS GUIDE Magazine says: ". . . as for out-of-warranty repairs, modular circuit design can cut service bills by 40-80% compared to what it costs to have a non-modular receiver repaired."

# **SCOTT®**

H.H. Scott, Inc., 111 Powdermill Road, Maynard, Mass. 01754  
Export: H.H. Scott, Inc., Maynard, Mass. 01754

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Check No. 100 on Reader Service Card



This is the A-6010U, top of the TEAC tape deck line. And these are just a couple of its supersonic breakthroughs: Unique phase sensing auto reverse operates electronically at any chosen point on the tape. Or it can take a sensing foil if desired. But don't look for this system on anybody else's machine. Separate heads for record and playback allow off-the-tape monitoring while recording; most other machines in this price range can monitor the sound source only. What's the barrier to your complete sound enjoyment? Chances are, TEAC has broken that, too.

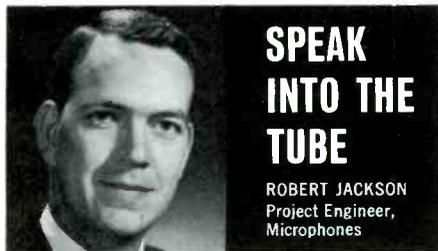
**Breaks  
the sound  
barrier.**

**A-6010U** • Exclusive symmetrical control system • Dual-speed hysteresis synchronous motor for capstan drive • 2 exclusive eddy-current outer rotor motors for reel drive • Pause control • Unique tape tension control • 4 heads, 4 solid-state amps, all-silicon transistors • Independent LINE and MIC input controls

**TEAC**

TEAC Corporation of America  
2000 Colorado Avenue  
Santa Monica, California 90404

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## SPEAK INTO THE TUBE

ROBERT JACKSON  
Project Engineer,  
Microphones

As aircraft become faster and more complex, the need for faultless communications becomes more vital. To this end, Electro-Voice has continued to explore new techniques of design and construction. E-V worked closely with air-frame manufacturers and government agencies in the development of the first noise-canceling microphones. The inclusion of small transistor amplifiers within dynamic microphones (to permit plug-in replacement of less intelligible carbon types) was another E-V achievement.

Currently a new concept to aid pilots is now being introduced. It consists of a tiny microphone (plus optional earphone) that clips to a headband or directly to the frame of a pair of glasses. A small (3/16" dia.) tube extends from the microphone to the lips of the wearer. In this way, the microphone is always very close to the pilot's mouth, but does not interfere with normal vision or speech and leaves the hands free.

The entire assembly (including earphone) weighs just 2.24 oz. to permit long periods of use without fatigue. Normally a press-to-talk switch is provided on the control wheel of the airplane to allow instant communications without unnecessary distractions. An optional press-to-talk switch is also available.

In order to match the high level carbon microphone inputs typical of aircraft radios, a two-stage transistor amplifier is located in the housing of the PJ-068 microphone plug. Despite complete RF shielding of the amplifier, the entire plug assembly is only fractionally larger than a standard unit.

The dynamic element has a distinct advantage over reluctance elements often used for this purpose, since distortion at high levels is substantially reduced, and danger of sudden failure due to mechanical or acoustic shock is virtually eliminated. Field service of the transducers is also a feature of the design.

The response curve of the earphone optionally available has been chosen to duplicate the output of military models selected for optimum intelligibility. Five ear tips plus two microphone tubes are standard to assure that each headset fits the user exactly.

While the basic design of both the microphone and the headset has been tailored specifically to the problems of aircraft communications, and has achieved TSO approval from the FAA, the headsets can also solve related communications problems. In addition, variations for such applications as broadcast commentary, ham radio, and other uses are now in development.

For reprints of other discussions in this series,  
or technical data on any E-V product, write:  
ELECTRO-VOICE, INC., Dept. 403A  
602 Cecil St., Buchanan, Michigan 49107



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# AUDIO

APRIL 1970 Vol. 54, No. 4

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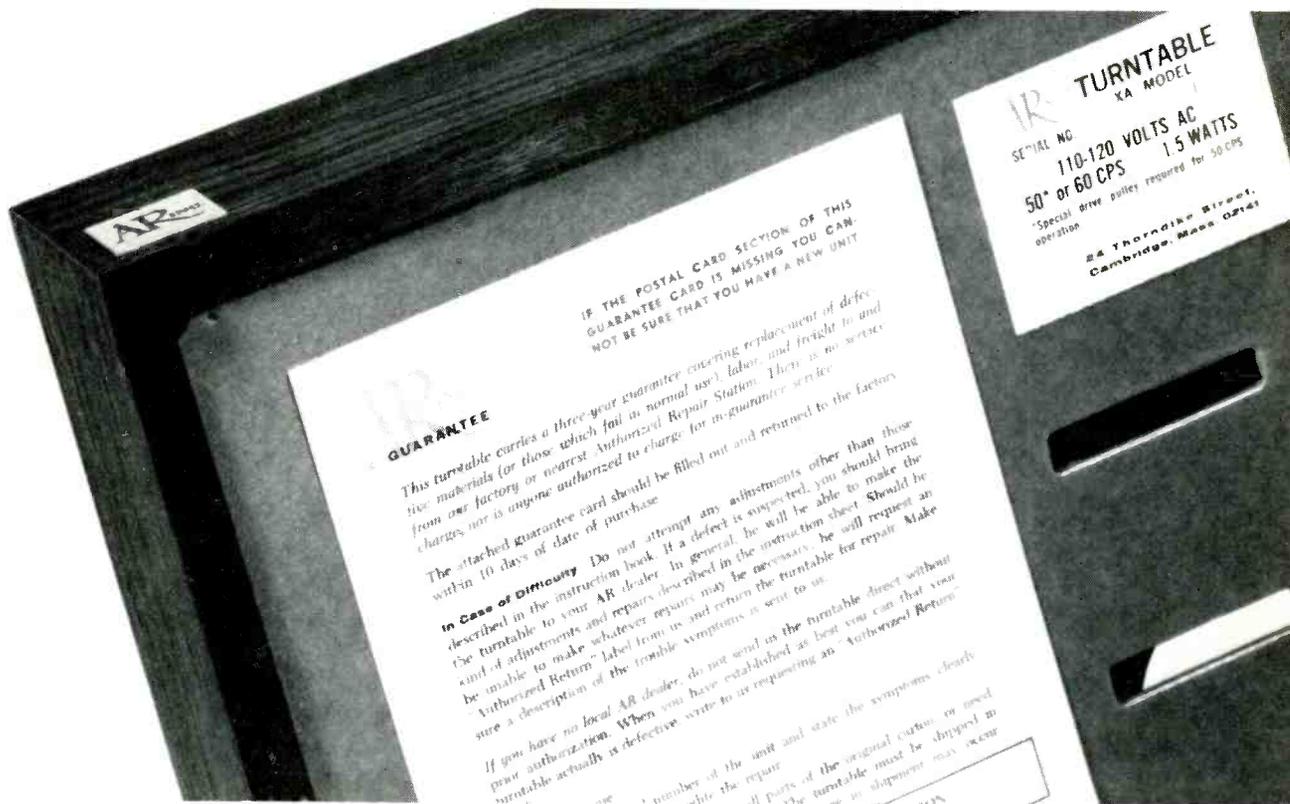
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AUDIO • APRIL 1970

**the AR guarantee:  
not one cent for parts,  
not one cent for labor,  
not one cent for service charges,  
not one cent for freight.**



**AR guarantees are unmatched in the high fidelity industry. They are also easy to read.** We believe that when a consumer buys a product, he should get one that works as he has been told it will work for the price he has been asked to pay. If the product then fails to operate correctly through no fault of the consumer, the manufacturer must accept responsibility for the failure at no cost to the consumer. A guarantee under which the consumer is forced to pay, perhaps repeatedly, for the manufacturer's errors, is not fair.

Acoustic Research guarantees its loudspeaker systems for 5 years, its turntable for 3 years, and its amplifier and receiver for 2 years from the date of purchase. During this time, if a product we have made fails to operate properly through no fault of the owner, Acoustic Research takes full responsibility for the necessary repairs. There is no charge for parts which need to be replaced; no charge for the labor of locating these parts and replacing them; no "service charge" by Acoustic Research or its authorized service stations; no charge for shipping, whether to the nearest authorized service station or all the way to our factory in Cambridge and back; not even a charge for a new carton and packing materials, if these are needed. The only cost to the owner is inconvenience, which we deeply regret and make every effort to minimize.



**Acoustic Research Inc.**

24 Thorndike Street, Cambridge, Massachusetts 02141

Acoustic Research International  
Radiumweg 7, Amersfoort, Holland

Check No. 3 on Reader Service Card

**There are 202 parts  
in a Garrard automatic turntable.**

**We make all but a  
piddling few.**



Today's automatic turntable is a beastly sophisticated device.

The Garrard SL95B, below, has 202 different parts.

That is, unless we tally the "parts" that go into such final assembly parts as the motor and pickup arm. In which case the total is more like 700.

A few of these parts we buy. Mostly springs, clips and bits of trim.

But the parts that make a Garrard perform, or not perform, we make ourselves.

### To buy or not to buy

At our Swindon works, in England, a sign reads "If we can't buy surpassing quality and absolute accuracy, we make it ourselves."

E. W. Mortimer, Director of Engineering Staff and a Garrard employee since 1919, says "That sign has been there as long as I can remember.

"But considering the precision of today's component turntables, and the tolerances we must work to, the attitude it represents is more critical now than it was even ten years ago."

Our Synchro-Lab motor is a perfect example.

To limit friction (and rumble) to the irreducible minimum, we super-finish each rotor shaft to *one micron*.

The bearings are machined to a tolerance of plus or minus one ten-

thousandth of an inch. Motor pulleys must meet the same standard.

"When you make them yourself," observes Mr. Mortimer "you can be that finicky. That, actually, is what sets us apart."

### Mass produced, by hand

Despite its place as the world's largest producer of component automatic turntables, Garrard stubbornly eschews mass production techniques.

Every Garrard is still made by hand.

Each person who assembles a part tests that finished assembly.

And before each turntable is packed in its carton, 26 final tests are performed.

Thus, we're assured that the precision achieved in its parts is not lost in its whole.

### Swindon, sweet Swindon

In fairness to other makers, we confess to a special advantage.



Our home.

At last census the total population of Swindon, England was 97,234. Garrard employs a rather large share of them, and has for fifty years.

"Not everyone has been here from the year one as I have," smiles Mortimer "but we have 256 employees with us over 25 years. Many are second and third generation.

"It's hardly your average labor force. Everyone feels a part of it."

### The sum of our parts

Today's SL95B is the most highly perfected automatic turntable you can buy, regardless of price.

Its revolutionary two-stage synchronous motor produces unvarying speed despite extreme variations in line voltage.

Its new counterweight adjustment screw lets you balance the tone arm mass to within a hundredth of a gram.

Its patented sliding weight anti-skating control is permanently accurate.

And its exclusive two-point record support provides unerringly gentle record handling.

You can enjoy the SL95B, the sum of all our parts, for \$129.50.

Or other Garrard component models, the sum of fewer parts, for as little as \$44.50.

Your dealer can help you decide.

**Garrard**<sup>®</sup>

## Peak Level Indicator

*Q. I like to listen to music at very loud levels.*

*My question is: can I hook up some type of flashing light or buzzer circuitry to warn me of the high power levels which can damage my speakers?—Douglas Parker, Los Angeles, Cal.*

A. I do not suggest a buzzer for this application as its sound may be drowned out by the "very loud level" at which you plan to listen.

The information you need can be obtained by the use of a neon lamp connected to the secondary of a step up transformer. You could use an ordinary output transformer for this application, connected backwards. You would need to protect the neon lamp with a suitable series resistor. You also must provide some means of calibrating the system. See Fig. 1.

Neon lamps fire on peaks, responding quickly to excitation. However, these peaks must be of relatively high voltage,

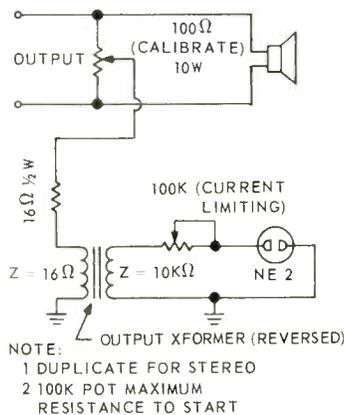


Fig. 1—Peak level indicator.

more than 90 volts. This is more than is available from an amplifier feeding 8-ohm speakers, even when this amplifier is putting out really high power. Under these conditions, the current is high, but the voltage is low. That is why the step-up transformer is needed. The ordinary output transformer will produce too high a voltage. Further, the neon lamp will tend to draw too much current even when the voltage is just above the ignition point. It is for this reason that a series resistor must be used to feed the lamp.

The calibrating pot is used to set the point at which the lamp fires. I suggest

that you calibrate the lamp to flash at a point somewhat below the actual danger point. Check the calibration from time to time to be sure that the neon lamp has not changed its firing characteristics.

## Unusual Hum Problem

*Q. I have a tube-type amplifier. Since purchasing it, I have lived in three different apartments. Here is where the problem begins.*

*In the first apartment the amplifier produced an audible hum. I checked out all the tubes, circuits, cables, and shielding. All seemed well. I noticed that, when the noise was most audible, one of the tubes glowed red hot and another gave off a violet color. Also, the hum would continue at a constant level, then suddenly increase in volume, and then return to the constant level. The sound was there with either "phono" or "tuner".*

*I moved into my second apartment. I wired everything up. I had no hum, no glowing tubes—just very acceptable performance from my system.*

*In my third apartment I am again plagued with the hum and glowing tubes.*

*What causes the hum? What can be done about it? Would I have the same problem with a transistor amplifier?—Richard Peterson, Iowa City, Iowa.*

A. I suspect that the differences in your amplifier's performance in your three apartments results from variations in line voltage. When you lived in the apartment which produced the humless amplifier operation, I suspect that the line voltage was lower than normal. Higher line voltages brought about the condition. I do not know anything about your particular amplifier, inasmuch as no brand was indicated. All I can do, therefore, is give you some general observations with the hope that one of them will be the right one.

Many amplifiers employ what is known as "fixed bias." This is an arrangement whereby bias for the output tubes is obtained from a bias supply rather than from a cathode biasing resistor. Perhaps this "fixed bias" voltage is too low. Usually this can be corrected by a pot incorporated in the amplifier for this purpose. Sometimes this adjustment takes the form of two pots, one for each output tube (in the case of a mono amplifier). Assuming that this bias voltage is too low, the output tubes will draw too much current, which, in turn, will lead to a

gassy condition in the tubes and hum in the amplifier. As you can guess, when the line voltage is reduced, the output stage will not draw as much current, and the gassy condition will not take place.

How much bias should be applied to your output tubes? Check a tube manual. See what the tube manufacturer calls for in terms of both grid bias voltage and plate current. Adjust the bias pots accordingly.

Not all amplifiers employ fixed bias; some use cathode bias. In some instances the cathode biasing resistor is also bypassed with an electrolytic capacitor. Should this capacitor become shorted or leaky, this will reduce the amount of resistance between cathode and ground, which will result in the output stage's drawing more current than it should, leading to your present problem.

The signal is supplied to the output-tube grids by way of coupling capacitors. If one or both of these becomes leaky, d.c. voltage from the driver stage will be applied to the grids, reducing or even eliminating the bias voltage. Check this source of potential trouble, too.

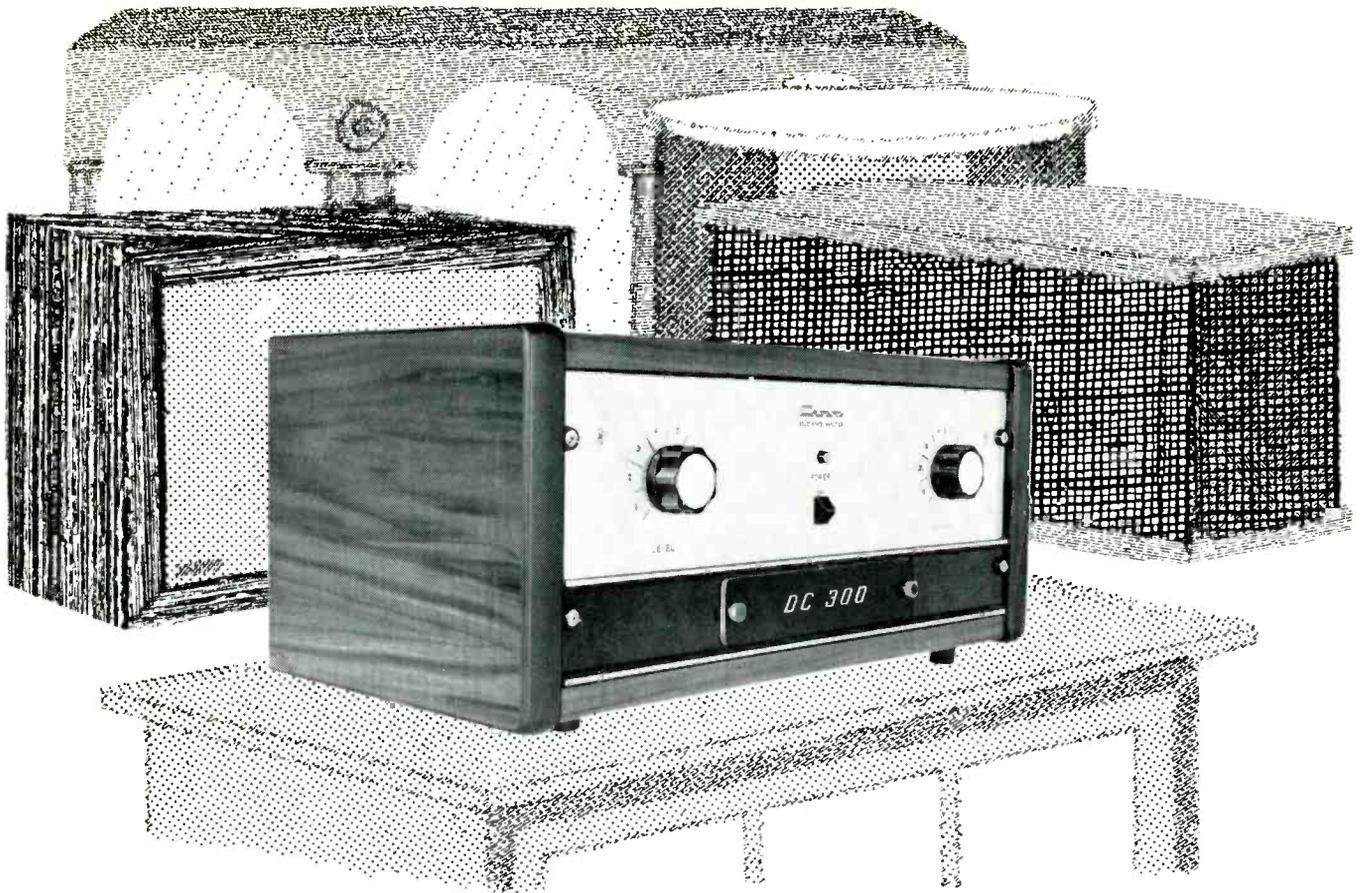
As you can see, this is not a problem which has to do with transistor gear. Transistors have their own problems, but you won't find a gassy one.

## Woofers and Tweeter Interaction

*Q. In his book, LOUDSPEAKERS, G. A. Briggs suggests using the ordinary 8-inch speaker, mounted in an enclosure measuring approximately 23 by 11 by 9 inches, in what appears to be an RJ manner, which I remember somewhat fondly. Now, if I were to mount an 8-inch speaker, as he suggests, would there be any woofer and tweeter interaction or distortion resulting because of boring another hole and mounting a small tweeter?—William Weiss, Los Angeles, Cal.*

A. There is no problem at all in this regard. The amount of internal volume lost by virtue of the tweeter's presence will not make any difference to the operation of the woofer. Further, no pressure waves from the woofer can affect the tweeter because of its sealed back.

If you have a problem or question on audio, write to Mr. Joseph Giovanelli at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107. All letters are answered. Please enclose a stamped, self-addressed envelope.



# AMONG HI-FI SPEAKER MANUFACTURERS CROWN'S DC300 IS MORE WIDELY USED THAN ALL OTHER AMPLIFIERS COMBINED does that tell you something?

If you attended the last L.A. High Fidelity Show, you may remember seeing Crown DC300's working in almost every speaker manufacturer's exhibit. And, if you could visit their factory engineering and test labs, you would see DC300's in nearly every plant. The reason is obvious. Manufacturers choose lab equipment strictly for utility. They must hear the sound precisely as their speakers express it, with no distortion, no noise whatsoever. Of course, this is also what you want.

If you suspect your hi fi system isn't living up to its full capabilities, visit your Crown dealer this week. Pick out a pair of speakers and ask him to set up an A-B test between a DC300 and any other brand amplifier. Your ears will tell you what you've been missing. Send us your name and we'll mail you several unusually admiring test lab reports from magazines like *Audio*, *High Fidelity* and *Stereophile*. Plus some literature with the most astonishing set of specs and graphs you've ever seen. But don't wait. Because you'll never *know* how great your system can sound, till you have the Crown DC300.

300 watts/channel RMS into 4 $\Omega$  DC-20KHz at 0.02% THD  
IM distortion under 0.05%, 1/10 watt to 300 watts  
S/N 100db below 150 watts RMS  
3-year warranty on parts and labor  
Damping factor greater than 200  
Individual proof-of-performance record  
Made only in America



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# Coming in May

**AES Convention Preview**—a look at some of the new products and details of the papers to be presented.

**Tape Cassettes and the Dolby System**—E. T. Canby

**Negative Feedback**—Norman Crowhurst concludes this series of articles.

**Getting Hooked on Chamber Music**—Richard Freed concludes this article with another list of recommended records.

**A New Electronic Synthesizer**—Alfred Mayer describes a low-priced voltage-controlled unit.

**Equipment Profiles** will include:  
**Advent** Balance Control  
**Citation 12** Amplifier kit  
**Ferroglyph 724** Tape Recorder

## PLUS

**Behind the Scenes** with Bert Whyte and all the regular features, tape and record reviews.

**About the cover**, this fine installation is in the home of Charles Price of Kansas City and it was designed by David Beatty Stereo. The amplifier and tuner are McIntosh, the turntable a Miracord 50H fitted with a Shure V15 cartridge. An Ampex cassette tape recorder can just be seen but the loudspeakers (JBL-44's) are well-concealed behind the blue grille cloth in the wall.

# What's New in Audio



## Lafayette LR-1500TA AM/FM Receiver

Lafayette Corporation have just introduced a new receiver which features an 'electronic tuning' circuit, automatic overload protection, built-in AM/FM anten-



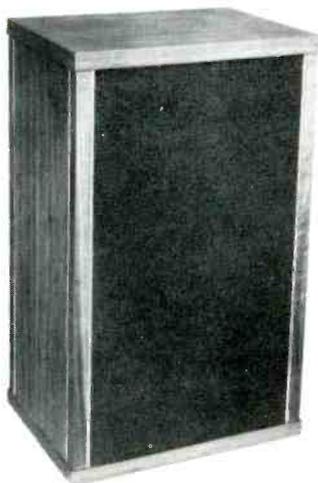
## New Sony Receiver

Sony announce a new low-priced AM/FM receiver, Model STR-222. Using 28 transistors, 1 FET, and 19 diodes, it has most of the features of more expensive receivers—but with a lower power output (8 watts per channel). FM sensitivity is quoted at 2.0 microvolts, and AM is rated at 10 microvolts. The STR-222 comes complete with built-in AM antenna plus FM ribbon dipole. Price \$149.50.

Check No. 22 on Reader Service Card

nas, muting switch, front and rear tape-output jacks, low- and high-frequency filters, and a dual speaker system switch. Output power is quoted as 220 watts (1HF) total, with a power bandwidth of 18 to 55,000 Hz.  
Price \$299.95

Check No. 25 on Reader Service Card



## Epicure 150 speaker system

An extra-wide dispersion is claimed for this new Epicure system and the frequency response is quoted as 35 Hz to 15,000 Hz ( $\pm 3$  dB). Cabinet size is 11" by 15" by 25" and it is trimmed with walnut and brass with a dark grille cloth. Price \$139

Check No. 23 on Reader Service Card

## BASF Tape Starter Kit

Ideal for beginners, this kit includes a 4-reel assortment of BASF tape, a spare professional-type reel, instructional literature and a hobby box.  
Price \$19.99

Check No. 24 on Reader Service Card

## Kenwood KR-7070 Receiver

This is the top-of-the-line AM/FM receiver and it features crystal filters, automatic protection circuits, step-type tone controls, a 'presence' control, high- and low-frequency filters, a 3-FETS, 4-gang



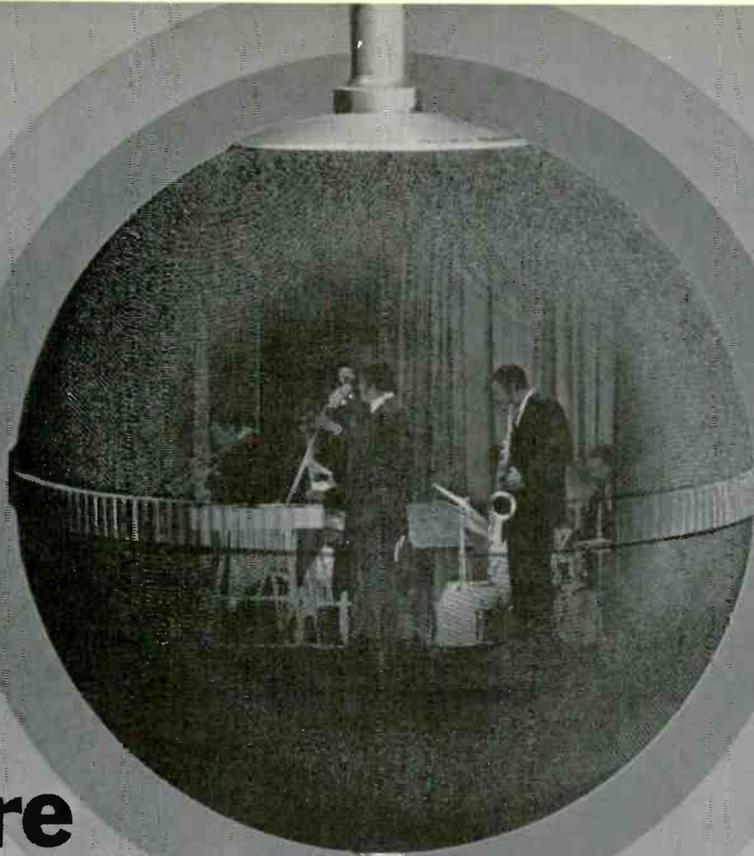
tuning capacitor 'front end' with a 1.5- $\mu$ V sensitivity and 1.5-dB capture ratio, and automatic tuning. This is a scanning system which can be set to operate on stereo stations only if desired, and a remote control unit is included. 1HF power is claimed to be 300 watts.  
Price \$549.95

Check No. 28 on Reader Service Card

## Books by Norman Crowhurst

A list of books by this talented and prolific writer. Includes books on electronic organs, stereo multiplexing, public address systems, and mathematics.

Check No. 36 on Reader Service Card



# You're surrounded ...by beautiful music

Now, with JVC's superb new model 5303 omni-directional speaker system, the rich, enthralling sounds of stereo are all around you. It's as though you were in the midst of a hot combo or a symphony orchestra.

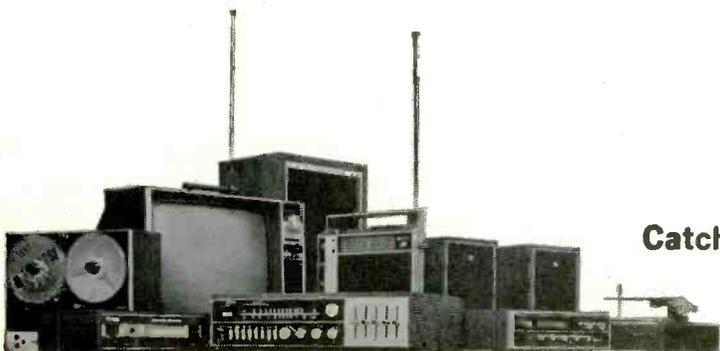
Since sound, as it emanates from musical instruments, is omni-directional, it makes sense that you need omni-directional speakers to enjoy it in its purest state.

The 5303's pulsating sphere makes that possible. Four free edge woofers and four horn tweeters on a globular diaphragm and encased in a punched metal enclosure ensure it.

You're surrounded, but free. Free to move anywhere in the room without losing the slightest nuance of stereophonic brilliance, free from the confining feeling of one-position listening.

If the idea of complete, all-encompassing sound captivates you, surround yourself with a new JVC 5303 omni-directional system. Visit the JVC dealer nearest you and give yourself up—to total stereophonic pleasure.

*list price: \$199.95*



Catching On Fast

# JVC

JVC America, Inc., 50-35, 56th Road, Maspeth, New York, N.Y. 11378 A Subsidiary of Victor Company of Japan, Limited, Tokyo, Japan

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[www.americanradiohistory.com](http://www.americanradiohistory.com)

# BEHIND THE SCENES

BERT WHYTE

Remember way back in the early '50's when all the hi-fi shows were involved with binaural and stereo sound, which for the most part was of the ping-pong variety? One of the favorite stunts was to "run a railroad train through the room," between the two speakers. I was with Magnecord in those days, and we were great "train runners." You know what it took to make a stereo recording of a train in those days? You loaded up the trunk of your car with equipment and headed for the railroad tracks. Then we set up generators and converters, the old staggered head PT6 transport plus the stereo electronics, mike stands, cables, mikes. If you were going to be fancy and use U47 Telefunken's, you had to set up their power supplies and then run power lines to them.

Recently in a fit of nostalgia, I made a new stereo train recording. It was at night. There was a foot of snow on the ground. The temperature was 9 degrees. I made the recording on a battery operated stereo tape machine that measured 8 by 10 by 3 inches and weighed 8 pounds. I operated at 15 ips . . . nothing chintzy about me! I had the recorder around my neck and my hand held an Electro-Voice RE15 cardioid mike which was connected to the left input of the recorder. My long-suffering wife held another RE15 thirty feet to my right facing the tracks. We hear the train whistling in the distance. I start the recorder and activate the stereo automatic gain control. The train roars down the track, whistle tooting, passes us (giving us a real nice doppler effect) and the clinkety-clank of wheels on rails fades into the distance. We rewind the tape and listen to the recording via the monophonic monitor speaker. Crazy, man! It's on the tape all right! We rush home to play the tape on our big stereo system. 300 watts RMS per channel. That should do it! We crank up the gain control. The tape is now feeding through the gate of our big 15-ips machine and there is the first whistle and suddenly this monster train is roaring across the living room and the cat is running for it's life!

How good was the recording? Just superb. Terrifying in it's realism. Ultra wide range, top and bottom. Far better than the recordings we made in the old days. Now the cynics and skeptics among you are wondering how we could get such a good recording from a little old battery-

operated portable recorder.

Well, friends, this little recorder costs \$1300 and it is worth every nickel. It is called the Stellavox SP 7 and is one of the most incredible pieces of precision audio equipment I have ever had the pleasure of evaluating. It is made in Switzerland and in feel and appearance reminds one of Leica and Linhof cameras. Incorporated in this tiny recorder are more advanced ideas and facilities than exist in even the most sophisticated full-size professional equipment. Hard to believe?

The recorder operates on 12 penlight batteries. The alkaline type will permit 6 to 8 hours of recording. It can also use rechargeable nickel cadmium batteries and external a.c. power which will recharge the nicad batteries. The motor is a servo-control type which drives the capstan directly. A photo-electric sensor delivers a signal related to the speed of a special motor rotor. This signal is treated and amplified to control a servo amplifier, which supplies current to the motor. A tiny motor meter on the front panel of the recorder indicates correct motor speed. The pinch wheel is solenoid operated so the recorder can be remotely controlled. All the electronics for the recorder are epoxy-encapsulated plug-in modules. The recorder operates at 3½ ips, 7½ ips, 15 ips, and 30 ips. Speed change is completely electrical. With a special accessory, tape speed can be varied from 1 to 30 ips. What is called the Stellavox Head Device is a precision die-cast head block which contains not only the heads but has incorporated in it the provisions for equalization and bias. The head blocks are interchangeable for different formats and

speeds. All are biased for Scotch 203 tape. Thus you can have mono full-track heads, or stereo half-track or practically any combination. The recorder furnishes synchronizing signals to drive movie cameras. The mono full-track assembly has erase, record, and playback heads, and a fourth neo-pilot sync head. The neo-pilot head cannot be fitted to the stereo head assembly because of crosstalk, so alternatively a third track is fitted in the center between the two stereo tracks and furnishes a synchrotone for camera sync. The third synchro track can also be used to activate a slide projector with a special accessory. Equalization will be correct for a given speed only if the corresponding head block is plugged in. For example 7½-ips speed with 7½ stereo head block in place. All heads in the blocks are pre-aligned and no adjustment is necessary when interchanging head blocks. All head blocks permit off-the-tape monitoring, which can be checked either by mono speaker or headphones.

On the top plate of the recorder is a two-position switch which controls mike input. One position is for conventional low-impedance dynamic types, the other for transistorized condenser mikes of the type that can be powered through the audio connection lines. This means you can do remote or location recordings with the SP7 with such mikes as the Sennheiser MKH405 powered right from the recorder. On the front panel of the recorder are the monitoring facilities, consisting of two calibrated VU meters, which read on playback as well as record. Two calibrated volume controls handle the stereo channels for recording. A switch on the right

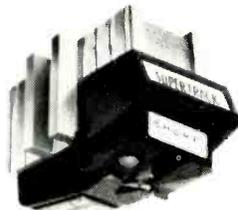
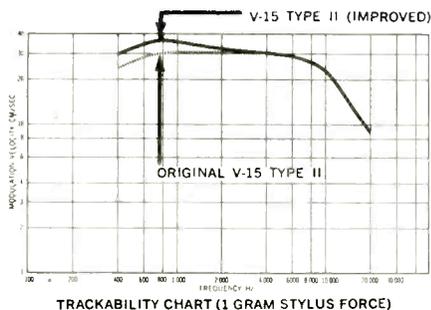


Stellavox Tape Recorder



The "Mint 400" Del Webb Desert Rally

# EVEN A HALF-TON DUNE BUGGY SOMETIMES WEIGHS $\frac{3}{4}$ GRAM



The same inertial forces that make a vehicle airborne when cresting a hill affect the tracking force of the phono stylus. Record surfaces, unfortunately, are a morass of miniscule hills and valleys. When the stylus is nominally tracking at 1 gram, this force significantly *increases* as the stylus enters a "hill," and *decreases* as it begins the downward "plunge." In addition, frictional characteristics of the tone arm or record changer mechanism may further affect uniformity of tracking forces; however, the *Shure V-15 Type II Improved Cartridge* retains its trackability throughout the audio spectrum. It accomplishes this difficult task within a critically determined latitude of tracking forces ( $\frac{3}{4}$  to  $1\frac{1}{2}$ ) to insure continuous contact with the groove walls regardless of the varying tracking forces caused by the hills and valleys in a record groove.

Here is why fractions-of-a-gram are important to record and stylus-tip life:  $\frac{3}{4}$  gram tracking exerts a pressure of 60,000 lbs. per sq. in. on the groove walls—and this rises to 66,000 lbs. per sq. in. at 1 gram, and 83,000 lbs. per sq. in. at 2 grams. At 2 grams you have added over  $1\frac{1}{2}$  tons per sq. in. to the groove walls over  $\frac{3}{4}$  gram tracking! Think about it.

**SHURE** V-15 TYPE II (IMPROVED)

Shure Brothers Inc., 222 Hartrey Avenue, Evanston, Illinois 60204

Check No. 11 on Reader Service Card

side of the panel controls tape motion and there is a special position labeled "automatic." This starts the tape and activates a stereo automatic gain control, which can be very handy if you are in a situation where you may not have time to set your gain manually. I used this facility when I recorded the train. The left panel of the recorder accepts stereo mike inputs, line in and out, headphone input, camera sync-signal output, and external power supply.

This remarkable unit normally uses 5-inch reels which have screw-down reel holders. There is a smoked plexiglas top cover which latches securely to the top plate. In this fashion the recorder can be subjected to high "G" forces while in operating condition (reporter running after Racquel Welsh for example) without any tape-speed variation or stalling. With the top cover removed and the addition of extension arms, reels up to the professional 10½ inches can be accommodated! It seems inconceivable that this small-motored unit would have sufficient torque to handle these large reels (and I haven't seen them at all), yet it is so claimed. We had extension arms on the old Magnecords, but they never worked too well, having high wow and flutter. I could go on and on about this Stellavox,

like gold-plated battery contacts, and so on, but I think you can believe by now what a fantastically versatile unit the Swiss have built.

What about its performance? I have made flawless recordings from discs and "off the air." In a few days I am going to record a jazz group in a night club. My good friend Marc Aubort, of Elite Records, one of the top recording engineers in New York owns this particular Stellavox. In his studio I have heard a recording of soprano and chamber orchestra that Marc made with the Stellavox in Boston Symphony Hall. The quality was quite literally astonishing! Utterly clean, without the slightest hint of wow or flutter. No one, including Marc, is suggesting that this tiny recorder can replace all the big professional recorders. But it can do things few other units are capable of duplicating. With this kind of quality so easily portable, all sorts of fascinating ideas come to mind for location and outdoor recording. This Stellavox is so "far out," that at the 30-ips speed and some special plug-in modules, recordings can be made up in the ultrasonic region, and it has been used to record the sound of dolphins and certain insects! The Stellavox SP7 is imported by the Sennheiser Electronic Corp. of New York.

## Noise Reduction

In this month's tape column, you will find me lamenting about the excruciating hiss which is such a drawback to the otherwise attractive idea of cassettes. Hiss is of course a problem with open-reel tapes and 8-track cartridges as well. By the time you read this, the Advent Corp. of Mass. will have demonstrated the first Dolby consumer-type noise reduction unit, built by Advent under a license agreement with Dolby Laboratories. This unit is basically similar to the Dolby system built into 2 models of KLH tape recorders. It employs what Dolby terms "B Type" noise reduction, which is a single-band system, as opposed to the 4-band system of the professional A310 unit. The band used covers the hiss frequencies and the device gives 8 dB of reduction at 2 kHz, rising to 10 dB at 5 kHz. With the Advent unit you have the facility of using the Dolby System with any kind of tape-recording format. Reportedly, you can record and playback with the unit. Presumably a playback only unit will be forthcoming and this assumes the existence of "Dolbyized" pre-recorded tapes. There is little doubt that some company will take the plunge in this direction, and when they do, others will surely follow suit. Æ

## Dear Editor.....

### AR and 4-channel

• It is always a pleasure to see the activities of our company reported in the press. We were therefore pleased to see Acoustic Research mentioned several times in the January 1970 issue of *AUDIO*. However, a number of editorial statements with which our name is associated are incorrect.

On page 12, Bert Whyte reports that "AR is expected to follow suit with" a single-chassis 4-channel amplifier. This is not true, nor is there any basis for that statement in any AR announcement or activity, public or private. It is worth pointing out that in Mr. Whyte's discussion of 4-channel broadcasts, he fails to mention that the first and only continuing series of 4-channel broadcasts is that which Acoustic Research presents to Boston area listeners every Saturday night. These are the only live 4-channel broadcasts in the country at the present time. Unlike the other broadcasts that Mr. Whyte mentions, the Boston series does not consist of sampler or experimental

tapes, but is a complete presentation of the entire season of the Boston Symphony, under the direction of William Steinberg and other famous conductors.

On page 22, the Boston Symphony 4-channel broadcasts are mentioned, and a diagram given suggesting a speaker arrangement for listening to the broadcasts. The diagram, unfortunately, is an incorrect representation of a system which we are no longer using. The correct arrangement is quite simple and requires no diagram: WCRB represents the front two channels and WGBH the rear.

Also on page 22 is a statement about Vanguard Recording Company and Acoustic Research, Inc., i.e., "these two firms have been sponsoring a series of live symphonic concerts utilizing the regular subscription series of the famed Boston Symphony Orchestra." This statement is incorrect, as Vanguard Recording Company has had no connection with the presentation or preparation of any of these broadcasts.

On page 62 is a review of the Acoustic Research AR-5 loudspeaker system in which is the statement, "AR does not specify frequency response in its published specifications..." Although we do not give brief verbal specifications of frequency response, we know of no other manufacturer of loudspeakers who pro-

vides as thorough and comprehensive frequency-response and distortion data as we publish and distribute for all of our loudspeaker systems (including the AR-5).

ROBERT BERKOWITZ  
Acoustic Research, Inc.,  
Cambridge, Mass. 02141

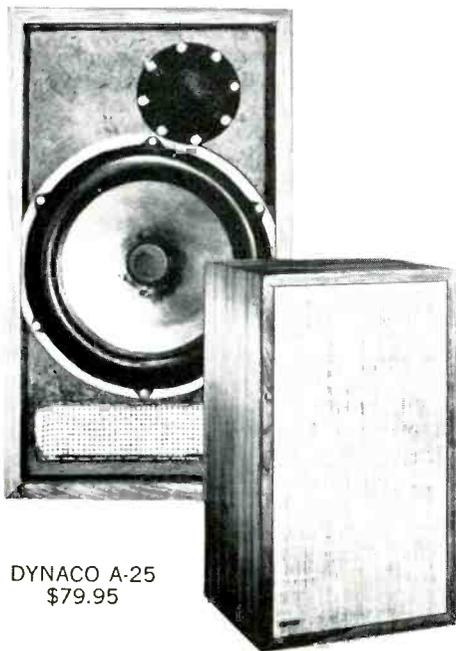
*Glad to set the record straight—but sorry that AR has no plans for 4-channel amplifiers—yet. The information concerning WCRB's microphone placement came direct from that station, and the rather unusual arrangement was in fact queried by Len Feldman. It would seem that they have had second thoughts. . . .*

*Although AR do not publish the frequency-response measurements in the usual manner (within x dB, 20 Hz to 22,000 Hz) they do make available very comprehensive specifications covering transient and frequency response, distortion, and complete polar diagrams. I only wish some other manufacturers would adopt the same procedure—Ed.*

To Charles M. Isherwood who writes asking for "assistance, moral, spiritual or physical" regarding a tape recorder. We may not be able to offer much in the way of spiritual comfort but we might be able to help in other ways—if only we could have your address.

**"... (the Dynaco A-25's) are quite probably the best buy in high fidelity today."**

The Stereophile Magazine.



DYNACO A-25  
\$79.95

Dynaco designed the A-25 loudspeaker system to have the most accurate reproduction of any speaker available, regardless of price, yet at a low cost to the consumer. Here's what two of the most respected publications say about the results of our efforts.

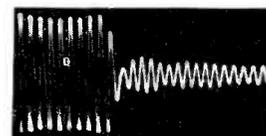
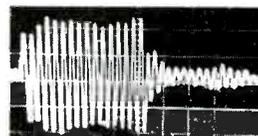
**The Stereophile, Vol. 2, No. 9**

"... (when) some really deep stuff came along ... what came out of the A-25's simply defied belief, for they went **deeper** even than two of our standard systems ... We were certainly **not** prepared to find these piddling little Dyna systems going **flat** down to 35 Hz and rattling windows at a hair below 30 Hz! ... these A-25's are better than anything else we've ever encountered for less than \$200 each ..."

**Julian Hirsch in Stereo Review, June, 1969**

"... the Dynaco had a remarkably neutral quality. Many speakers have response irregularities that ... leave no doubt in the listener's mind that he is listening to a speaker. The A-25 had less of this coloration than most speakers we have heard, regardless of price ... nothing we have tested had a better overall transient response ... Not the least of the A-25's attraction is its low price of \$79.95.

“The excellent overall transient response of the Dynaco A-25 speaker system is shown by the tone-burst response photos at (left to right) 600, 2,000 and 10,000 Hz.” (Stereo Review)



Send for literature or pick some up at your dealer where you can also hear the A-25

**DYNACO INC.**

**3060 JEFFERSON ST., PHILA., PA. 19121**  
IN EUROPE WRITE: DYNACO A/S, HUMLUM, STRUER, DENMARK

# Tape Guide

HERMAN BURSTEIN

## Cross-Field Heads

*Q. I have been told that the cross-field head has more distortion than the conventional type. Is this true? If so, do the advantages of the cross-field head outweigh its bad points?—Richard Cleary, APO San Francisco, California.*

A. To my knowledge, the cross-field head does not cause more distortion than does the conventional type of recording head. However, if this head uses insufficient bias in order to achieve extended treble response, then extra distortion would result.

## Double Recording

*Q. Would you be good enough to suggest a method whereby I could use two tape decks and an audio preamp so that I could record and play back from a common source. If this is not possible, is there a unit or circuit or perhaps a switching arrangement that could be used. Perhaps recording and playback from deck to deck could also be incorporated.—J. Metz, Chicago, Illinois.*

A. I assume that you want to be able to record into your two tape machines simultaneously; and that you want to be able to switch between either machine in playback. So far as recording goes, you might try a Y-connector between the tape recorder output jack of your audio preamp and the inputs of your two tape machines. Such a connector is available for a relatively few cents from mail order houses. Inasmuch as the preamp's output impedance is usually low, while the input impedances of the tape recorders are usually quite high, there is a good chance that the two tape recorders will not interact so as to affect each other adversely. Similarly, you might try a Y-connector between the outputs of the two tape machines and the tape input jack of the audio preamp. You would have to perform your switching between the two machines by means of each one's individual controls.

If the Y-connector does not work satisfactorily in playback, then you can go to a simple switching arrangement whereby you alternately connect the hot lead of each machine's output cable to the hot terminal of the preamp's tape input jack. Alternatively, you could use one of the mixers on the market, feeding the output of the tape machines into the mixer, and the mixer output into the preamp's tape input jack.

## Tape Storage

*Q. What is the best way to store tapes? My tape machine has the automatic reverse function, which nine times out of ten means my tapes will be returned to their containers tightly wound. My tape machine has a tension selector that provides a setting for use with 1/2-mil tape. Would you advise my using the 1/2-mil setting?—DuLaurence A. Miller, APO San Francisco, Calif.*

A. The preferred way of storing is after operation in the normal operating mode (such as 7.5 or 3.75 ips) and tail out (last part of the recording at the outside of the hub). Accordingly, when you come around to playing the tape, you are obliged to rewind the tape, thereby relieving stresses that may have accumulated during storage. It is undesirable to store tape after fast wind or rewind, because of the stresses that build up during such winding. I would suggest following whatever instructions are supplied by the manufacturer with respect to tension setting, storage, and so on. He generally knows best, and the more reputable the manufacturer and his product, the most wisdom there is in following his instructions.

## Using Earphones

*Q. I have a \* \* \* \* tape deck. When I record I find that I'm unable to monitor the tape with earphones. As soon as I place the earphones in the tape deck, my VU meter stops registering. It seems as though the*

*power is drawn to the earphones because I can't hear anything from my speakers. What might be the reason and what can I do?—Martha Flack, APO San Francisco, California.*

A. It seems that the earphones are shorting out the playback signal. Apparently the source impedance of the tape recorder is a good deal higher than the loud impedance presented by the earphones. Have you tried using high-impedance earphones? Does your audio system amplifier provide a place for monitoring by earphones?

If I am correct that your earphones are of much too low impedance to be used satisfactorily with your tape recorder, and if you don't wish to buy new ones, you might be able to obtain an impedance-converting transformer to be used between the tape deck and the earphones. Consult electronic supply houses for an appropriate transformer. However, this might not be cheaper than buying new, high-impedance earphones.

## 15 ips?

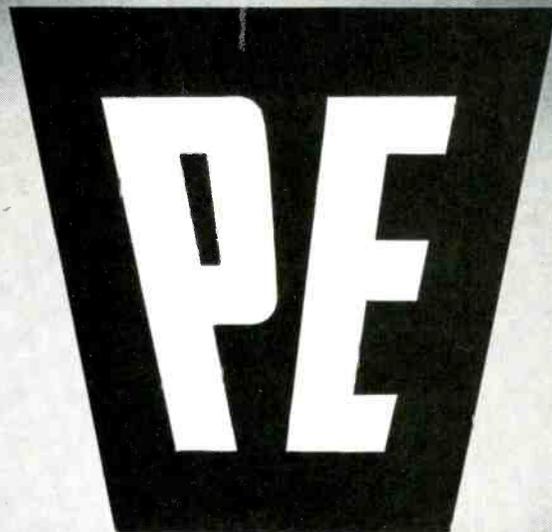
*Q. I am considering the purchase of a tape deck for dubbing purposes. Would it be to my advantage to purchase a deck with 15-ips speed? I would use this deck only to record at lower speeds, probably 3.75 ips. Are 15-ips prerecorded tapes readily available?—Robert B. Kellogg, APO 96312*

A. I can't see any point in purchasing a 15-ips deck if you will not be using this speed, unless such a deck offers a quality of performance at lower speeds that you cannot find in other decks.

I don't know of prerecorded tapes at 15 ips that are readily available. Prerecorded tapes are usually offered at 7.5 and 3.75 ips.

If you have a problem or question on tape recording write to Mr. Herman Burstein at AUDIO, 134 North Thirteenth Street, Philadelphia, Pa. 19107.

# PERfection in PERFORMANCE



## AUTOMATIC TURNTABLES



### The inevitable choice among automatic turntables

Feature for feature PE automatic turntables stand alone: Dial-a-Matic vertical tracking angle adjustment . . . Gentlest, fingertip cueing action . . . One-Lever Control . . . Fail safe stylus protector . . . Automatic record scanner. Awarded "DIN" Seal of Excellence for PERfection in PERFORMANCE. Get a demonstration on the world's gentlest automatic turntable at your PE dealer, or send for details: Elpa Marketing Industries, Inc., New Hyde Park, N.Y. 11040.



PERfection in PERFORMANCE

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# Editor's Review

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In Philadelphia, City of Brotherly Love, we have just had a Hi-Fi week, and by all accounts it was very successful. It was organized by the Delaware Valley Hi-Fi Dealers Association in conjunction with the Philadelphia *Daily News* which issued a well-illustrated 68-page supplement for the occasion. Judging from the articles therein, many dealers are far from satisfied with the IHF amplifier power ratings and they had some harsh words to say about the 'numbers game' or 'watts watt'. Said the Chairman Ed Gorak at a recent meeting "The dealer has as much to lose as the customer when the customer is fooled by promotional and advertising gimmicks: they cannot afford to have potential customers distrusting them or the industry they represent." Amen to that—but I would go further and stress the fact that the *manufacturers themselves cannot afford to be distrusted*. Some 30 or 40 years ago, one of my favorite writers, H. L. Mencken, said "No one ever went broke *underestimating* the intelligence of the Great American Public." And there is no doubt that if H.L.M. were alive today he would see no reason to change his mind—especially if he watched TV for a day or so! However, in our particular industry, buyers are discriminating, more knowledgeable, and the few who are misled will find out sooner or later. What happens then?

We have mentioned the  $\pm 1$ -dB power rating several times in the past, pointing out that 1-dB was roughly equivalent to 21% and so an amplifier rated at 100 watts  $\pm 1$  dB need only put out 79 watts. But we regret to say this dishonest method is still being used, and unfortunately the IHF gives it a tacit approval when it says in effect—if you use it, you must also quote the IHF figure.

\* \* \*

The article by Richard Freed on Chamber music (page 22) is the first of a series on music, and comments will be welcome. 'Chamber' music of course simply means 'music for the room' and

with a good program source and reasonable equipment, it is not too difficult to imagine that the players are indeed right there in the room. In fact, I have always played this kind of music to demonstrate just how realistic Hi-Fi *can* be.

\* \* \*

Bert Whyte has had some health problems but I am glad to say he has now recovered. He was, however, prevented from going too far Behind the Scenes but he did get out of bed to test the Stella-vox tape recorder in conjunction with the Long Island Rail Road). He says in his article (page 10) that the recorder was very well made and ideal "for running after a subject." Now Bert is, shall we say, massively built and the mental image of him running along, recorder swinging from shoulder and mike grasped in one hand is a very pleasing one. . . .

\* \* \*

Ed Canby has an interesting article on the listening room (page 24), and he describes his experiences with an Advent Frequency Balance unit. Next month, he will be writing about the Dolby system and cassettes—among other items. Incidentally, the "E.T.C. Canby" music program can be heard over WNYC, New York, on Sundays at 1 p.m.

\* \* \*

Now for a few words about letters: these are always welcome (even if they *are* critical). Technical queries should be marked for the attention of Joseph Giovanelli or Herman Burstein if appropriate, but please, please do not forget to enclose a stamped addressed envelope for a reply. We now have a growing collection of letters that cannot be answered because the senders forgot to include their address!

G.W.T.

---

"If we could have devised an arrangement for providing everybody with music in their homes, perfect in quality, unlimited in quantity, suited to every mood, and beginning and ceasing at will, we should have considered the limit of human felicity already attained"

— *Looking Backward*, Edward Bellamy, 1887

# Only Pickering offers Dynamic Coupling Factor... your assurance of greater listening pleasure



A sophisticate who can afford the finest in stereo components and equipment, would select the Pickering XV-15 Cartridge labeled 750E, 400E or 350. They're the proper ones to deliver "100% Music Power."



With the more simple equipment that characterizes today's informal living, the XV-15 with a DCF of 150 or 200 will assure "100% Music Power."



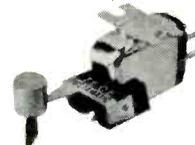
A Pickering XV-15 Cartridge with a DCF of 100 or 140 will guarantee "100% Music Power" on the type of set up that the young in your house use for dancing or listening.

The Dynamic Coupling Factor is an index of maximum stylus performance when the cartridge is related to a particular type of playback equipment. This resultant number is derived from a Dimensional Analysis of all the parameters involved. To select a pickup for a professional manual turntable, with its sophisticated, dynamically balanced tone arm, tracking at an ultra-light force, a higher DCF index would be required than, say, for a pickup to be used in an ordinary record changer. For maximum distortion-free response, this index to application relationship properly determines maximum stylus performance in your playback equipment. 100% music power is assured at all frequencies — linear response from 10 to 20,000 Hz virtually a straight line — due to the extremely low mass of its moving magnetic system — 1/5 to 1/10 of ordinary pickups.

There are seven DCF rated XV-15 models. Each is equipped with the famous patented V-Guard "floating stylus" — the easily replaceable stylus assembly that protects the diamond and record while it plays. In addition each model includes the DUSTAMATIC™ brush that automatically cleans the record groove while it plays.

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THE NEW PICKERING XV-15/750E. PREMIER MODEL OF THE XV-15 SERIES. TRACKS AT 1/2 TO 1 GRAM. DYNAMIC COUPLING FACTOR OF 750 FOR USE IN FINEST TONEARMS. \$60.00. OTHER XV-15 CARTRIDGES FROM \$29.95. PICKERING & CO., PLAINVIEW, L.I., N.Y.

# Negative Feedback

NORMAN H. CROWHURST

## CONTINUED

**D**ISCUSSIONS OF THEORY are both more easy to understand and more easy to apply, if illustrated by an application associated with something familiar to us. So let's consider the design of inputs and outputs for professional units to be used with 500-ohm line connections.

Professional equipment is designed for line-impedance inter-connections, which means the insertion gain, frequency response, distortion, and dynamic range are all measured and specified when input and output impedances, external to the amplifier or other unit, are each 500 ohms.<sup>1</sup>

### The Problem

This does not say that the internal impedance is also 500 ohms. Quite often it is not. And this fact can lead to wrong operation of combinations of units. For example, if one unit designed to operate from an external source of 500 ohms, has an internal impedance of 5,000 ohms, and an output to which this input is connected, designed to operate into a 500-ohm load, but having an internal impedance of 50 ohms, we may actually have a 50-ohm source working into a 5,000-ohm load (Fig. 1).

This variation from 'ideal' can cause a serious invalidation of gain calculations, which may be the least of our worries. What may prove more important is invalidation of specified frequency response and increase in distortion. We'll not go into that further for the moment, but accept it as fact and also note that a desirable remedy would be to make all such units match, in the classical sense.

This means that a 500-ohm input, as well as being intended to operate from a 500-ohm source, will present an input load of 500 ohms. And that a 500-ohm output, as well as being intended to operate into a 500-ohm load, presents a source impedance of 500 ohms at the output.

Before proceeding, let me stress this. Many who went to school and learned

<sup>1</sup>Strictly speaking, most professional equipment in the U.S.A. is based on line impedances of 600 ohms, but this does not invalidate the theory presented by the author. ED.

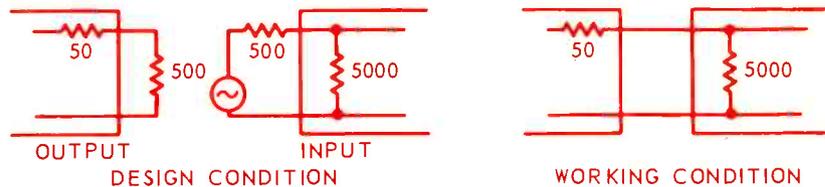


Fig. 1—Comparison between idealized and working conditions in coupling between two audio units using nominal 500-ohm line impedance input and output.

from classical matching theory, fondly imagine that connecting a nominal 500 ohms to a nominal 500 ohms automatically achieves this classical concept. It doesn't always, for the reason just stated. If you don't believe me, please start at the beginning of this article again, and read down to here, before you proceed.

### Input Circuit

Now for the input end. This is usually the easiest to make right. In amplifiers using tubes, the grid is almost open circuit. An internal load can be achieved, at some loss, by use of resistance that reflects the appropriate value to the external circuit. For example, a 10:1 input step-up may be used, when loading its secondary with 50K will reflect 500 ohms on its primary (Fig. 2).

An actual choice may be to split the loading between primary and secondary. For example, 1K primary shunt with 100K across the secondary, which would produce an effective parallel value of 500 ohms. This choice would be determined by transformer parameters and response optimization, which we needn't consider further here.

That arrangement doesn't involve feedback. The transistor equivalent does involve a simple concept of feedback, if the input stage operates in the common emitter mode (Fig. 3). The base input resistance, with no emitter resistor, is quite low, and non-linear. With an emitter resistor, it is substantially the emitter resistor value, multiplied by the working current gain of the transistor.

The working current gain is subject to change, with temperature, changing transistors, and so on. So we may use

feedback to stabilize this. Obtaining bias for the first stage with a resistor from collector to base provides such gain-stabilizing feedback (Fig. 4).

In this circuit, the current gain depends on the relationship between the a.c. collector load and the feedback resistor value. Part of the a.c. collector load is the input impedance to the next stage, which will usually be much lower than the collector-circuit impedance of this stage. So the current gain can depend on this base input impedance, which may also be subject to variation and non-linearity.

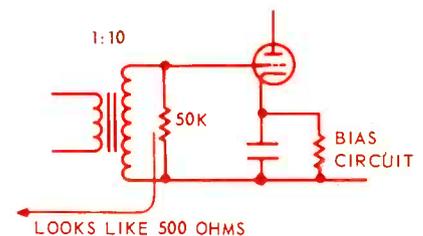


Fig. 2—Matching with transformer in old-fashioned tube input circuit.

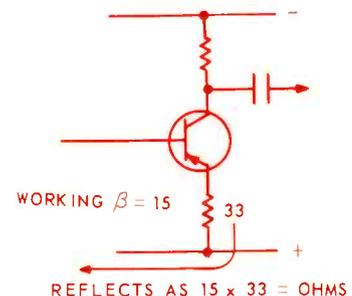
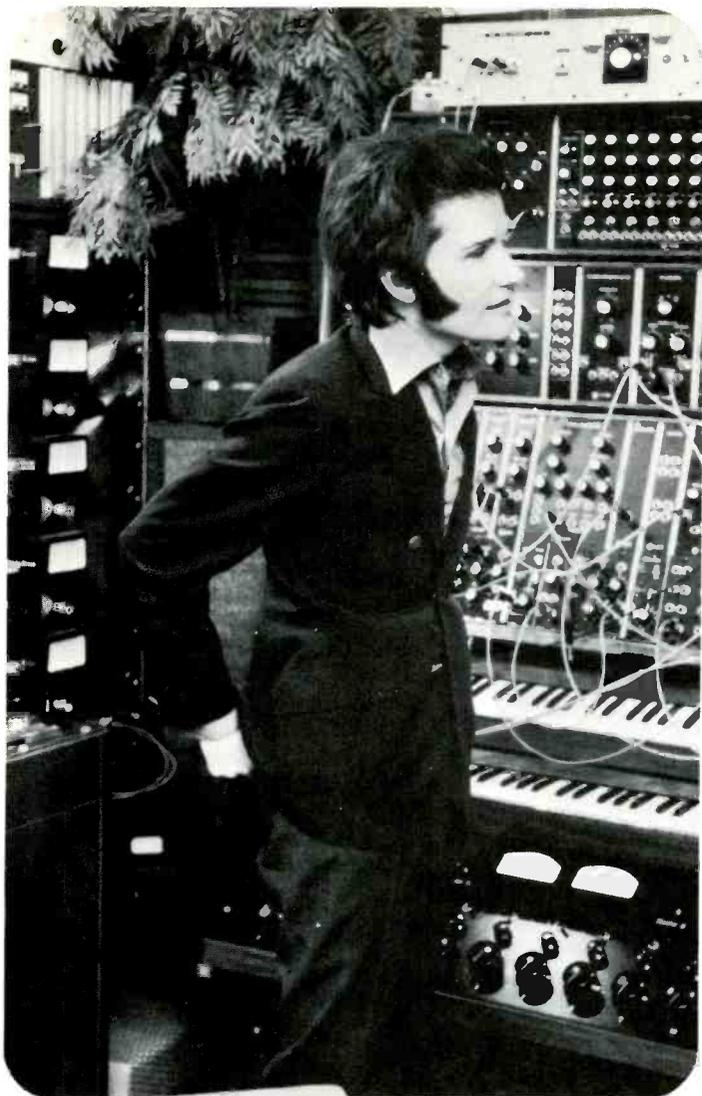


Fig. 3—How the emitter resistor can provide matched input impedance.



**Walter Carlos,  
creator of  
"Switched-On Bach"  
and "The Well-Tempered  
Synthesizer,"  
uses the Dolby System.**

Mr. Carlos says, "The raw materials of electronic music — the outputs of my Synthesizer, for example — are sounds which can be varied from striking purity to extreme complexity. After a desired sound is created, often with considerable effort, it must be preserved with care, to be combined later with others in a meticulous layer by layer process. The noises of magnetic recording are significant hazards in this regard, since they are particularly noticeable in electronic music. However, my experience confirms that the Dolby System effectively attenuates the noise build-up in electronic music synthesis. My studio at TEMPI is equipped with ten Dolby units, which I consider to be indispensable in my work."

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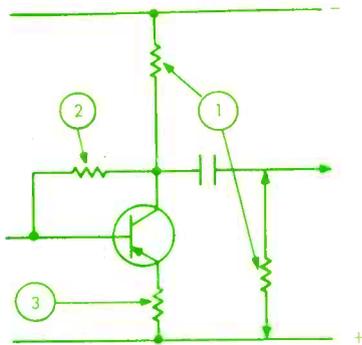
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Fig. 4—Showing the effects of principal resistors in an amplifying stage.

This may be remedied in two ways: either interpose a resistance large enough to swamp such variations, without materially affecting overall gain; or use an emitter resistor in the next stage that stabilizes its input impedance. But that involves other interactions that may reach clear to the output circuit.

Let's put some figures in. Assume we use a transistor with an average current gain (beta) of 100, that may vary between 70 and 140. Assume an appropriate collector resistor is 1K. If we stabilize current gain down to 25, we shall swamp variations due to the transistor. This means the feedback resistor from collector to base should be 24 times the a.c. collector load of this transistor.

The input impedance of the following stage may be, say 200 to 500 ohms. If we use another 1K as series coupling we shall about halve the current gain passed on to the next stage, but a value this large is needed to swamp input impedance variations. Let's make the collector resistor 3.3K, so most of the current gain is passed to the following stage (Fig. 5).

Now the a.c. impedance in the first-stage collector is 3.3K in parallel with 1K plus the next-stage input impedance,

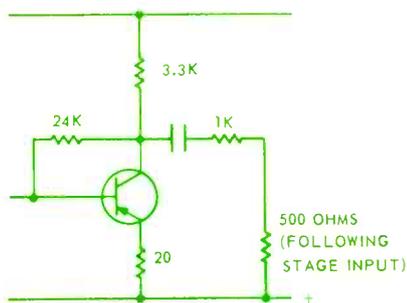


Fig. 5—Stabilizing current gain of a transistor stage.

say 500 ohms, making about 1K for the parallel load value for the first-stage collector. The feedback resistor should be 24 times this, or say 24K.

Now we want to make the input impedance 500 ohms. So the emitter resistor should be 1/25th of this, or 20 ohms. This circuit will now provide a nice stable, reasonably linear input impedance of 500 ohms, for classical matching.

### Output Circuit

The output isn't so easy to fix. For one thing, to keep distortion low, we need a fairly large amount of feedback, taken from the output to a suitable injection point nearer the input. It shouldn't be injected right at the input, in any part of the stage just discussed, because that would also invalidate the simple achievement we have just discussed. And we've linearized the input stage pretty well by what we have just done.

But we must think of a suitable output stage, with provision for lashings of linearizing feedback. We have a choice: voltage or current feedback, or a combination of both.

Assume that we select an operating condition that gives good linearity as a

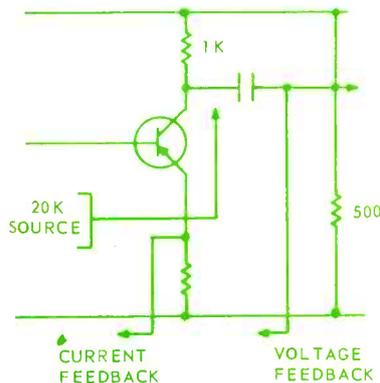


Fig. 6—Showing voltage and current feedback.

starting point from which to allow feedback to improve, when loaded by the nominal 500 ohms. Possibly a 1K collector resistor, with the collector resistance (internal to the transistor) of the order of 20K (Fig. 6).

With 500 ohms as external load, the parallel impedance from which voltage feedback will be taken is 330 ohms. Say we use 26 dB feedback—a gain-change factor of 20: this will reduce effective output impedance from 330 to 16.5 ohms.

But the actual external output load remains 500 ohms. So the effective internal impedance, with this much voltage feedback, must be just over 17 ohms, to make the parallel combination with 500 come to 16.5 ohms.

Let's try the alternative: current feedback. The logical place to derive this would be off an emitter resistor. Now we must regard the output differently. Short-circuiting the output removes voltage feedback; but open-circuiting the output does not completely remove the current feedback.

Removing the 500-ohm external load changes the collector load from 330 ohms to 1K. The transistor's internal collector resistance is about 20K, so the current gain would change only in the ratio 20.33:21, a very small percentage. The major effect of removing the 500-ohm external load, with 26 dB of current feedback, would be to multiply output signal voltage by almost exactly 3, while the signal current *delivered by the output transistor* hardly changes.

With this current feedback, the effective source resistance is still substantially 1K—the output-collector resistor. The effective internal collector resistance may rise 20 times, but the 1K resistor is still there.

To sum up then, 26 dB voltage feedback reduces internal impedance to about 17 ohms, while 26 dB current feedback makes little difference to the internal impedance 'seen' by the external impedance. How can we use 26 dB of feedback to achieve the classical matching value of 500 ohms?

The fairly obvious answer is to use voltage feedback to bring the internal impedance down to 500 ohms, and then use current feedback for the rest. How much voltage feedback do we need? The parallel collector load, without feedback, is 1K paralleled with 500 ohms (external assumed). With feedback, it should 'look like' 500 paralleled with 500, or 250 ohms. So the needed gain change, due to voltage feedback, and with the load connected, is 33/25, or 4/3 (about 2.5 dB).

(Continued on page 69)

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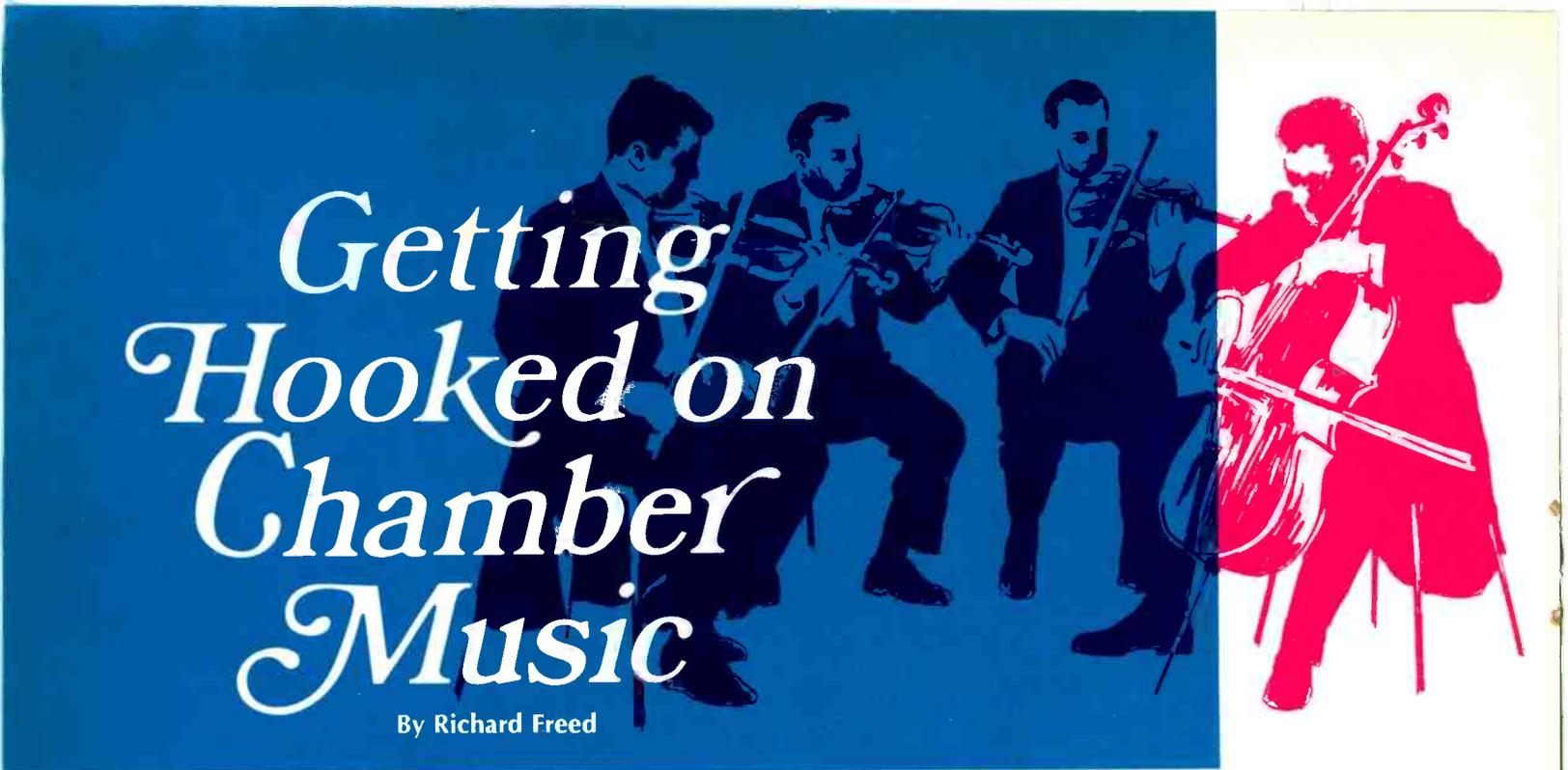
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# Getting Hooked on Chamber Music

By Richard Freed

During the last twenty-five years or so there has been an enormous upsurge in chamber-music activity in the United States. The number of performing organizations has increased, and so has their audience, both "live" and via recordings. In the realm of the string quartet, as in that of the symphony orchestra, we find young American ensembles dominating the scene now, setting the standards by which others are measured. The artistry of the Juilliard Quartet, the Fine Arts Quartet, and the Guarneri Quartet is readily available to the record collector (and the La Salle Quartet, long admired by connoisseurs, has at last begun to make records). No less readily available, of course, are recordings by such outstanding European groups as the Quartetto Italiano, the Vlach, Borodin, Smetana, Drolc, Amadeus, and Allegri quartets, the Melos Ensemble of London, and the Vienna Octet. The unforgettable Budapest String Quartet, too, remade much of its repertory in stereo before its remarkable forty-six-year career came to an end three years ago. The staples of the string quartet repertory are represented now by almost as many recordings as those of the popular symphonies and concertos, and "integral" recordings of the quartets of Beethoven, Brahms, and Schumann are undertaken by today's active foursomes, just as our prominent conductors give us "integral" recordings of the symphonies of these same composers.

Despite all this activity and all these recordings, there are still many thousands of people who love the Beethoven symphonies but who are "afraid" of the Beethoven quartets, who love Mozart's operas and concertos but who would not

voluntarily seek out a performance of the G-minor Quintet. Astonishing as it may seem now, with so much music so accessible to so many listeners, many, many people who do respond to music are denying themselves what many others consider the essence of the musical experience because they fear they cannot "understand" or "appreciate" chamber music without special training or preparation. Listener X, who attends a performance of the *Eroica* or *Tristan und Isolde* with confidence and satisfaction, is afraid the Mozart Clarinet Quintet may be beyond him!

Richard Freed is Director of Public Relations at the Eastman School of Music and Consultant to the New York State Council of the Arts, New York Philharmonic, and many other organizations. He is a regular contributor to *Saturday Review*, *Chicago Tribune*, *House Beautiful*, and many other journals. His own program is broadcast from WEFM in Chicago every week.

Oswald Spengler, who spent the last years of his life listening to the late quartets of Beethoven, cited certain of those works to illustrate the course of civilization in that most profound of philosophical works, *The Decline of the West*. Beethoven's A-minor Quartet (Op. 132) is the device used by a character in Aldous Huxley's novel *Point Counter Point* to prove the existence of God. To be sure, some great philosophical depths, too vast for words, are probed in such works—just as they are in the *Eroica* and the Ninth Symphony. And, to be equally

sure, there is gaiety as well as profundity to be found in chamber music, and dozens, perhaps hundreds, of shadings between those extremes. There is no more ingratiating music in any form, none more amiable in its demands on the listener, than the same Beethoven's utterly charming and utterly weightless Serenade for flute, violin, and viola (Op. 25).

Some of the great works of chamber music may have been written in a consciously "philosophical" vein (just as some of the great symphonies, operas and ballet scores have been), but some were actually written to be used as dinner music. Schubert wrote many of his most beautiful works with no more involved object in mind than having something to perform at one of the "Schubertiads" held in his home, the informal gatherings at which he and his friends played new music at sight. One of Mozart's finest chamber works, the Clarinet Trio (K. 498), has been referred to as the *Kegelstatt* Trio since the time it was first heard, because Mozart is said to have written it during an evening at a bowling alley. His numerous serenades and *divertimenti* are, for the most part, entertainment music pure and simple.

Many of those who are so certain they "would not" or "could not" enjoy chamber music have actually been listening to it and enjoying it for years. Mozart's popular Serenade *Eine kleine Nachtmusik*, which most orchestras play frequently to show off their strings, was originally composed for string quartet and double bass. Some of Mozart's *divertimenti* for string quartet and two horns are also played by the entire orchestral

string section now and then. Samuel Barber's *Adagio for Strings* happens to be the slow movement of his String Quartet No. 1, arranged for a larger body of strings at the request of Arturo Toscanini, who himself made similar arrangements of movements of some Beethoven quartets and recorded the Beethoven Septet with full orchestral strings. Tchaikovsky's *Andante cantabile*, the Borodin *Notturmo*, and the famous Minuet of Boccherini are still more examples of chamber music taken into the repertory of the string orchestra. None of these works is in any way less attractive in its original form. On the contrary, the original in every case has a spontaneity, a flexibility and an intimacy just not quite possible in the expanded versions, no matter how polished the playing. The emotional range and intensity of symphonic music, however, are available in chamber music; if the larger-scaled heroic gestures and grand coloristic effects are not, the compensation is that *intimacy* found only in chamber music.



While the string quartet may be the basic unit, the chamber music experience is by no means limited to the quartet, or even to strings. Some of the supreme masterworks feature the flute, oboe, clarinet, piano, or other instruments with strings. There are fascinating works for winds alone by composers from Mozart and Haydn to Hindemith and Alec Wilder, others for brass quintet, and even chamber music for percussion. A little more than fifty years ago the tradition of the harp quintet was born in France, and since that time many French composers have written for the combination of flute, harp, violin, viola, and cello; Debussy dispensed with the violin and cello in his Sonata No. 2, and Ravel added a clarinet and second violin for his uniquely beautiful *Introduction and Allegro*. Louis Spohr in his Nonet wrote for an orchestra in miniature (most of the instruments, but only one of each), as Stravinsky did later in *L'Histoire du Soldat* (for septet including percussion), while Heitor Villa-Lobos exploited the manifold coloristic capabilities of a single instrument in his *Bachianas Brasileiras* Nos. 1 and 5 for an ensemble of eight cellos (the latter with the celebrated part for solo soprano as well).

Musicians themselves, almost without exception, feel chamber music is basic, elemental. Both virtuoso soloists and orchestral players play chamber music for relaxation, and many of them include

it in their professional activity as well. Many great orchestras sponsor chamber music ensembles drawn from their ranks, among them the Vienna Philharmonic, the Berlin Philharmonic, the Boston Symphony, the Philadelphia Orchestra, and the Chicago Symphony. Heifetz, Rubinstein, Piatigorsky, Menuhin, both Serkins, and both Oistrakhs are among the virtuosos who perform and record chamber music regularly. The great violinist Arthur Grumiaux has formed a superb string trio with the violist Georges Janzer and the cellist Eva Czako. A half-century ago Pablo Casals, Alfred Cortot, and Jacques Thibaud performed and recorded together; today Casals plays chamber music with younger colleagues, and Isaac Stern, Leonard Rose, and Eugene Istomin spend a substantial part of every season playing as a trio, touring together and making records.

These performers find a unique *involvement* in chamber music, and the listener can hardly fail to find it, too. Whatever one may seek in music—uplift, stimulus, solace, humor—the supreme characteristic of the chamber music experience is the intensity of involvement which makes even the listener a participant in something shared instead of just a spectator.

Audio buffs in general have tended to give less attention to chamber music than to orchestral and other large-scale material because many of them feel it cannot offer the same opportunities for testing or showing off a system. While a string quartet will not produce the power-handling challenge that comes from a full Straussian orchestra, or the tonal range encountered in *The Planets* or *The Pines of Rome*, the clean and lifelike aural image of four distinct stringed instruments can be an impres-



sive demonstration or meaningful test for a well-designed speaker system.

More to the point, though, is the observation that a good deal of chamber music was intended for performance in what might be spoken of as a large living room or salon—in other words, a music room in a house instead of a big auditorium. Thus a good chamber music recording offers a top-flight system the possibility of creating the illusion of “live” sound, for a string quintet or piano trio really could be playing in one's living room; an orchestra could not possibly.

We have purposely avoided any reference to the historical development of the string quartet, changing styles over

the years, and other matters which might smack of things musicological. The only point we feel worth making is that chamber music is an *enjoyable* experience. To this end, we have drawn up a list of fifteen recordings we feel might help those who have yet to discover the pleasures of chamber music. This is not intended to represent a “basic repertory,” nor are the works listed here necessarily the “greatest” or the most important, though some of them fit those descriptions. This is simply a compilation—an admittedly personal selection—of works whose appeal is so direct and intense as to make them immediately habit-forming.

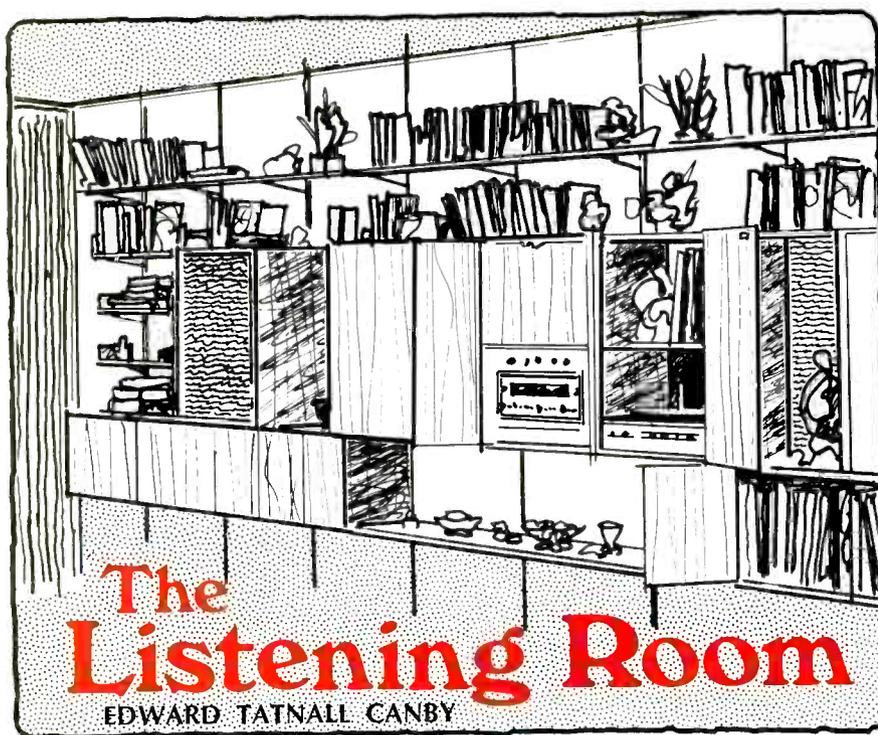
Some of this material is profound, some of it simply charming, and some of it (e.g., the greatest of all string trios, which Mozart chose to call a Divertimento, K. 563) manages to be both. The list, as may be seen at a glance, is not alphabetical and is not chronological; it is laid out in the sequence in which record purchase (or, at least, exposure) is recommended. To avoid confusion, only a single recording of each item is shown in the list, but alternative versions of some of the works are discussed in the brief comments on the music in the remainder of this article.



Some readers may be surprised to find the first two items in our list included in such a collection at all, let alone leading it off, but the Bach and Stravinsky works only underscore the flexibility and scope of the category of music we are dealing with. The *Brandenburg* Concertos may be regarded in some quarters as orchestral music, for they are performed and recorded by symphony orchestras, but, properly speaking, the *Brandenburgs* are chamber music, to be played by a small ensemble, generally only one or two strings to a part. Moreover, “authentic” performance calls for a number of baroque instruments—*violino piccolo* and *corno da caccia* in No. 1, high trumpet in No. 2, recorder in Nos. 2 and 4, *viola da gamba* and *violone* in No. 6. A symphony orchestra may include a harpsichord in its Bach performances (as continuo, but rarely as solo instrument), but not the old wind and string instruments, and just as well, for their distinctive sounds would be largely lost under the weight of the large modern aggregation.

As works combining many of the most attractive features of both orchestral and chamber music, the *Brandenburgs* constitute an ideal “first step” into the latter

(Continued on page 28)



## The Listening Room

EDWARD TATNALL CANBY

For twenty years and more we have been trumpeting about hi fi equipment in all its ever-improving diversity, and yet we've had scarcely a thing for sale that might directly help the acoustic matching element which is most important of all for hi-fi (except, of course, your ears)—the listening room. Now, to my pleasure, the hi fi makers have discovered the front parlor, and are doing something about it. Many things, all of them, needless to say, costing money; but the intent is to give you satisfaction in return. I think we are on a right track.

We've made a certain amount of fuss over the placement of stereo speakers and, before them, the lone mono speaker that previously had the job of providing an orchestral spread of sound from a single point in the room. We've talked living room decor, and cabinetry and convenience and connections. But the implication has been, right along, that if you buy good equipment, you buy good sound—and don't worry about the room; it'll have to take care of itself.

Now I've never subscribed to this particular subscription, not even in my hi-fi youth when I was collecting 78 12-inchers to play through a huge Midwest 16-tube radio via one of the earliest phono attachments. Even then, I learned to aim my big fat console for maximum distribution and reflection—I hated to have a speaker playing straight at my knees. And when separate speakers came along, I began all sorts of experiments with room sound, having decided by that time that if one could tell where

the sound was coming from there was something definitely wrong. I was literal about "filling my living room with glorious sound," if not about that putative best seat in the concert hall.

My preference was to aim an unobtrusive speaker diagonally towards a corner, from one side, with enough hard reflecting surfaces in the way—the curve of a grand piano, backs of wooden chairs—to blur and spread the apparent sound source so that the music seemed to come from a wide area quite removed from the speaker itself. This stunning illusion of space was my special pride and I would have it again, if there weren't stereo to change things. It gave as much realism to mono sound (which has no literal width whatsoever) as could ever be achieved in that medium. And it took maximum advantage of the living room itself.

Stereo, I might add in parenthesis, creates its own spread of space by the interaction of its two spaced-out signals, as they reach the ear from different directions. The more reflection, the less stereo you get—but our recordings are designed for an average amount of general room diffuseness in reproduction. A good stereo system, like my mono arrangement, completely disguises the speakers' locations for the ear. The sound is heard from virtual-image sources all the way across from speaker to speaker and (so theory says) well beyond on either side, and all this *without* the aid of reflection, which now merely smooths down and blunts the sharp directionality. So, ideally, our rooms are much more

adaptable to stereo, just so they don't overdo the reflection business. Too much reflection and you revert to mono. No directionality left.

For this reason I view with some jaundice one of the popular answers now being provided for stereo room trouble—reflecting speakers, aiming up or back or all over, to diffuse the sound source. My best judgment is that this a fine panacea, substituting a very attractive near-mono effect for a poor stereo one. A net gain, in many a bad room situation! But not the ideal solution, to my way of thinking. If you're going to hear stereo you've got to have point sources, reasonably direct and unimpeded. Two of them. Real or imaginary.

Real speakers, of course. But also, to an extent, the strange "virtual images" created by Jensen's new one-box speaker system, discussed in detail in *AUDIO* for November, 1969 (p. 62), which I have been trying too. Especially in a confined space, the Jensen "Stereo 1" (one of the year's clumsiest titles) is an interesting answer to room problems. Definitely, from its single cabinet with the matrixed speakers comes a stereo spread and a stereo sound—but, oddly, I could not really tell left from right. It did not seem to matter, for the important thing in stereo is, speaking subjectively, the heightened *immediacy* of apparent hall sound, at least for classical music, my main fare. The Jensen system projects it remarkably, and should do well in boats, camper busses, hotel rooms, where the virtual images will seem to emanate straight from the other side of the nearby walls.

One element in the listening room, though, has until now been carefully left alone, for lack of much that the manufacturers could do about it, that frequency balance of the total room, with associated resonances, standing waves and what-not, which converts the flattest of loudspeaker emissions into a jagged and peak-filled "curve" in every living room. We live all the time with these gross distortions of the original, and the living isn't half bad. But it would be good if we had at least the power to do something about it. Only the pallid tone controls, raising or dipping a wide butterfly wing of highs and lows, have been provided in the attempt to match our systems to our rooms. Suddenly, a whole array of gadgets is now available designed precisely to cope in detail with this very problem. I note three, including the one I have been trying myself, the Advent Frequency Balance Control, designed to plug into your system before

the amplifier and warp its sound selectively to mirror the room characteristics in reverse.

Now it happens that in 1964 CBS Labs put out its "Seven Steps" test record (for which I wrote the rambling commentary), a gallant attempt to provide specific tests for room sound as your ears actually hear it via ingenious subjective comparisons, octave by octave in frequency over the entire sonic range and point by point (to pick up stray buzzing resonances) via glide tone. This pink-noise test, along with some simpler equipment adjustments, indicated the desirable corrections remarkably well—but there was nothing we could do to put them into effect. The over-all tone controls were virtually useless.

And so I have just mated together the 1964 test disc and Advent's astonishingly similar octave-by-octave contouring gadget, a beautiful little machine with two rows of ten vertical sliders each (for stereo), moving above and below a "flat" center-line position, each slider controlling a sharply defined octave of boost or cut, from 40 Hz to 20 kHz. It works! Even though the successive CBS test tones, comparing a pink-noise burst with a loudness reference frequency (also pink noise) are more closely spaced

than Advent's sliders, two or three to each octave. So much the better. It was astonishing how accurately the Advent picked up the CBS third-of-an-octave bands of pitched noise (covering approximately a musical third in pitch width) and boosted or attenuated them, via the slider, to match the standard reference tone in loudness. On a single playing of the record I was able to come out with a visible room "curve" which, just incidentally, rather neatly matched a known deficiency in my speaker system, a dip in mid-range. I can see that on more careful repeated trials I could narrow down some of the room resonances which show up vividly on the glide tone (which sounds like a piston plane going through a thunderstorm)—and adjust narrow single segments of the frequency range to reduce their impact on my ears. Never before has this been possible outside of a fairly fancy audio lab. Who listens to music there?

The Advent Balance Control is an intriguing toy, too, and you will have as much trouble as I did getting down to systematic work with it. Fascinating to hear the selective vowel-like whines, as one or another segment of the spectrum is suddenly boosted 'way up. Interesting to discover how much harder it is to hear "holes" of the very same magni-

tude. Is *that* significant for listening! The peaks are what show. Wonderful to find that a sharp boost as high as 160-320 Hz still gives the impression of a *bass* boost, however added; whereas 320-640 (next slider) is for the ear clearly treble. That tells something about small speakers and hyped-up low ends. Nice to realize that the middle ranges, from 500 up to 5000, are so thoroughly in control of apparent volume level. Boost any segment in that range and the over-all volume pops up. Not so nice to find that the extreme right slider, 10,240 to 20,480, has no audible effect at all on my ears. That's for kids.

I hate to think how we're going to raise the cash to pay for such beautifully built gadgetry as this. But I also hate to think of giving up my newfound corrections. Granted that our biggest listening advantage is that we get used to our own sound situation and quickly learn to treat it as normal or "flat," just as we adjust to colored light after a while and see it as white. Even so, in the quest for perfection it is always better to start right and adapt later. So I am all in favor of this development, for those who can afford it. Perhaps a slightly—very slightly—simplified version may some day appear in our best amplifier-control systems for the home?



## Quadraphonic News

⊗ Contrary to popular belief 'stereo' does not mean two-channel, it comes from the Greek stereos-or 'solid'. So stereo sound is really solid sound. Eventually, I suppose, four-channel stereo will just be called 'stereo' but in the meantime we will refer to it as four-channel or use the term Quadraphonics—which is more correct than quadrasonics when you come to think about it.

⊗ The **Scheiber** system for recording four channels on disk will have been demonstrated by the time these notes appear in print. Peter Scheiber, who was formerly with the Dallas Symphony orchestra, describes his system as an "analog multiplex" arrangement and some details will be found in our January issue. The great advantage of this system is its compatibility, and disc can be played monophonically or via two channels. Furthermore, no new equipment is required at the broadcast station and encoded records are broadcast normally.

⊗ **Wollensak** have commenced a country-wide demonstration program using their "Quad/Stereo" decks. Model 6154 has built-in preamplifiers and costs \$499.95 and Model 6364 includes the power am-

plifiers for \$559.95. Matching speakers are available if required.

⊗ **Lear-Jet**: according to James Gall, Vice-President of that company, their eight-track equipment is being modified to play four-channel and two-track cartridges. He also said "Four-channel sound is little short of fantastic and will surely turn on the youngsters, but the big problem is lack of recording standards."

⊗ **Vanguard** have now issued 11 more 4-channel tapes, these include Mahler Symphonies No. 3 and No. 9, the Berlioz Requiem (all by the Utah Symphony orchestra) Handel's Jephtha, (English Chamber orchestra), and The Amazing Electronic Sound of Jean Jacques Perrey. These reels are priced at \$14.95 (7½ ips)

⊗ **Stuart Hegemann** of **Hegemann Laboratories** had a few words to say about quadraphonics "... it is good only when it wins popular support from the public and that means when it sounds good to their ears. My first impression of 4-channel sound was good but I can't say what whether it will become a monster or a beauty."

⊗ **Philips** were more cautious and a spokesman said "they were not yet con-

vinced 4-channel sound was an improvement and he urged the industry to do everything possible to promote compatibility and went on to say "until we have explored the feasibility of a uniform and compatible system for cassettes we are firmly opposed to a casual adoption of other sound methods."

### In Brief

⊗ **Russ Molloy** of **Telex** (among the first to introduce a 4-channel tape deck) had this to say "4-channel sound is the most exciting development of the decade, it is an experience where the listener is totally engulfed with sound." **Avery Fisher** was reported as saying "I do not envision 4-channel sound as a mass market but it could become popular with Hi-Fi addicts." From **Broadcast Management Engineering** on the AR permanent New York demonstrations "... the total effect is gorgeous and made converts out of skeptical BM/E editors. And from Japan comes news that the **Victor Company** will have tapes and complete compact systems available within a few weeks. It was noted that one of the systems uses three front speakers and one at the rear.



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## ■ ■ ■ Chamber Music

(Continued from page 23)

realm, and the late Karl Ristenpart's stylish, energetic handling of these scores is *sui generis*. His tempi are invigoratingly brisk, but never headlong; rhythms are vibrant but rockfirm. This is *joyous* music-making, on the part of the conductor and every one of his brilliant associates. Even those who think they know the *Brandenburgs* are likely to sit up wide-eyed almost as soon as the First Concerto begins, for Ristenpart decided those triplets for the horns were really meant to be heard and Martin Oheim and Oskar Wunder, who play the *corni da caccia* in this performance, decorate the aural landscape with exuberant fanfares that sound for all the world like glorious ad libs between the familiar solo phrases. No other conductor has brought this out as Ristenpart did, and there is similar excitement all through the set, all within the framework of unquestionable musical integrity.

(For those to whom these concertos may not be familiar, the variety within the six works may be suggested by a rundown of the instrumentation. The First Concerto, in F major, is for *violino piccolo*, two *corni da caccia*, strings, and continuo. No. 2, also in F, is for violin, oboe, alto recorder, high trumpet, strings, and continuo. No. 3, in G, is played by nine strings and harpsichord. No. 4, in the same key, and No. 5, in D, are concertos in the modern sense, the former featuring the violin and two recorders as soloists, the latter for solo flute, violin, and harpsichord, with strings and continuo. The final concerto, in B-flat, is a dark-hued work for string sextet and harpsichord, in which the strings are two violas, two *viola da gamba*, cello, and *violone*.)

In its original form, Stravinsky's *L'Histoire du Soldat* ("The Soldier's Tale") is a setting of a fantastic Russian story about a soldier, a violin, and the devil, for seven instrumentalists, dancers, and reciters, with a French text by the Swiss poet C. F. Ramuz. Stravinsky prepared a concert suite of the nine musical sections, preserving the original instrumentation of violin, clarinet, bassoon, trumpet, trombone, double bass, and percussion. The music is filled with vitality and is amazingly varied in character, with moments of exquisite delicacy and of the most grotesque irony. A strutting march, a gentle pastoral, a tango, a waltz, and a "Ragtime" dance occur in the sequence, whose final number ("Triumphal March of the Devil") ends with an extended drum solo.

The composer's own recording of this

suite, the second item in our list, is on a record which includes another Stravinsky chamber music masterpiece, the Octet for Wind Instruments, and, for good measure, the *Movements for Piano and Orchestra* (with Charles Rosen) and two very short chamber works, the Double Canon for string quartet and *Epitaphium* for flute, clarinet, and harp. The same Stravinsky-conducted recording of *L'Histoire* is also available on another Columbia record, paired with the orchestral suite from his Pergolesi-derived ballet *Pulcinella* (MS-7093). *L'Histoire* has also been recorded in its complete form, with spoken parts, most notably on Philips PHS 900-046, with Igor Markevitch conducting the septet and with Jean Cocteau and Peter Ustinov heading the dramatic team. Leopold Stokowski has done the complete version for Vanguard, and his performance, with Madeleine Milhaud, Jean-Pierre Aumont, and Martial Singher, is offered in both French (VSD-71165) and English (VSD-71166); the Markevitch is only in French, but comes with full bilingual text.

Schubert's "Trout" Quintet is probably the most beloved work in all chamber music, for reasons plain enough to every ear. It is good-natured in the extreme, extravagantly blessed with good tunes, and rich in harmonic and rhythmic inventiveness. The performing ensemble is piano and strings—not the usual string quartet, but a single violin, viola, and cello, plus double bass, a combination giving the work an endearing "both-feet-on-the-ground" tonal framework to complement its abundant good humor. The sobriquet "Trout" comes from Schubert's use of his famous song *Die Forelle* as the basis of a set of variations in the fourth of the work's five movements (it turns up again in the high-spirited finale).

There has never been an unsatisfactory recording of the "Trout" Quintet, and every one available now can be guaranteed to please. Naturally, some are bound to please more than others, and none other quite so much as the magical version from Marlboro led by Rudolf Serkin, a performance of such exhilarating spontaneity that there is no question of "interpretation," only of supremely apposite *feeling*. Fine sound, too. If the word must be used once in this discussion, let it be this record that is designated *irresistible*.

The Beethoven quartet in our list is the first of the three so-called "Rasumovsky" quartets. It has no introduction,

but begins straightaway with a theme of unpretentious nobility, stated by the noblest of instruments, the cello. The theme itself is strikingly similar in shape to that of the first movement of the "Archduke" Trio to come, but with an even greater tension and thrust. It pursues its lofty course with majestic self-confidence, straightforward and virile. The second movement is a magnificent scherzo, a rustic dance with a sweeping, soaring second theme. The slow movement, deeply felt and reflective, leads without a break into the finale, a warm-hearted treatment of a Russian folk-song.

(Andreas Kyrilovich Rasumovsky, who commissioned the three quartets that brought him immortality, was the Russian ambassador in Vienna during Beethoven's first twenty-five years there and, as an accomplished amateur violinist, an active chamber music player. Each of the three "Rasumovsky" Quartets includes a citation of a Russian folk-song; the one in the Scherzo of the E-minor is the melody Mussorgsky used in the Coronation Scene of *Boris Godunov*.)

Beethoven was to write still greater quartets later in his life, but none in which his sheer joy in his own creative powers and the breadth of his compassionate spirit are projected more effectively. Of current recorded performances, the one by the Fine Arts Quartet on Concert-Disc conveys these qualities most successfully. It is available on the single disk indicated, or as part of a very economical three-record set of all five "middle-period" quartets (Op. 59, Nos. 1-2-3; Op. 74; Op. 95), SP-506/3. Almost as movingly performed, and more handsomely recorded, is the four-disk RCA set of the same five works played by the Guarneri Quartet (VCS-6415), also a good buy. (The nine-disk Everest set of *all* the Beethoven quartets by the FAQ is to be avoided because of inconvenient side layout and compressed sound; the Concert-Disc format is quite economical enough.)

Mozart's Quartet in B-flat major, K. 458, is known as the "Hunt" Quartet because of the "hunting-horn" figure with which it opens. In addition to that cheery motif, the first movement is characteristically prodigal in its offering of themes. The Minuet which follows has a particularly beguiling trio, and the slow movement, just tinged with melancholy but not really sad, is suffused in mellowness. All the most attractive qualities of the three preceding movements seem to be summed up in the robust finale.

(Continued on page 48)

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# Some Loudspeakers Past and Present

By BOB BERKOVITZ

Of many puzzling questions encountered by the music listener learning about sound reproduction, one must gnaw persistently. If the design of high-fidelity loudspeaker systems is aimed at the single clear objective of accuracy, as is the case for amplifiers, cartridges, and tuners, why should there be so many different kinds of speaker systems available? Surely, the listener thinks, engineers, men of science, those who speak the language of mathematics, will agree upon meter readings or the location of marks upon a paper chart. Then, one method of design, one kind of speaker system will show itself to be the best in such measurements. Yet speaker systems which sound very different from each other are offered for sale, each on the basis that it alone stands on the frontier of acoustic knowledge. Each is advertised and the listener is urged to move the frontier into his living room. And the listener, having attempted to do so, is not unlikely to discover that the frontier, in the meantime, has moved on.

Of course, scientists do not really disagree about the ultimate objective of speaker design—it is a device of such high impedance as to consume practically no energy, in order that it be most efficient; it is so small and thin as to verge on invisibility, making it ideal for installation in any room; it is intelligent, and therefore able to analyze any signal fed to it, deducing and radiating in the spatial pattern correct for each instrument in the ensemble, while cancelling out the acoustic properties of the room in which it is being played. Its frequency response is assuredly flat when heard from any direction, indoors or outside. And it can be stamped out of sheet plastic, like an electroacoustic cookie, or, to satisfy the most glassy-eyed dream of a certified accountant, sliced from lumps of trash now being discarded as waste by another member of the corporate conglomerate. If that is a correct summary of the device which will, by its appearance, signal the end of the road in speaker-system development, we certainly have a long way to go.

On the other hand, it is fair to believe that the appearance of a speaker system like that described above will not end the aspirations of those who make and sell competitive systems. They will think of a feature that is missing, a function that is still unfulfilled. Just as many designs have been hailed in the past as having achieved the ultimate in speaker-system design, each has been supplemented by another approach, offered by its maker to fill lacunae unobserved or unattended by his predecessor. The past editions of mail-order catalogs of electronic equipment are filled with such afterthoughts about someone else's afterthoughts.

Didn't they know that they were barking up the wrong tree, that their inventions, measured according to the most elementary acoustic criteria, could be shown to be *inaccurate*?



The answer, at least in part, is that accuracy has not always seemed equally important to all speaker system designers, and even many listeners have, at least for a while, been persuaded that satisfaction of their personal taste in sound is what they are shopping for at the audio salon. It is an interesting conception, offering the gratification that comes only with the knowledge that the listener is going to establish his status and discover his identity in one transaction. The idea is attractive, until it is set

in less appealing language: "What kind of distortion do you like best?" It is like asking a prospective camera buyer not to purchase the sharpest lens with the best correction, attested by data, but to buy instead an instrument that gives a little barrel distortion to the scene, for "presence," and a subtle red tint to color shots to give "warmth" to outdoor portraits and landscapes. Just as the optical designer producing such a camera would claim to have risen above conventional testing methods, some speaker system designers have claimed to have discovered higher truths. Such claims are often associated with little-understood but extraordinary discoveries about hearing or music. To know why such speaker systems fade from sight, while older amplifiers and tuners still go on, we will have to consider some actual cases.

## Musical Speakers?

There is an entire class of speaker systems, all but a few in the blessed past, which are based not upon science but upon metaphor.

A good example is the speaker system with f-holes, like those on a violin or cello. The literature describing this product, seen a number of years ago by one of the authors, showed an enclosure of a size large enough to make a bass-reflex design of good performance. However, instead of the classical rectangular port, or the somewhat more modernistic duct, this one had f-holes cut in the front panel, and carried an explanation which was both clear and thought-provoking. The finest instruments used to play music derived their great sound quality from the vibration of their enclosures and the perfection of design of such details as the f-holes of the string instruments. So, the system in question was made of wood which would vibrate just right. It was natural for a reader to joke, "But how does a tuba solo sound through it?" Actually, the system may have sounded rather good, despite the appeal to analogy by its advertiser; we have no way of knowing. But we do know that if the

(Continued on page 36)

\*Acoustic Research, Cambridge, Mass.

# It takes nerve to ask \$1,000 for an FM/FM stereo receiver. Unless you have the stuff to back it up.

This is our SA-4000 stereo receiver. It costs \$1,000. But don't look for it at your Panasonic dealer yet. Because the first 25 units in existence have been snapped up by audio laboratories. They're ripping it apart to see how we created it.

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Every component, from the tiniest transistor to our 36-inch woofer, is manufactured in one or another of our 80 factories. Tested, inspected, and quality controlled by 40,000 master technicians. That's why we're so absolutely certain of their compatibility. Their excellence. And their reliability.

Nobody makes audio equipment like Panasonic.

And this goes not only for our \$1,000 receiver. But our 4 other stereo receivers as well. The same imagination. The same rigid quality control. The same loving attention to detail is present in all our stereo receivers. They'll give you sound that'll knock your ear on its ear.

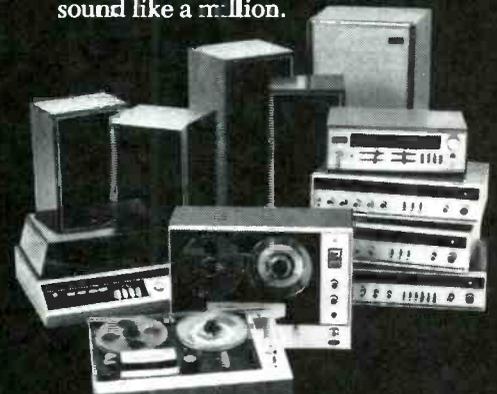
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**T**HERE are simple reasons for combining a KLH tape recorder with other KLH equipment in an all-KLH system, and there are complicated ones.

The simple reasons are things like being sure the input and output levels will match, that the plugs of this will go into the jacks of the other thing nicely, and that you will have all the controls you could possibly want without having two or three of anything.

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- *KLH equipment does what it promises.*
- *KLH equipment is designed to be operated with a minimum of on-the-job training.*
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- *KLH equipment is priced as low as we could price it and still make it do everything it ought to do, and still stay in business.*

## THE MODEL FORTY-ONE TAPE RECORDER

This stereo tape deck cuts the cost of tape in half by recording superbly at half the usual speed. Its tapes at  $3\frac{3}{4}$  ips are not only as good as other machines' at  $7\frac{1}{2}$  ips, but compare unblushingly with 15 ips recordings. Small and simple to operate, it still has it all—including the Dolby Audio Noise Reduction System that helps make wide-range recording feasible at  $3\frac{3}{4}$  ips.

The big thing about the Model Forty-One is that its combination of performance, convenience and economy will make you *use* it rather than worry about whether something is worth recording, or what tape thickness to use *this* time, or whether the tape will run out before the music. Quite a big thing.

*The suggested price: \$249.95.*

## THE MODEL TWENTY-SEVEN STEREO RECEIVER

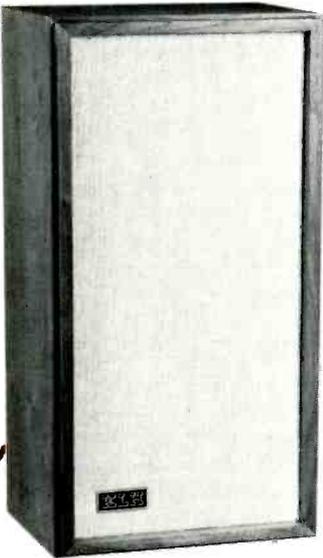
This AM-FM stereo receiver is our only receiver. That means we had to build it to compete with everybody else's biggest and best receiver; so we did, and it does. Somehow it didn't come out as big or as expensive as some of the others, but you'd never know it judging from its power, its flexibility, the way it brings in the most difficult FM stations, and the surprising things it does for AM broadcasts. It sounds wonderful. What else can we tell you?

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### THE MODEL SIX

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*Suggested prices: East Coast, \$134; West Coast, \$141.*

### THE MODEL FIVE

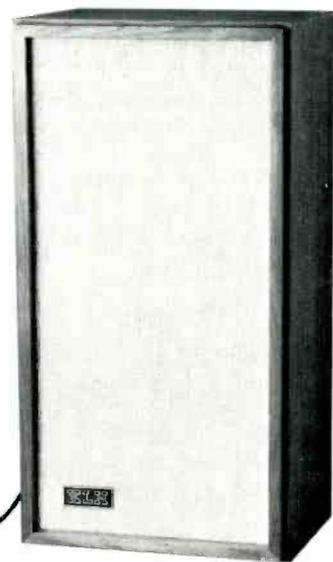
Though it is the size and price of other manufacturers' "middle of the line" speakers, the Model Five has every bit of the authority of their "best." By this we mean it has the ability to reproduce all the impact and every nuance of the very best recordings presently available. And, by the way, if you get to comparing it with someone else's "best" and can't hear any difference, and then get to comparing the price tags and decide it must be your ears, we won't accept that.

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### AN ALTERNATIVE

It occurs to us that, for the very same reasons we are suggesting you put together an all-KLH system, you might just prefer to have one that we have put together. There are several of these: compact, three-piece stereo music systems that have become the most imitated products in the audio industry, we are pleased to say. (Though why it should please us is a question; vanity most likely.)

We particularly recommend that you investigate the Model Twenty (*suggested price, \$399.95*) and the Model Twenty-Four (*suggested price, \$319.95*). They offer performance and sound quality that are unmatched in their price ranges, no matter who puts what together.



• A TRADEMARK OF KLH RESEARCH AND DEVELOPMENT CORP.

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(Continued from page 32)  
enclosure did vibrate like a violin, with its own set of resonant modes, these would be a result of the dimensions and materials used to make it, and would bear no necessary relation to the music being reproduced by the system. Not only tuba music, but violin music would have added to it the "music" of the speaker system.

### ... And Artistic Enclosures

An artist, a genuinely wise man and a highly gifted one, expressed to the author a fascinating conviction about the home-made speaker system owned by the artist. It sounded rather good, in fact, having been made by mounting a JBL 12-inch loudspeaker on a flat baffle, and placing the flat baffle across a corner of the room. The circular cut-out for the JBL speaker was covered with gray silk. The flat baffle itself, which rose from the floor to about 6 feet in height, was white. It was made of marble, as thick as a man's hand, cut by a maker of monuments. The artist smiled as he told visitors that the brilliance of "the highs", caused by the use of the white marble, surpassed all other speaker systems.

Lest readers laugh at such a judgment as naive, it must be pointed out that the possibility that the marble-facade speaker system is exceptionally accurate is in no way compromised by the owner's possible error as to the reason for its excellence. We are concerned with the disparity between subjective judgments and probable realities. On the other hand, just looking at a thick, polished white marble slab might make some listeners hear singing "highs."

Moreover, there is a precedent, of sorts. In a unit described in Wood's *Acoustics* as "the H.M.V. loudspeaker," the voice-coil was attached to a flat sheet of aluminum alloy about thirty inches in diameter, tightly stretched and bolted to metal rings at its edge.

### The 'Cats Door' System

Another area of unceasing activity has been that in which breakthroughs of various sorts are uncovered. The "perfect baffle," last seen by the author about fifteen years ago, was such a breakthrough. To all intents and purposes, it was an ordinary speaker system, at least from the front. Cone speaker. Grill cloth. Rectangular box. Then you turned it around and saw the little door, and your eyes popped. Every time the system hit a really loud bass note, the door opened for an instant on a thin leather hinge, and

closed again a moment later. It was sold under the name, "perfect baffle," and the little swinging door was said to relieve pressure built up in an ordinary enclosure which limited cone motion. Its manufacturer pointed out that the "perfect baffle" was based on an "ultimate scientific principle." Possibly this was to forestall any attempts at post-ultimate developments; if so, the ploy was ineffective.

The design of speaker systems is, or can be a rational process, and engineers do not really differ much on the best current techniques for the achievement of each design goal. Nor is there much disagreement regarding techniques of measurement. The differences of opinion among speaker-system designers probably center about the criteria used to establish which design goals are most important, and which are less relevant to the application for which the system is intended. To a certain extent, these differences are understandable.

A designer who has spent his life, or the better part of it, designing speaker systems to be used for sound reinforcement in large halls or theaters will have naturally come to place a higher degree of importance on efficiency. Since large regions in an assembly hall or theater are unoccupied by listeners, the theater system designer will tend to design directional systems, rather than flood all of space with sound where there are no listeners to hear it. The designer primarily concerned with and experienced in the engineering of systems for home music reproduction, on the other hand, must recognize that the location of the speaker systems by the home listener can be controlled only in a very general way, and that listening locations in the room will vary greatly in suitability, unless the speaker system is omnidirectional. Efficiency will be less of a problem to the designer for home use, since concert levels are easily matched in typical living rooms. Moreover, bandwidth, small size, and freedom from peaks in response will be preferred by most listeners; unfortunately, theater-type speakers must often sacrifice excellence in these respects in order to achieve maximum efficiency.

It is remarkable that such divergences do not lead to gross variations in speaker systems, since the different viewpoints alluded to above are often expressed by their proponents with great vigor. However, the important fact is that engineers, as has been said, do not disagree fundamentally, and few, if any, would say that rough frequency response is good, or that efficiency is a bad or worthless design

goal. As a result, loudspeakers that are well-engineered sound good, regardless of the design philosophy of the firm or person responsible for them. Engineers can meet and discuss the merits of their designs, be applauded or congratulated by their colleagues, and exchange ideas about speaker evaluation with little of the recrimination displayed by amateurs toward each other when arguing about their favorite loudspeakers.

When a speaker system is designed in a fit of passion, or in a state of technical or intellectual isolation, different factors emerge, however. The absence of proper test facilities can give supreme confidence to a designer who never needs to subject his brainchild to rigorous examination. As a result, concepts which have become almost stock jokes among engineers reappear periodically on the market as novel "breakthroughs."

### The "Sweet Sixteen Array"

The array of many small speakers is a good example. In a rather thorough paper published years ago in *AUDIO*, James Novak and Philip Williams of Jensen established rather conclusively that the benefits typically claimed by designers of "build-it-yourself" arrays, such as that called one "Sweet Sixteen," are non-existent, or so meager that they are easily surpassed by a conventional speaker system both in economy and performance. The gist of the analysis by the two Jensen engineers was that the "Sweet Sixteen"—which used sixteen inexpensive Jensen radio replacement speakers—sounded like sixteen inexpensive speakers. The directionality of such an array, the prominent peaks in response, and the cumbersome physical object which results, all worked against its acceptability as a music reproducer, yet a surprising number of home hobbyists sent away for the loudspeakers prescribed by the designer. The main idea appears to have been that if the excursion requirements of the loudspeaker are reduced to one-sixteenth of what they would normally be, very low frequencies can be reproduced without distortion. Although the statement has an element of truth (as is often the case with such designs), achieving the excursion needed for good bass response has not been a real problem for a long time. The design appears to have been intended to solve a problem which simply did not exist; Novak and Williams were able to show that much better bass response with less distortion was obtainable from a single bookshelf system! At a very well-attended meeting of audio technicians and engi-

(Continued on page 71)

**"... the Dynaco PAT-4 is unsurpassed  
... a remarkable unit and unmatched at  
anywhere near its low price ..."**

(Stereo Review January 1968)



DYNACO PAT-4  
\$89.95 kit  
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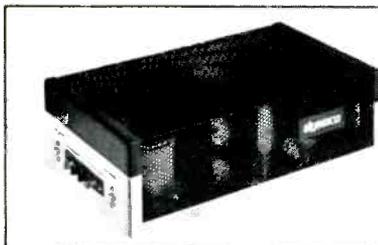
A separate preamplifier can offer superior performance and greater flexibility than available on any integrated control amplifier or receiver. How well did Dynaco succeed with its PAT-4? Here's what two of the most respected publications say.

**The Stereophile, Vol. 2, No. 9, 1968**

"With all of its tone controls and filters set to Flat, and feeding any high-level input, we were simply unable to tell whether we were listening to the original 'raw' signal or the output from the PAT-4. In this respect, we cannot see how any preamp, present or future, could surpass the PAT-4."

**Julian Hirsch in Stereo Review, January, 1968**

"... (the PAT-4 has) an extraordinary degree of operating flexibility ... (and) in sonic quality, we would unhesitatingly say that the Dynaco PAT-4 is unsurpassed by any preamplifier we have seen. It is a remarkable unit and unmatched at anywhere near its low price of \$89.95 in kit form or \$129.95 factory-wired."



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# Only Marantz Has Variable

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The chief design engineer of a major competitor once said that no one even tries to compete with many of Marantz' sophisticated features; it would be just too expensive. Marantz designs its circuits the same way the aerospace industry designs missiles and jet planes — for utmost performance and reliability.

### Variable-Overlap Drive

When you buy a Marantz stereo, you can look forward to sterling performance

year after year. Marantz reliability is due in great part to such exclusive features as Variable-Overlap Drive. This Marantz circuit eliminates irritating cross-over notch distortion found in most solid-state amplifiers. In addition, Variable-Overlap Drive compensates for the natural aging of an amplifier's components. This means that even after years of listening enjoyment, Marantz still delivers "like-new" performance.

### Features, Not Gimmicks

The unique features of a Marantz component are there for only one purpose: to make possible the highest level of listening enjoyment.

That's why we put an oscilloscope in our best components.

An oscilloscope is kind of a TV tube. But instead of the Wednesday Night Movie, it shows you a green wavy line. An electronic picture of the incoming FM radio signal, telling you exactly how to rotate your antenna for minimum multipath distortion (ghost signals) and maximum signal strength (clarity) even from the weakest stations.

The "scope" also shows correct stereo phasing; that is, if the broadcasting transmitter or your equipment is out of phase. And it lets you set up optimum stereo performance



and reception to create a solid "wall" of sound.

### Gyro-Touch Tuning

Marantz even offers a different tuning experience because you rotate the actual tuning flywheel. This results in the smoothest, most precise tuning possible. And this Marantz-exclusive design requires

considerably fewer moving parts than conventional systems used by other

manufacturers. The benefits: reduced friction, wear, and service problems. We call this patented pleasure "Gyro-Touch Tuning."



### Built To Last

Marantz stereo components aren't built in the ordinary way. For example, instead of just soldering connections together with a soldering iron, Marantz uses a highly sophisticated waveflow soldering machine — the type demanded by the Military. The result: perfect, failproof connections every time. Even our printed circuit boards are a

# -Overlap Drive!

special type—glass epoxy—built to rigid



military specifications, ensuring ruggedness and dependability.

## Marantz Power Ratings Are True

When someone tells you he has a "100-watt amplifier," ask him how the power was rated. Chances are his 100 watts will shrink to about 75 or 50 or perhaps even as few as 25. The reason is that most manufacturers of stereo amplifiers measure power by an inflated "peak power" or "IHF music/dynamic power."

Marantz states its power as "RMS continuous power" because Marantz believes this is the only method of measurement that is a true, absolute, scientific indication of how much power your amplifier can put out continuously over the entire audible frequency range.

But if Marantz were to use the unscientific conventional method, our Model Sixteen 100-RMS-100 power amplifier could be rated as high as 600 watts!

Moreover, you can depend on Marantz to perform. For example, the Model 16

can be run all day at its full power rating without distortion (except for neighbors pounding on your wall). That's power. And that's Marantz.

## Marantz Speaks Louder Than Words

In a way, it's a shame we have to get even semitechnical to explain in words what is best described in the medium of sound. For, after all, Marantz is for the listener. No matter what your choice in music, you want to hear it as closely as possible to the way it was performed.

In spite of what the ads say, you can't really "bring the concert hall into your home." For one thing, your listening room is too small. Its acoustics are different. And a true concert-hall sound level (in decibels) at home would deafen you.

What Marantz does, however, is create components that most closely recreate the sounds exactly as they were played by the musical performers. Components that consistently represent "where it's at" in stereo design. No one gives you as much—in any price range—as Marantz.

## Every Marantz Is Built The Same Way

Every Marantz component, regardless of price, is built with the same painstaking

craftsmanship and quality materials. That's why Marantz guarantees every instrument for three full years, parts and labor.

## Now In All Price Ranges

Today, there is a demand for Marantz-quality components in other than very-high price ranges. A demand made by music-lovers who want the very best but must consider their budgets. Though you can easily invest more than \$2000.00 in Marantz components, we now have units starting as low as \$209. True, these lower-priced models don't have all the same features, but the quality of every Marantz is exactly the same. Marantz quality.

And quality is what Marantz is all about.

## Hear For Yourself

So now that you *know* what makes a Marantz a Marantz, *hear* for yourself. Then let your ears make up your mind.



**marantz.**  
Components • Speaker Systems • Receivers

©Marantz Co., Inc., 1970. A subsidiary of Superscope, Inc., P.O. Box 99A, Sun Valley, Calif. 91352. Send for free catalog. Shown above, Model 22. \$449.

# Tape Transport Maintenance

H. W. HELLYER

## PART 5/Heads, Guides, and Pressure Pads

Dust is the great enemy of tape recorder mechanisms. Audio enthusiasts care for their disks as a mother cares for her child. They wrap them in paper sleeves each time they are stored, preen them with dust collectors each time they are played, and meticulously remove all the goo they can find—and some they may only imagine—from the precious stylus point. But too many tape recorder users are content with a perfunctory wipe over the recording and replay head faces when high-frequency losses become too painfully obvious. Tapes may be stored in boxes, but no special care is taken to exclude dust or the creeping effect of humidity, and this is transferred to the head at first play.

Perhaps the reason for this neglect is that spacing-effect losses are not always so obvious to the listener in their early stages as are the pops and crackles evinced by a dirty disk.

Losses of this sort begin at the high-frequency end of the sound spectrum, and this is where other system losses have their effect, and where the hearing of the listener first begins to fail. Dirt on the heads is the primary cause of spacing-effect losses.

Loss of tape contact on the pole pieces of a head most seriously affects the response of that head. The effect on a replay head is worse when the wavelengths of the 'magnets' on the tape are short, (higher frequencies), partly because such short wavelengths have a weaker external field. Movement away from the pole faces causes dropouts.

Dropouts can be measured pretty accurately. Just lately, a good deal of work has been done into their annoyance value, and for a long time a simple formula has been used, expressing the severity of dropouts, thus

$$S = \frac{l.d.h.}{t.s.}$$

where  $S$  is an arbitrary expression of severity,  $l$ =length of impurity,  $d$ =depth,  $h$ =height,  $t$ =width of the track and  $s$ =tape speed. From this we can see that dropouts are worse at lower speeds and narrower tracks and depend

directly on the volume of the impurity. Unfortunately, this expression could be challenged by any practicing engineer, because the depth of an impurity has such a drastic effect on recording.

The strength of a magnetic field varies as the square of the distance from the source of the flux. So a soiled head that causes a slight loss during replay will cause a much more severe deterioration in signal level and response when a recording made under these faulty conditions is played back with the same head. The circumstances for recording are similar insofar as dropouts have the same result—a loss of signal. But while the spacing of the tape from the head, caused by the impurity, will reduce signal strength, so will it also reduce the magnitude of the applied h.f. bias field. Reduction of bias, among other things, causes a lower signal amplitude to be recorded. So the trouble is cumulative, and the tiny scrap of dirt we have ignored impairs playback of a pre-recorded tape by a factor of  $X$  but reduces replay of our new recordings by a factor of  $X^2$ , i.e. the square of the distance times the square of the distance. This is why the complaint is often heard when a tape recorder owner brings his machine to the mechanic: "Playback is O.K. but recordings are weak." What he really means is that he has not noticed the slight degrading of replay and has perhaps un-

consciously compensated for it with his controls, but the drop in recording strength is very noticeable.

We can be more precise than this and measure the spacing loss for a given distance (or size of impurity). Call the attenuation  $A$  and the distance of tape from head  $d$ , as in Fig. 2, and plot a curve whose vertical axis is the attenuation in decibels and the horizontal axis the spacing in proportion to the tape magnet wavelength, and we get something like Fig. 3. The wavelength depends on tape speed (the higher the tape speed, the longer the wavelength) and the frequency being recorded (the higher the frequency, the shorter the wavelength). Again, we note that the greatest effect is to the higher frequencies, and at the lower speeds.

The tape flux attenuation is given by the formula

$$A = e^{2\pi \frac{d}{\lambda}}$$

where  $e$  is the base of natural logarithms, 2.718,  $2\pi$  is 6.28 and  $\lambda$  the tape wavelength. So when the spacing equals the tape wavelength  $d/\lambda=1$  and  $A=20 \log e^{2\pi}$  or  $40\pi \log e$  which is 54.5 dB.

So again we can get down to actual figures and say that at 15 kHz, our highest frequency to be recorded, with a tape speed of 3 $\frac{1}{2}$  in/sec, the wavelength



Fig. 1—"Loss of tape contact seriously affects the response." This Grundig deck collected so much dirt it was a wonder it played at all!

# The independent test labs think as highly of the Dual 1219 as we do.

No surprise. Because with every Dual tested, every performance claim we've ever made has been confirmed by independent test labs. With no exceptions.

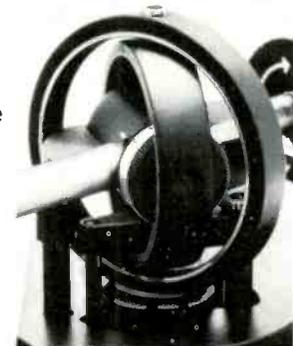
Four years ago, for example, we introduced our 1019. Audio experts rated it the finest automatic turntable ever made. But we were already hard at work on what was to become the Dual 1219.



"anti-skating... reduced wear on the record grooves..."  
Audio

Is it the worthy successor to the 1019 we believed it would be? Stereo Review says it is.

"The 1219 is a good illustration of how an already superior product (the 1019) can be further improved by intelligent and imaginative design and engineering."



"...four point gimbal-bearing system of extremely low friction."  
American Record Guide

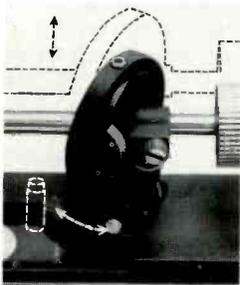
High Fidelity also agreed, with such specifics on the 1219's performance as these:

"Speed accuracy is greater (than the 1019), wow and flutter are a bit lower, tracking force and anti-skating adjustments are more precise...outstanding in all these characteristics."

As for the benefits of the 1219's gimbal-suspended 8-3/4" tonearm, The American Record Guide's results showed:

"The arm carries the cartridge in a way that permits it to extract every subtlety it possibly could from the record groove."

We actually felt the 1219 might have more precision than most people would ever need. But Audio disagreed, we're pleased to note:



"...novel adjustment for optimizing vertical tracking angle..."  
High Fidelity

"Whether or not the advantages of exact setting for vertical tracking and for anti-skating can be identified by the average listener, measurements show that there are improvements...reduction in distortion, and...reduced wear on the record grooves, particularly on the side of the groove nearest the center of the record."

Complete reprints of these test reports are yours for the asking. So is a 16-page booklet which reprints an informative Stereo Review article on turntables and tonearms.

After you look through all of this, you'll understand why most hi-fi experts have Duals in their own systems. And why every record you buy is one more reason to own the \$175 Dual 1219.



"...will have greatest appeal to those who dislike any compromise..."  
Stereo Review

**United Audio** Products, Inc., 120 So. Columbus Ave., Mt. Vernon, New York 10553. 

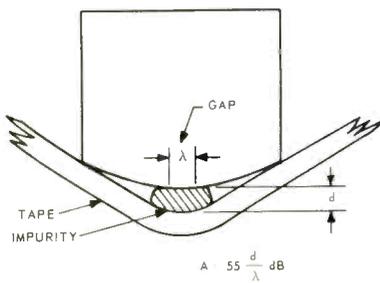


Fig. 2—Spacing loss is 55dB per wavelength.

will be 3.75/15,000 or 0.00025 in. So an impurity of only a quarter of a thou' will produce a 54.5-dB attenuation in replay. That's a voltage ratio of approximately 560:1. The loss after recording does not bear thinking about!

The foregoing dip into basic mathematics was quite deliberate. A shock treatment, if you like, to show that head cleanliness can never be taken for granted. A regular and habitual routine of cleaning and degaussing should be part of any tape recorder's schedule. There are plenty of preparations and cleaning kits available; no need to resort to worn-out toothbrushes and household detergents. The fluids are mild, non-toxic, will not damage plastics, are non-flammable, and should evaporate in reasonable time. Some cleaners carry a small amount of lubricant which is deposited while the carrier is dispelled. In other kits, the cleaner and tape lubricant are separate. One kit, at least, has a pylon arrangement which can be mounted on some decks to provide an extra running surface for the tape, with the lubricant dropped in the pylon to infiltrate the outer felt and provide a slow, regular application to the tape. When it is necessary to run old tapes through your previous sound channel, this preliminary cleaning can be an invaluable aid.

Other head cleaners may be too mild for cleaning of a heavy oxide deposit from a neglected head assembly. By the look of some tape recorders that arrive in the author's workshop, many owners operate in a coal-hole and have never heard of head cleaning. These have to be tackled with a stiff-bristled nylon brush and denatured alcohol, methylated or surgical spirit. Stubborn deposits are better removed by several ventures than a harder, protracted scrubbing.

When cleaning worn tape heads, always rubs along the line of the tape

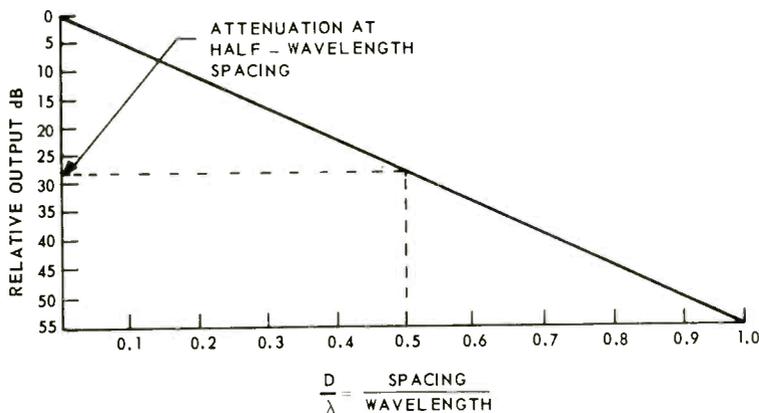


Fig. 3—Showing relationship between attenuation and wavelength.

travel, not up and down. There will have been a tendency for oxide to have collected in any horizontal grooves made by wear, and cleaning this way helps to remove the deposit. Some heads have horizontal slots in the facing, aiding the tape contact by a suction effect. Oxide can build up in these. The nylon brush is the answer, *not* a poke with a screw-driver blade.

Final cleaning and polishing can be done with cotton wool on the end of a manicure stick, or, better still, the slightly pliable cottonwool sticks supplied by cleaning makers.

There are two philosophies about guides. The tape must move in a true horizontal plane, without lateral or vertical wandering, so there must be a degree of back tension. One system requires the trapping of the tape against the head with a fairly tight pressure pad, a roller, or a band. All three types are illustrated in Fig. 3. The alignment is often by a U-shaped piece, perhaps part of the head assembly, or by a closely machined central guide post, keeping the tape in true horizontal traverse.

With this first system, a mumetal shield on a sprung plate may be used, and this has been utilized as an auxiliary guide in more than one design. Great care has to be taken that this shield slides properly and completely into place and that any felt pad on its inner face is kept soft and free from impurity. Quite often, this shield is the only guiding the tape gets, apart from vertical machined pins without flanges. It can be demonstrated that a larger-diameter guide is much more efficient as regards tape wear, regularity of control (freedom from flutter), and lateral guiding effect, yet deck designers continue to fit ridiculously small pins, saving a couple of cents and eschewing the loss in quality.

The second system has critically machined guides whose flanges route the tape precisely across the head gap. Pres-

sure pads, where these are used, only perform the function of keeping the tape in intimate contact with the head facing. The head shape assumes more importance. Many high-quality decks use no pads, but rely on the wrap of the tape around the head, and the contoured head for which much advantage has been claimed—and challenged—is very much in evidence. One incidental advantage to the maintenance man is that contoured heads are often easier to clean, and keep clean.

Machined guides present their special problems. Tape width is standardized at 0.246 in.  $\pm 0.002$  in. Although usually described as 'quarter-inch' tape, the domestic variety is nothing of the kind. However, some earlier standards specified  $\frac{1}{4}$ -in. with a tolerance of  $-6$  thou. So some tape is still around with a slightly oversize width, and this can jam in a closely machined guide. Any tape with poor edges, or that has been damaged, should be scrapped. Cut and splice ruthlessly. Tape is not all that expensive; and if there is valued prerecorded material on it, the practice should be to dub it off before the tape falls to bits, using a machine with more-tolerant guide dimensions. Even the less-precise

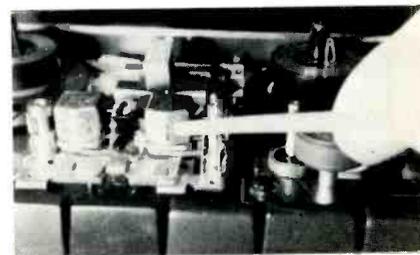


Fig. 4—Sanyo deck with contoured heads.

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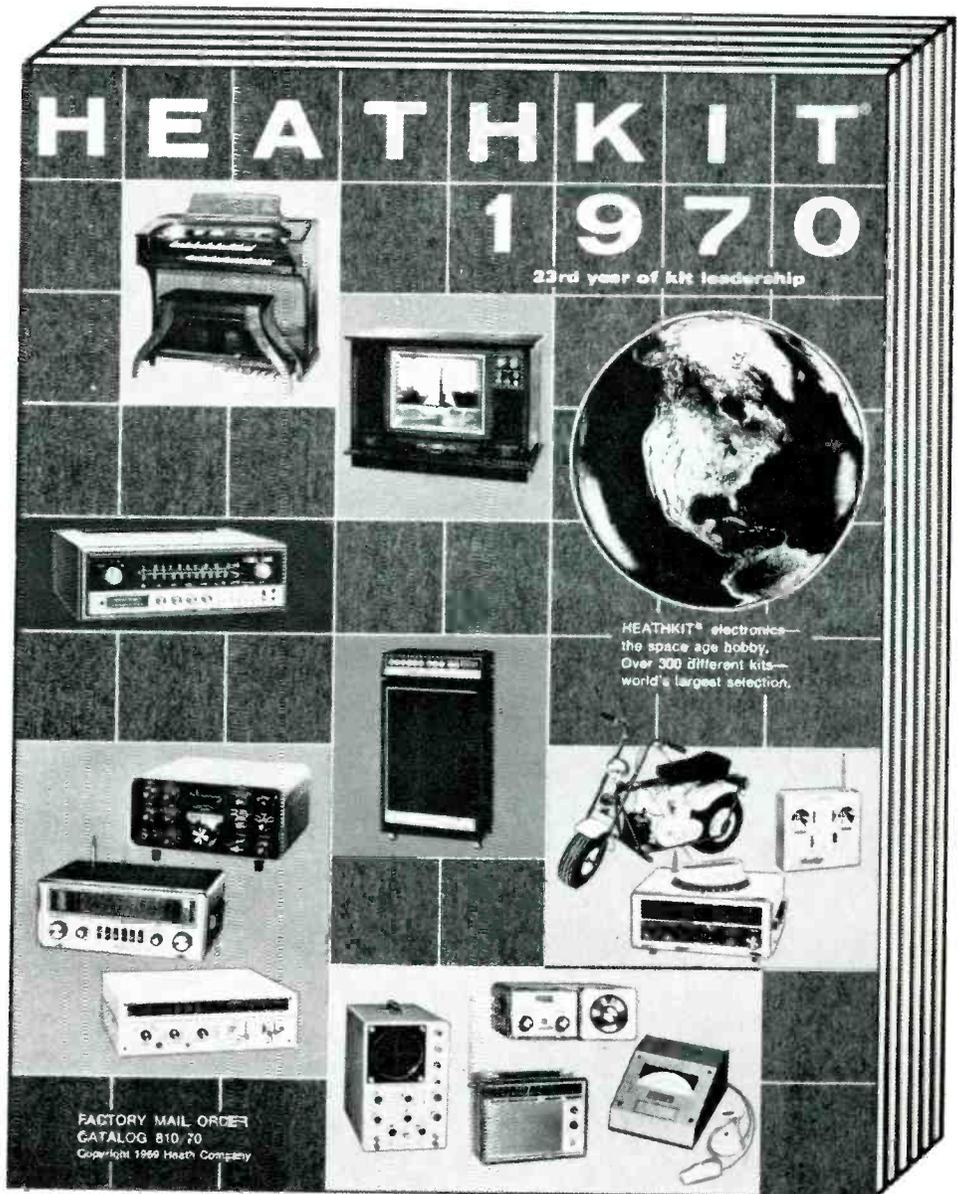
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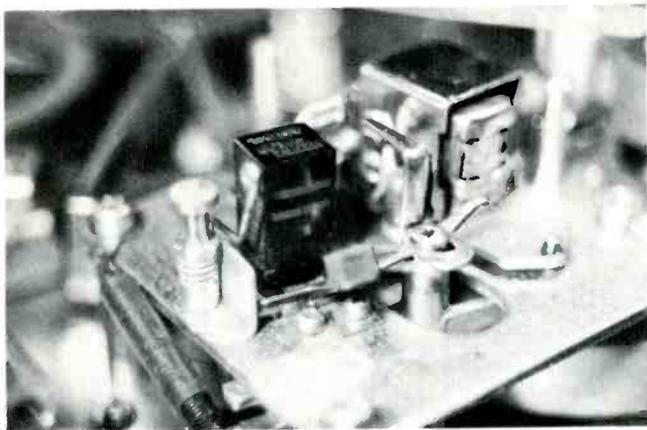


Fig. 5—Sony TC260 showing pressure pad held off by the forked arm from its contact with the erase head. In this Sony design, the Record/Replay head relies on the tape wrap for good contact.



Fig. 6—Uher 4000 allows very little access for cleaning and is better served by an impregnated cleaning band.



Fig. 7—Accessibility is half the battle! The front trim of this Grundig deck lifts away completely to allow free access to the heads.

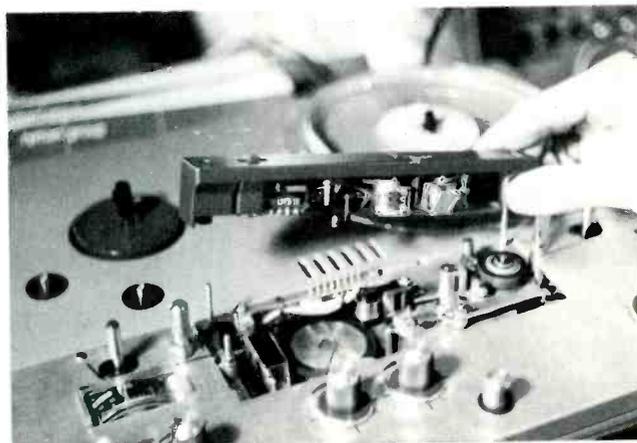


Fig. 8—The Ultimate! In this Uher Varicord design, the complete head assembly can be removed and interchanged for different track formation. Accurate machining of mountings is the secret.

guide formations of medium-class machines, with their 'play' between tape edge and flange of between 2 and 8 thou. can trap a poor tape; and the build-up of dust and oxide will rapidly diminish the tolerance.

The trouble is that some tolerance is needed, to allow for variations in tape and prevent any tendency to edge curl. But as the track width of a quarter-track tape is only forty thou', any tendency of the tape to wander, aggravated by too generous a tolerance, causes amplitude variations. Tape trapping by narrow-flanged guides or by rough guide barrels will cause flutter during record and play functions and will retard fast winding of many low-torque machines. This is one of the first areas of investigation when the fault symptoms are that the tape slows near the end of a wound reel.

Guides are often adjustable, see Fig. 9. Spring-loaded, with locknut, or simply screwed into the deck, many guides can be set to regulate the datum line for tape travel, and where this is so, setting the guides should be the first job, before any adjustment to the head positioning is made. On a strange deck, always inspect the assembly and look for some fixed datum. It may be the securing of the erase head, a popular method, or the mounting of the plate on which the heads themselves are pivoted: see Fig. 10. Setting the height of the guides according to the maker's instructions is very often an early stage in maintenance and should not be neglected. All the later adjustments that preserve full frequency response, reduce noise, avoid cross-tracking, and generally improve recording will depend on this setting.

Occasionally, we run into trouble with

tape edges rubbing on spool flanges and the inevitable temptation is to alter the guide position to rectify the error. Before doing this, check the spools themselves and their carriers. The guides seldom go out of adjustment, and if they do, are more likely to exhibit their fault by being loose on their mountings. For adjustment where no information is available, first set the tape run to the fixed datum, then adjust the guides for a level run between spools, noting particularly any tendency of the tape to rub flanges or the top cover of the deck when the spools are turned by hand. After this, set the level of the erase head so that the upper edge of the top track can just be seen above the edge of the tape, stretched tightly against the face of the head. Finally, set the record and replay (or combination) heads so that the upper edge of the tape just cuts the visible upper line of the

# If everyone were an expert, there'd be only three speakers left on the market.

We mean this very seriously.

If everyone had a good ear without any high-frequency loss...

If everyone listened to *live* music regularly...

If everyone understood the idiosyncrasies of commercial records and tapes...

If everyone could see through shallow technical arguments...

In sum, if everyone had the qualifications of an expert judge of loudspeakers—then only three of the current models on the market would survive.

The **Rectilinear III**, the **Rectilinear Mini-III** and the **Rectilinear X**.

We base this brash assumption on our study of people possessing the above qualifications.

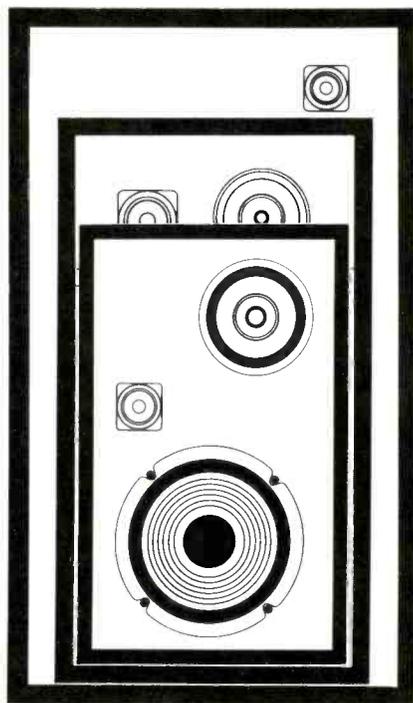
They seem to reject, to a man, all speakers created for a particular "taste." The big-bass taste. The zippy-highs taste. The Row-A-spectacular taste. Or even the more refined taste for subtly rich bass with slightly subdued upper midrange but sharply etched highs.

They want no personality at all in their speakers. Just *accuracy*. What goes in must come out, no more and no less. If the input is less than perfect, they use tone controls and filters, rather than loudspeaker

manufacturers, to improve it.

And they're unimpressed by novelty for novelty's sake. They've got to *hear* that engineering breakthrough, not just read about it.

These people are invariably reduced to a choice of no more than six or seven models, out of literally hundreds. Three or four of this ridiculously small group of neutral-sounding, transparent speakers are full-range electrostatics. Which means that they're huge, awkward to place, murderously expensive and far from indestructible. Which, in turn, leaves only three, as we said:



The **Rectilinear III**, a classic after less than three years, acclaimed by every reviewer under the sun as the floor-standing monitor speaker without equal; four-way with six drivers, \$279.00.

The **Rectilinear Mini-III**, the only small compact with class; three-way with three drivers, \$89.50.

The **Rectilinear X**, "the world's fastest bookshelf speaker," with unprecedentedly low time delay distortion; three-way with three drivers (including our new high-excursion 10-inch woofer), \$199.00.

Of course, in the real world out there, everyone is *not* an expert, so there'll be many speakers left on the market.

But there seem to be enough experts around to keep one company very happy.

(For more information, see your audio dealer or write to Rectilinear Research Corp., 30 Main St., Brooklyn, N. Y. 11201. Canada: H. Roy Gray Co. Ltd., 14 Laidlaw Blvd., Markham, Ont. Overseas: Royal Sound Co., 409 North Main St., Freeport, N. Y. 11520.)

## Rectilinear

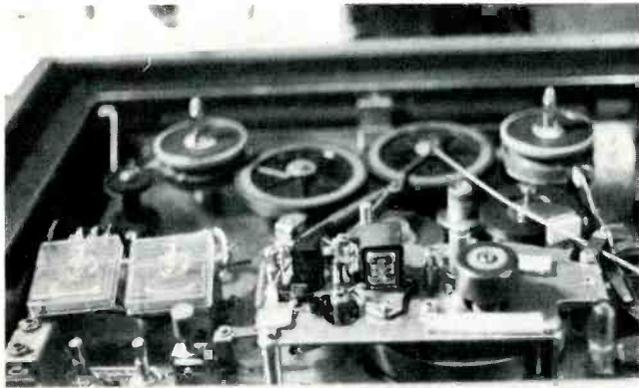


Fig. 9—Showing various adjustable guides on another Sony deck.

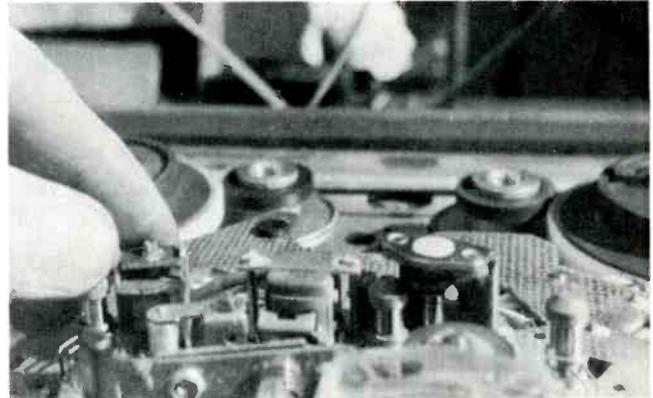


Fig. 10—Telefunken deck showing guides before, during and after tape path through channel.

polepieces. In other words, when in doubt, allow the erase head to overlap a little. Signal-strength tests will prove the final setting, and the normal rocking action of azimuth alignment completes the adjustments.

Plain brass guides, pins, and auto-stop feelers tend to wear badly if dirty tape is used. Quite often, a groove will be made in the rounded surface, and this is a prevalent cause of tape trapping, flutter, and retarded fast winding. View the cleaned surfaces on which the tape bears under a bright light, when these grooves and 'flatted' surfaces will be revealed.

Mobile guides such as free rollers, auxiliary brake pins, or tape-end-stop feelers are much in evidence on better-class machines. Because they continually

present a renewed surface to the tape, they wear less readily, but a tape deck with these devices should be inspected carefully for any tendency to bind. Free-running guides should spin freely. Other types, on sprung arms, should swing readily as the tension on the tape is altered.

Watch for compensating springs that have seized, or arms that have bent, throwing the guide axis out of true vertical. Lubricate spindles very lightly, after the usual cleaning. Spring-tension arms have been mentioned in the previous sections on clutches and brakes. From our point of view this month, they can be treated as auxiliary guides and should receive the same careful treatment.

Watch out for the pin or spring guide between the heads, a form of auxiliary

adjustment on many models with a sharply sprung pressure-pad plate. This device tends to wear badly when the head-gate assembly becomes cluttered with abrasive dust.

Pressure pads and the plates on which they are mounted have already been mentioned, but the adjustment of these and of the hold-off arms that limit their throw should be rechecked after other adjustments and repairs have been done. Pads must be soft, may need cleaning and perhaps resurfacing by making a small skim with a razor blade. Whatever the action that has been done, it may require a resetting of the inward tension, and this is a final check on the maintenance work around the head channel.

Æ

Next:—Brakes

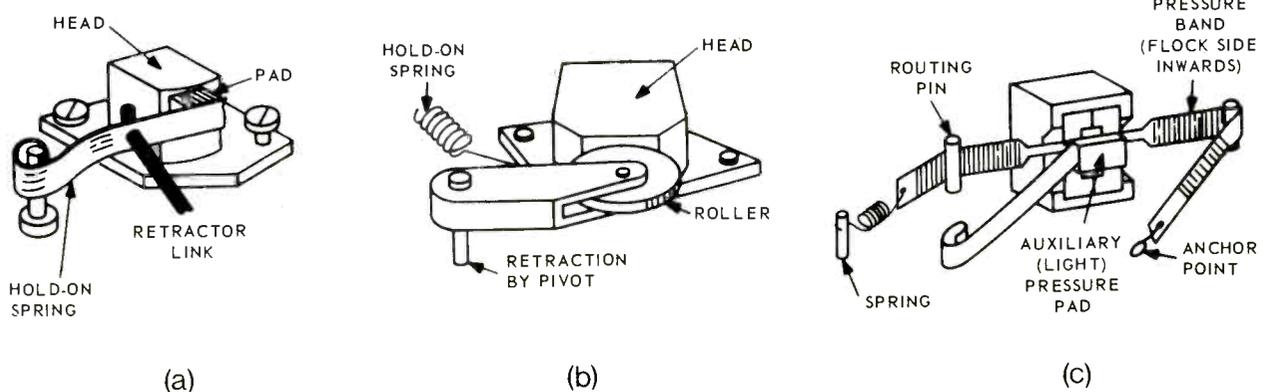
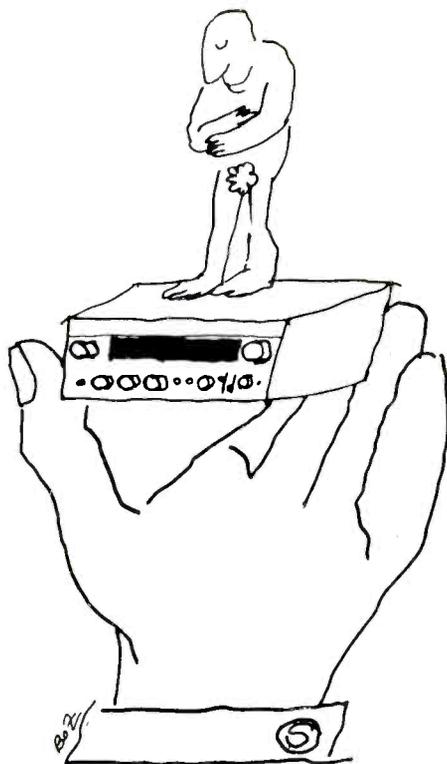


Fig. 11—Three methods of maintaining good contact of tape to head (a) pressure pad on spring arm, (b) pressure roller, and (c) felted band which gives greater degree of wrap.



### **Sony humbly nominates itself for the understatement-of-the-year award**

We priced the Sony STR-6050 FM Stereo/FM-AM receiver at \$279.50 — quite reasonable, we thought. However, the renowned Hirsch-Houck Laboratories seems to feel that we understated the price and said so in their report in the May issue of Stereo Review.

“When we received the Sony STR-6050 stereo receiver for testing we did not know its price. Before making any measurements we listened to it for a time and estimated its price from its general performance. Our guess was about \$120 higher than its actual selling price, which should give you some idea of what an excellent value this receiver is.”

Most humbly, we point to this “\$120 Understatement” as indicative of the way we understate other points about our products like performance, specifications, etc. We’d rather let the owners of Sony stereo components speak up for us. Audition the Sony 6050 and our other fine stereo components at your Sony high fidelity dealer, or write for catalog. Sony Corporation of America, 47-47 Van Dam St., Long Island City, N.Y. 11101

**SONY® STR-6050**

## ■ ■ ■ Chamber Music

(Continued from page 28)

For so popular and substantial a work, there is not quite the selection of recordings one might expect. The version listed, by the Amadeus Quartet, is a stylish account of the music, and is paired with an equally attractive performance of Haydn's "Emperor" Quartet, one of that master's very finest (its slow movement is a set of variations on a tune which has come to be known under several titles, including *The Emperor's Hymn* and *Deutschland uber Alles*). A reasonable alternative, and at half the price, is the Allegri Quartet performance on Music Guild MS-864, with another Mozart quartet, the "Dissonant" in C major, K. 465. For those who do not insist on stereo, the three-disk mono "Vox Box" containing the "Hunt" and its six immediate predecessors, all played by the Barchet Quartet (VBX-13), is worth looking into. The Barchets have recorded all the Mozart quartets; not all of them came off equally well, but the seven in this collection are all played beautifully and the "Hunt" in particular is one of the best ever recorded.

From its first bar, the Schumann Piano Quintet brims over with energy; themes seem to tumble out after one another in a rush of spontaneous exuberance. The balance between the piano and the string quartet is that of a real partnership, and the effect of any decent performance of the work is unfailingly refreshing. There are many decent performances on records, but the Serkin-Budapest version has more to offer than its rivals. On the record listed it is paired with one of Brahms's most interesting and unusual (and least-heard) works, the Horn Trio; it is also available as side four in Columbia's two-disk set of the Brahms string quartets with the Budapest Quartet (M2S-734). Another good version on a single disk, by Christoph Eschenbach and the Droic Quartet, shares a Deutsche Grammophon record with the last of Schumann's three string quartets (SLPM-139144).

The beautiful, sensuous, imaginative quartets of Debussy and Ravel are offered together now on no fewer than eight different records, and they make an eminently sensible package. They are the finest chamber works composed by Frenchmen and, despite the distinctions scholars like to point out between these two composers' styles, their string quartets are remarkably similar in structure and character. Both were written by young men (the Debussy at thirty-one, the Ravel at twenty-seven), and it is youthful passion that informs them both.

Anyone who enjoys *The Afternoon of a Faun* or *Daphnis and Chloe* will find these quartets more than congenial.



The Quartetto Italiano performances of both the Debussy and the Ravel are vigorous, sensual, and aristocratic in just the right proportion, and always compellingly musical. The Vlach Quartet, on Artia ALS-7204, and the Droic Quartet, on Deutsche Grammophon SLPM-139369, are hardly less impressive, and the Concert-Disc by the Fine Arts (CS-253) is a genuine bargain.

The clarinet assumed an unexpected importance for both Brahms and Mozart near the end of each composer's life, and each responded to the artistry of a particular virtuoso (Anton Stadler in the case of Mozart, Richard Muhlfeld for Brahms) by creating some of his finest works, including a quintet for clarinet



and strings which stands very near, if not at, the top of the list of his chamber music. Anyone discovering the Brahms or the Mozart Quintet will be curious about the other, and no one is likely to be disappointed by either of them. Both works are ideally suited to the clarinet's own character: generally mellow and by turn bucolic, humorous, melancholy, and in the case of the Brahms, passionate.

The Brahms Quintet is conspicuously darker than the Mozart, cast in autumnal tones as if in a spirit of conscious farewell; tenderness and gentle melancholy prevail. The Mozart, in contrast, is a sunny work with few clouds on its horizon and with an abundance of infectious tunes. Neither work is lacking in depth, or in realization of the coloristic possibilities of this combination of instruments. Each, incidentally, ends with a set of variations.

Gervase de Peyer and his Melos Ensemble colleagues easily carry off top honors for their recordings of both the Mozart and Brahms Clarinet Quintets. The Mozart is especially recommended because it is paired with an equally splendid account of another Mozart masterwork for clarinet, the Trio in E-flat. There is an attractive low-priced alternative, however, in the form of a Mace record on which Heinrich Geuser and the Droic Quartet play the Clarinet Quintets of Mozart and Weber (MCS-9028).

It is hoped that some or all of the records recommended here will give the newcomer to chamber music some idea of what he has been missing and encourage him toward further exploration on his own.

## A "Starter" Collection of Chamber Music Records

1. **Bach:** Brandenburg Concertos, complete. Karl Ristenpart conducting the Saar Radio Chamber Orchestra, with Jean-Pierre Rampal, flute, Pierre Pierlot, oboe, Hans-Martin Linde, recorder, Helmut Schneidewind, trumpet, Georg-Friedrich Hendel, violin, Robert Veyron-Lacroix, harpsichord, and other soloists. *Nonesuch HB-73006* (2 discs)
2. **Stravinsky:** *L'Histoire du Soldat*—Suite; Octet for Wind Instruments; Double Canon for String Quartet; *Epitaphium* for flute, clarinet, and harp. Chamber groups conducted by the composer (with *Movements for Piano and Orchestra*). *Columbia MS-6272*
3. **Schubert:** Quintet for Piano and Strings, A major, D. 667 ("The Trout," Op. 114). Rudolf Serkin, piano; Jaime Laredo, violin; Philipp Naegele, viola; Leslie Parnas, cello; Julius Levine, double bass. *Columbia MS-7067*
4. **Beethoven:** Quartet in F major, Op. 59, No. 1 ("Rasumovsky" No. 1). Fine Arts Quartet. *Concert-Disc CS-255*
5. **Mozart:** Quartet in B-flat major, K. 458 ("Hunt"); **Haydn:** Quartet in C major, Op. 76, No. 3 ("Emperor"). Amadeus Quartet. *Deutsche Grammophon SLPM-138886*
6. **Schumann:** Quintet for Piano and Strings, E-flat major, Op. 44. Rudolf Serkin, piano, with the Budapest String Quartet; **Brahms:** Trio for Piano, Violin, and Horn, E-flat major, Op. 40. Serkin, with Michael Tree, violin, and Myron Bloom, horn. *Columbia MS-7266*
7. **Debussy:** Quartet in G minor, Op. 10; **Ravel:** Quartet in F major. Quartetto Italiano. *Philips PHS 900-154*
8. **Mozart:** Quintet for Clarinet and Strings, A major, K. 581; Trio for Clarinet, Viola, and Piano, E-flat major, K. 498. Gervase de Peyer, clarinet, with members of the Melos Ensemble. *Angel S-36241*
9. **Brahms:** Quintet for Clarinet and Strings, B minor, Op. 115; **Reger:** Scherzo from Quintet in A major, Op. 146. Gervase de Peyer, clarinet, with members of the Melos Ensemble. *Angel S-36280*
10. **Beethoven:** Trio in B-flat major, Op. 97 ("Archduke"). Eugene Istomin, piano; Isaac Stern, violin; Leonard Rose, cello. *Columbia MS-6819*

(To be continued)



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**RCA** Recording  
Tape

# Equipment Profiles

## This Month:

- Teac Model AS-200U Amplifier
- Sony Model DR-6A Stereo Headset
- Marantz Model 22 AM/FM Receiver
- University "Project M" Speaker System
- Ampex Micro-52 Stereo Cassette Deck

## Teac Model AS-200U Amplifier

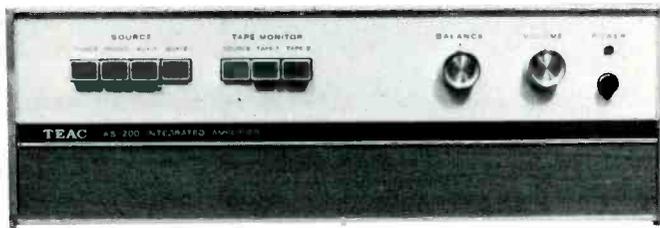


Fig. 1

### MANUFACTURER'S SPECIFICATIONS

**Power Amplifier Section:** RMS Power/Channel, 50 watts at 8-ohm load; 60 watts at 4-ohm load. THD: 0.5% at rated output. IM Distortion: 0.5% at 40 watts output or better. Frequency Response: 29 Hz to 80 kHz +0, -1 dB. Residual noise: less than 0.5 mV. Input impedance: 100 k-ohms. Input Sensitivity: 0.7 volts for rated output.

**Preamplifier Section:** Output voltage: 1 volt. Record Output Voltage: 150 mV. Input Sensitivity. Phono 1 & 2: 2 mV; All High-Level Inputs: 150 mV. Frequency Response, High-Level Inputs: 30 Hz to 30 kHz +0, -1 dB; Phono: within 0.5 dB of RIAA curve. Tone-Control Range: Bass,  $\pm 10$  dB at 100 Hz; Treble:  $\pm 10$  dB at 10 kHz. S/N: Better than 70 dB on phono; better than 90 dB on high-level inputs.

**Power consumption:** 22 watts at no signal, 180 watts at rated output.

**Dimensions:** 11 $\frac{7}{8}$ " W x 5 $\frac{1}{2}$ " H x 11 $\frac{7}{8}$ " D. Price: \$299.50.

Combining excellence in performance with totally pleasing aesthetics, TEAC Corporation's new integrated amplifier, Model AS-200U will appeal

to the serious audio enthusiast who insists upon separate components. The "separateness" of this smart-looking entry actually extends beyond the normal definition of an "integrated amplifier," for the preamplifier section can be electrically separated from the power-amplifier section by removing two metal "jumpers" from the rear panel, enabling the user to interpose all manner of accessories, such as expanders, reverberation units, tone-control-contouring devices and the like. Actually, one could even use the preamplifier section in a completely independent manner from the power amplifier since, with the jumpers removed, about the only thing the two components share is a power supply and a chassis upon which they're built.

Aesthetically, too, the front panel is arranged to convey the "duality" of the product. In Fig. 1, the front panel is shown with its hinged lower panel door closed. All one sees is an attractive matte gold, black and walnut front panel equipped with a minimum of controls, as might befit a dual power

amplifier. These most often used controls are Balance, Volume, a push-push power switch mounted below a small indicator lamp, and a series of four push buttons for signal source selection (tuner, phono, Aux-1 and Aux 2) as well as three more matching push buttons for tape monitoring functions.

Upon opening the hinged lower section of the panel, the "secondary" preamplifier controls are exposed. These consist of a lever switch for selecting either one of two identical phono inputs, a mode switch (for selecting stereo, mono, stereo reverse, and even right or left channels to both outputs), bass and treble controls, tone-control defeat and low- and high-filter lever switches as well as another lever for introducing or defeating the loudness-contour circuits. A speaker-selector switch selects main, remote, or both speaker systems and has an "off" position for headphone listening. The usual headphone jack completes the layout of this normally "hidden" portion of the panel. From a human engineering point of view, the layout is *almost* flawless. We wish the headphone jack had not been located behind the trap door, so that it might be used without having to keep the "door" open.

The rear panel of the AS-200U is shown in Fig. 2. Two switched and one unswitched convenience outlets are provided. A center-channel preamp output jack enables the use of a third, external power amplifier for feeding monophonic "mixed" programming to another location. Speaker terminals for main and remote speakers are color coded and spring-loaded, making wire connection as simple as threading an oversized needle and also practically eliminating the possibility of shorted speaker leads. The Amp-Preamp jumpers have already been



Fig. 2—Rear panel view.

*Build a complete stereo system  
around any of these  
Pioneer Outperformers*



**SX-1500TD AM-FM STEREO RECEIVER**

Exclusive microphone mixing. Audio output: 180 watts (IHF); FM Tuner Sensitivity: 1.7 uV (IHF); 6 sets of inputs; accepts 3 speaker systems; walnut cabinet. \$399.95 incl. microphone.



**SX-990 AM-FM STEREO RECEIVER**

Audio output: 130 watts (IHF); FM Tuner Sensitivity: 1.7 uV (IHF). Completely versatile with inputs for: 2 phono, tape monitor, microphone, auxiliary & main amps; walnut cabinet. \$299.95.



**SX-440 AM-FM STEREO RECEIVER**

Audio output: 40 watts (IHF); FM Tuner Sensitivity: 2.5 uV (IHF); Frequency response: 20-70,000 Hz. Oiled walnut cabinet. \$199.95.



**SX-770 AM-FM STEREO RECEIVER**

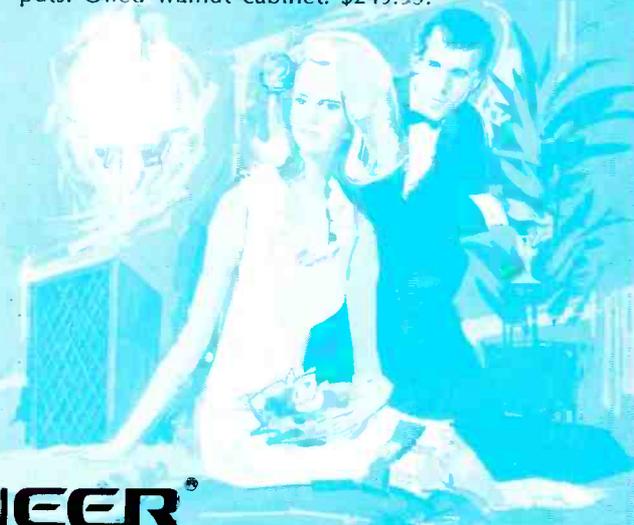
Audio output: 70 watts (IHF); FM Tuner Sensitivity: 1.8 uV (IHF); 4 sets of inputs; 2 speaker outputs. Oiled walnut cabinet. \$249.95.

*Depending on the number of refinements you're looking for in an AM-FM stereo receiver, Pioneer has one in your price range.*

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mentioned, and above them is a pair of thermal-overload-relay reset buttons. In addition to the usual in/out and tape out jacks, there is a REC/PLAY DIN connector, wired in accordance with European and other imported tape recorder standards. A spring-loaded grounding terminal completes the rear-panel layout.

A unique feature of the AS-200U is the provision of multiple tape input and output connections which enable a very elaborate system to be set up with central control.

## Measurements

The TEAC AS-200U measures even better than it looks. We could not find a single discrepancy between published and measured specs and, in the case of IM distortion and Power Bandwidth, the unit we tested actually exceeded published claims. Harmonic Distortion characteristics are shown in Fig. 3, while IM is plotted in Fig. 4. Note that 0.5% IM distortion is reached at a power output of about 45 watts, as opposed to the 40 watts claimed. Power bandwidth is shown in Fig. 5, while preamplifier characteristics such as tone-control and filter action, as well as loudness-contour curve for a -30 dB volume control setting is shown in Fig. 6. Structurally, the amplifier is laid out in a very professional manner and only the best quality of components are used. Another convenient feature we discovered upon removing the walnut enclosure was the ease with which this unit can be converted to "overseas" operation at 220 or 240 volts. Line-voltage requirements are changed simply by removing a small plug and reinserting it in the proper position in its socket for 100-, 117-, 220-, or 240-volt operation.

## Listening Tests

The TEAC AS-200U Amplifier sounds like the powerful piece of equipment that it is. Driving a pair of inefficient but good-quality bookshelf-type speaker systems, we were able to reach levels beyond anything we (or

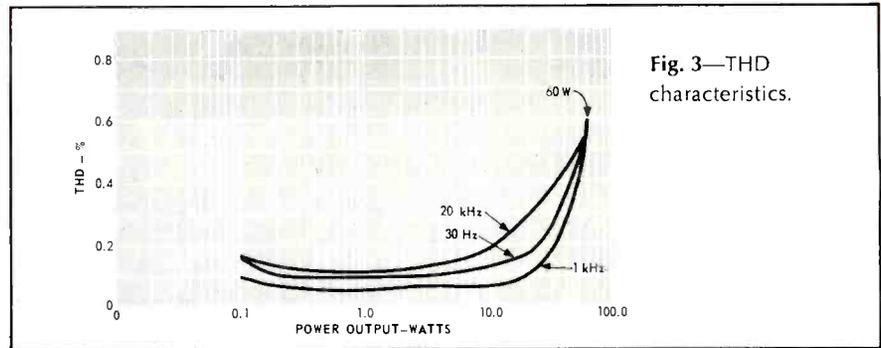


Fig. 3—THD characteristics.

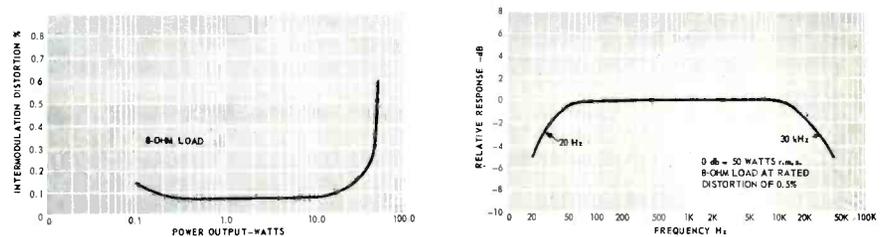


Fig. 4—IM characteristics.

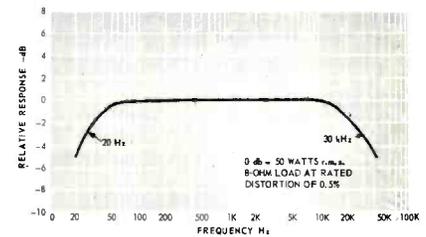


Fig. 5—Power bandwidth.

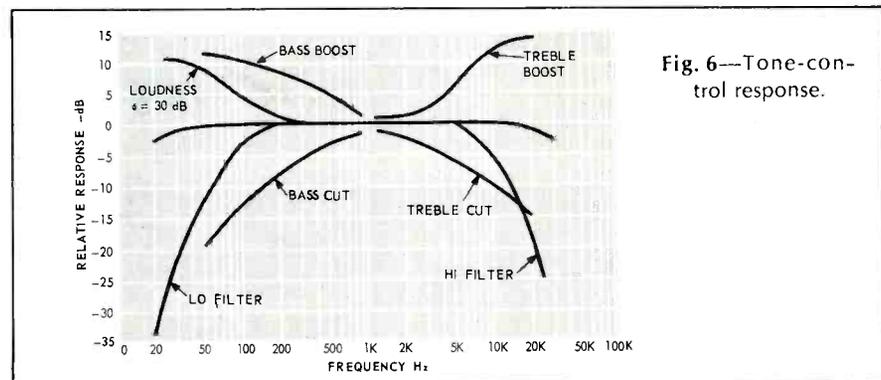


Fig. 6—Tone-control response.

the neighbors) might ever desire. Adding a second pair of remote speakers hardly "made a dent" in the power capability of this amplifier—this despite the fact that protective series resistance is added internally when two pairs of systems are played simultaneously. As explained in the operating instruction booklet, this nicety is incorporated to allow users to connect two pairs of 4-ohm systems *without* creating a resultant impedance of less than 4 ohms, which would be below the safety point for the output transistors. In any event, the only way we could make the overload relays "pop" was by applying a direct short across the speaker terminals and driving the amplifier with signal. And then they popped *fast*—long before any possible damage might have taken place. After four hours of high-level operation, the output transistors were only moderately warm to the touch—a good indi-

cation of conservative heat-sink design and good overall thermal stability. Sound seemed very well balanced, and transient response was excellent. Damping factor (though not stated by the manufacturer) was found to be in excess of 30, measured with respect to an 8-ohm load.

In all, we liked the sound we heard and we liked the control features which made that sound possible. If you own a tuner and need only a high-quality integrated preamplifier-amplifier to complete your home sound system or if you'd like to start with tape and/or phonograph facilities and leave the FM for later, the TEAC AS-200U represents a \$300 investment in a well designed and produced piece of high fidelity equipment that should not be overlooked.

Check No. 40 on Reader Service Card

**Sony Stereo Headset  
Model DR-6A**



**MANUFACTURER'S SPECIFICATIONS:**

**Frequency Response:** 20 to 20,000 Hz.  
**Input Impedance:** 8 ohms. **Power:** 1mW.  
**Cable length:** 7 feet, with standard plug attached. **Weight:** 14 oz. **Type:** Dynamic.  
**Price:** \$27.50.

There are almost as many stereo headsets available as there are manufacturers of hi-fi components, and they differ in various ways, although most of them are more than adequate for the average user. As with automobiles or cameras, a few are way out ahead, and their cost reflects their excellence. Those who want the best of everything will willingly spend the extra dollars to obtain one of the higher-priced models which can better satisfy his ego, even if his ears cannot tell the difference. The difference may be justified in some critical applications, just as the same critical user can justify the expenditure of several hundred dollars for a single loudspeaker—and twice several for a pair—but for the average headphone user, a more modest expenditure will usually suffice, just as it does with loudspeakers.

This is not intended to imply that the Sony DR-6A phones are not excellent in their field. They are. But they are modestly priced, and should serve most users to their complete satisfaction.

Measurements on headphones are extremely difficult, so we make no attempt to present definitive "absolute" curves

on their performance. We do measure them, however, since we do not trust our hearing in the upper reaches of the frequency spectrum. We measure them against another pair of phones as a comparison, with the other pair being of known performance, as attested by the manufacturer. Thus we can eliminate any idiosyncracies of our "artificial ear" and the microphone we use. By this technique, we feel we can provide a fairly accurate picture of the performance of any given pair of phones.

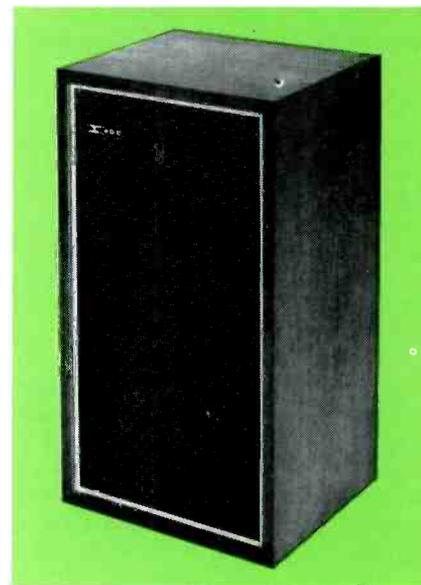
Physically, the Sony phones are attractive in appearance, being finished in black and chrome, with a dark gray plastic headband cover over a pair of steel wires, and with a dark gray set of ear pads. These pads are foam filled, slightly oval in shape so as to encompass the ear completely and comfortably. They may be worn for long periods without creating a headache and without interference with or from glasses—always a consideration to those who wear them. The individual phones move up and down on the headband to accommodate different head sizes, and they are identified by colored labels which are also marked right and left. The right label is red, the left blue. The cord is covered with a woven nylon sleeve, and resembles the traditional wool-thread woven cords of yesteryear. The foam pads are removable for washing.

The phones provide sufficient output with an input of 1 mW, which is the usual output across 8-ohm phones when plugged into the headphone jack on the average receiver with the usual 100 ohms in series with each channel. Low-end performance remains within  $\pm 5$  dB down to 40 Hz, and at the high end, output is heard up to 14,000 Hz, and measured to 16,000. The overall balance is excellent, and reasonably musical in quality. At the comparatively low price of \$27.50, the enthusiastic listener could well accommodate two or more pairs so that others in his family could also enjoy "personal" listening.

A similar pair of phones is available with an impedance of 10,000 ohms for applications where one wishes to plug the phones directly into the monitor jack of a tape deck or to the output of a preamp. This model is the DR-6C, which is priced at \$29.50.

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We make 303AX speakers for fussy audiophiles. Each one is crafted by hand and contains a two-way acoustic suspension system that's accurate enough to please even the most discriminating listener. The ADC 303AX lacks the distortion and coloration often found in speakers in its price range. Which makes it a superb value in a full-sized bookshelf speaker.

Of course, there's only one way to find out how really accurate our speaker system is. Go to your nearest ADC dealer and compare it to other models. After all, hearing is believing!

**SPECIFICATIONS**

**Type** . . . Bookshelf.  
**Cabinet** . . . Oiled Walnut.  
**Dimensions** . . . 23 $\frac{3}{4}$ " H x 13" W x 11 $\frac{3}{4}$ " D.  
**Weight** . . . 37 lbs. each.  
**Frequency Response** . . . 33Hz—20kHz  $\pm 3$  db (measured in average listening room).  
**Speakers (2)** . . . High accuracy, wide dispersion tweeter with Hi Flux Magnet and 10" high compliance woofer.  
**Nominal Impedance** . . . 8 ohms.  
**Power Required** . . . 10 watts min.  
**Price** . . . \$100 suggested resale.  
Write for details about other ADC speaker systems. From \$55-\$350.



**AUDIO FOR  
AUDIOPHILES**

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## Marantz Model 22 AM/FM Receiver

### MANUFACTURER'S SPECIFICATIONS:

**Tuner Section:** IHF Sensitivity: 2.4  $\mu$ V. Selectivity: 80 dB. S/N: 65 dB at 50  $\mu$ V input. THD: (Mono) 0.3%; (Stereo) 0.5%.

**Stereo Separation:** 40 dB @ 1000 Hz. **Sub-carrier suppression:** 60 dB.

**Amplifier Section:** Power Output: 120 watts total IHF music power, 8-ohm load.

**RMS Power Output/channel:** 40 watts, 8-ohm load. THD: 0.3% at rated output. IM: 0.3% at rated output.

**Power Bandwidth (IHF):** 20 to 20,000 Hz. **Hum and Noise:** High-Level Inputs: -80 dB. Phono: 1  $\mu$ V equivalent input. **Damping Factor:** Greater than 35 for 8-ohm load.

**Input Sensitivity:** Phono: 2 mV; High Level: 180 mV. **Phono Frequency Response:** RIAA  $\pm$  0.5 dB.

**General:** Power Requirements: 105/125 V a.c., 50/60 Hz, 33 watts at idling to 220 watts both channels driven to full output.

**Overall Dimensions:** 17" w. x 5-9/16" h. x 15" d. **Suggested Retail Price:** \$425.00 in metal wood-grained enclosure. (Walnut enclosure optional, extra.)

The Marantz Model Twenty Two is the first all-solid-state receiver offered by that distinguished company! Before readers take pen in hand to cite the Model 20 reviewed in December we hasten to add that this unit was equipped with a vacuum tube—the famous oscilloscope tube which served as a tuning aid and audio monitor. This feature is not included in the 22—with a consequent saving in cost—offset to some extent by the inclusion of an AM band. The IF system uses 3 IC's with ceramic interstage filters to provide a controlled bandpass and the FM front end utilizes two FET's plus a conventional transistorised local oscillator. The Twenty Two has the traditional Marantz front panel look, including the horizontally mounted, direct tuning thumb-flywheel introduced on earlier Marantz tuners and receivers, as can be seen in Fig. 1. The upper half of the gold and black panel is devoted to the tuning wheel, dial scale, stereo indicator light, two tuning meters and a pushbutton called "Antenna Tuning." This button, used in conjunction with one of the two tuning meters, provides one of the important functions previously assigned to the 'scope tube on earlier models—the facility of rotating an FM antenna for least "multipath" reflections using a visual indicator. More about its use later. Ordinarily, the meters act as center-of-channel and sig-



Fig. 1

nal-strength indicators for FM tuning, while the second meter is only active in AM tuning, as a signal-strength indicator.

The lower portion of the panel is tastefully fitted with knobs and pushbuttons, all of turned metal and all arranged so intelligently as to provide total familiarity after about five minutes of exploration. Major rotary knobs include a six-position selector switch, balance control, volume control, and dual-concentric clutch-type bass and treble controls. The cluster of three push-push buttons at the left include the tape-monitor function and L and R mono-mode buttons. The latter provide a unique way of getting either L or R alone from both speakers. If both buttons are depressed, the usual mono mix of L & R is obtained. The central cluster of four similar buttons offer "Hi Blend," a cross-mixing of high frequencies for reducing noise (while at the same time reducing high-frequency separation) in marginal stereo FM receiving situations. This button is followed by low- and high-frequency cutoff filters and a loudness (or contour) button. The final, left-most group of three more buttons provides for mute-defeat and selection of main, remote, or both sets of speakers. With neither speaker button depressed, sound will be heard only through headphones when they are connected to the front-panel headphone jack. A pair of "dubbing jacks" (duplicating the rear panel "tape in and tape out" jacks) and a push-push power on/off button complete the front-panel makeup.

The rear-panel layout, shown in the photo of Fig. 2, includes one switched and one unswitched convenience outlet, a thermal relay reset button, the usual

input and tape-output jacks, an FM input attenuator switch (which reduces input signal strength by 20 dB in cases of severe overload—which we never encountered), a muting threshold adjustment and a good sized grounding terminal for use with external record changer, turntable or tape deck. The muting adjustment is a most worthwhile feature, for users in different locations will want to set the mute adjustment to suit individual conditions. The range of this adjustment, we found, enables the mute to be overcome at signal levels from 5  $\mu$ V to about 25  $\mu$ V. Speaker and antenna connection terminals are by far the simplest and most reliable type ever invented—and they have been appearing with increasing frequency



Fig. 2—Rear panel view.

on the latest crop of receivers, particularly those imported from abroad. Piano-key tabs are depressed, exposing a small hole, into which the stripped end of a speaker or antenna wire is pushed. Releasing the key-tab, which is spring loaded, clamps the wire firmly in place. There are no screws to loosen, no wires to twist under the heads of screws and, best of all, the possibility of shorts is all but eliminated.

# our family plan...



Some people think our "Audio family" of the '70s has a generation gap! Certainly not!

We have planned and produced the finest solid state stereo Receivers, Amplifiers, Tuners, Headphones and Speakers for an entire generation of people.

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FAM-14 AM-FM-MPX Stereo "AMPLI-TUNER" offers private listening with stereo headphones plugged into the front panel, by way of a unique built in power amplifier: Dual gate Fe; AM-FM Muting circuit, Plug in Module I.C., MPX section; Modular construction throughout with triple NK NW-1 Circuit Breaker Protection.

TRM-50 Stereo PRE-AMP Power Amplifier. Power output 66 watts  $\pm$  1db at 8 ohms; Controls for two sets of speakers; Dual Function Controls, Treble, Bass, Scratch and Rumble Filter Modular I.C. and plug in type printed circuit boards with NK NW-1 Triple Circuit Breaker protection.

Now you can see we have eliminated the "Scund" generation gap in the 70's, so can you; at your local Nikko dealer.

See the sensibly priced FAM-14 Amplituner and TRM 50 pre-Amp Amplifier.

P.S. For the Budget Minded we have the FAM-12 and TRM 40



This scheme is used on both antenna and speaker terminals in the Model Twenty Two. Antenna terminals permit either a 300-ohm or a 75-ohm cable to be properly matched, though the customer instruction manual favors the use of *shielded* 300-ohm lead-in cable, to minimize multipath interference.

Eleven individual circuit modules, including completely separate FM and AM front ends, are used in the rugged chassis. At least some of the layout can be seen in Fig. 3 and, while the AM-IF, FM-IF and FM-Stereo circuits are all assembled on one p.c. board, they are totally separate circuits too. The stereo decoder circuitry has been simplified by the use of a new integrated circuit which, together with three external tuned circuits, is all that is required to decode the composite stereo signal into separate left and right outputs. Five other integrated circuits appear in the FM-IF and audio circuits. In addition, there are fifty three bi-polar transistors, four field-effect transistors and some thirty-eight signal, regulating, and rectifying diodes in this receiver design.

### Electrical Measurements

It should come as no surprise to anyone acquainted with previous Marantz products to learn that in many instances, performance measurements exceeded published specifications. For example, the actual measured IHF sensitivity was 2.1  $\mu\text{V}$  as opposed to the 2.4  $\mu\text{V}$  claimed. Furthermore, this figure was equalled at

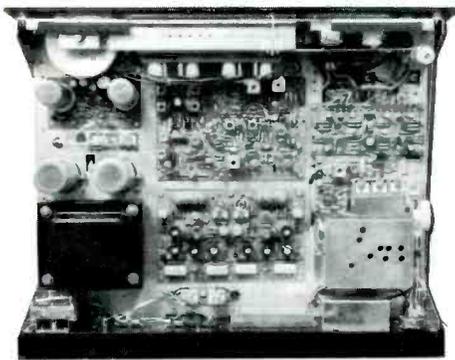


Fig. 3—Showing internal construction.

all three test frequencies (some manufacturers try to squeak out their best figures at 98 MHz, sacrificing the end points, since IHF sensitivity is supposed to be measured at that one frequency). Ultimate S/N for mono FM reached an incredible 72 dB at 100  $\mu\text{V}$  and even with an input signal of 50  $\mu\text{V}$ , for which Marantz claimed a S/N of 65 dB, we read 71 dB! Full limiting was reached at just under 2  $\mu\text{V}$ , a fact which Marantz does not mention, but one which, in our opin-

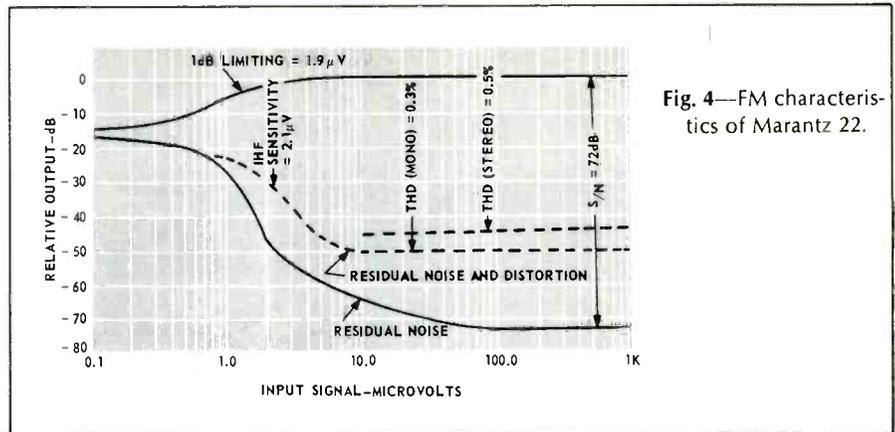


Fig. 4—FM characteristics of Marantz 22.

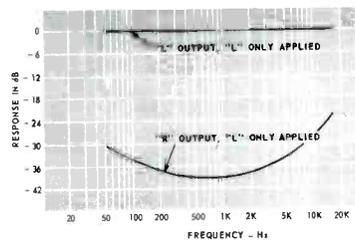


Fig. 5—Stereo separation.

ion, separates the really good FM performers (such as this one) from the run-of-the-mill tuners. Figure 4 graphically illustrates these important FM characteristics, while Fig. 5 is a plot of stereo FM separation. While we were able to obtain only 38 dB of separation at 1 kHz, that is close enough to the 40 dB claimed, and both figures are *more* than adequate. In fact, we did measure 40 dB at 400 Hz and maintained at least 30 dB of separation down to 50 Hz and up to about 8 kHz. At 15 kHz separation was down to 23 dB.

Figure 6 is a plot of both THD and IM, referencing an 8-ohm load with both channels driven. Rated distortion of 0.3% is reached at 43 watts in the case of THD and at 41 watts in the case of IM, both results above published claims. There is no evidence of increasing distortion at lower power levels, sometimes typical of complementary-symmetry output-circuit configurations and, more significantly, wattages just below maximum output are produced with barely measurable IM and THD (both well below 0.1%). In the case of THD, our equipment is capable of measuring down to 0.05%, and this is what we measured, indicating that actual distortion at lower power output

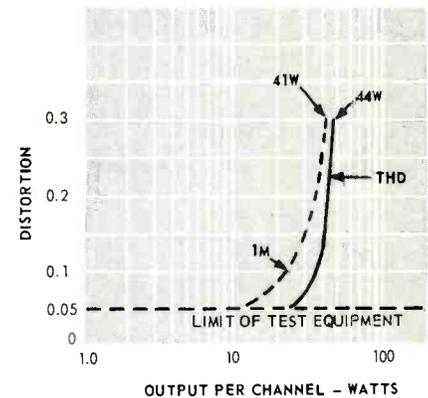


Fig. 6—THD and IM characteristics.

levels was probably better than that very low figure.

Tone-control action, loudness-contour compensation (at 30 dB below full volume), and low-frequency and high-frequency filter action are all plotted in Fig. 7. The filters have a slope of only 6 dB per octave and therefore cut into the program material to a greater extent than we would like to see. For example, the "rumble" filter causes the low-frequency response to be down about 5 dB at 80 Hz and the scratch filter attenuates 7 kHz signals by a similar amount. Chances are, however, that owners of this equipment will seldom want to use these secondary circuits anyway, if companion equipment and source material is in good condition. Power Bandwidth, plotted in Fig. 8, extends from 15 Hz to 30 kHz, considerably beyond published claims.

### Listening Tests

Since our laboratories are equipped with an antenna rotor, we were able to put the "multipath meter circuit" to the test, and a word about its novel approach is in order. When the antenna tuning button is depressed, two changes occur in the FM tuner circuitry. The output of the IF

# IN A **TDK** CLASS BY ITSELF

Today, there are only 3 or 4 cassette tapes in the world that are completely reliable, with low signal-to-noise ratio, with practically no hiss, low wow and flutter and truly worthy of the name "stereo high fidelity". But among these 3 or 4 leaders there is again one and

only one cassette tape that is truly in a class by itself – the TDK Super Dynamic cassette tape.

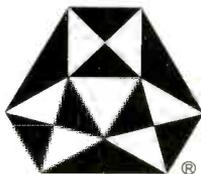


TDK's exclusive new patented magnetic material and coating techniques give you a cassette tape with heretofore unheard-of frequency response range of from 30-20,000 Hz, a signal-to-noise ratio of 55dB and an extremely wide dynamic range. All this plus minimal head wear.



The SD cassette mechanism is manufactured by TDK with the same care and quality control that is used in the tape itself. The result is a smooth running and virtually jam-proof construction. Compare a TDK SD Cassette with the present brand you are using. We know you will be amazed at the difference.

TDK Cassettes are available at leading audio dealers everywhere.



**TDK** World's leader in tape technology since 1932.  
**TDK ELECTRONICS CORP.**  
NEW YORK • LOS ANGELES • CHICAGO

system is fed to an AM detector, rather than to its normal FM ratio detector. It is characteristic of multipath reflections to cause partial out-of-phase cancellation of the incoming signal. This results in an IF signal which is not fully "limited" and therefore has AM modulation riding upon it. The output of the AM detector is fed to the audio chain, so that with the Antenna Tuning button in its depressed position, we can hear the products of AM detection *audibly*. Their presence indicates multipath! These same AM products are rectified to create a pulsating d.c. voltage, which is applied to the meter used in this mode. As the antenna is rotated, the audible AM products reach a null, and so does the meter reading. The "null" is therefore the optimized position for the antenna and the test is quick and accurate. In this application, we feel that this method of antenna orientation is as easy to use as the 'scope method previously featured on Marantz products and it is certainly less costly and requires no high-voltage power supply. As for the effectiveness of FM reception, we were able to pick up 43 stations using just an indoor dipole, reorienting it as demanded by the "antenna meter." Shifting to a multi-element outdoor directional antenna increased the number of usable FM signals received to 57, of which some twenty-two were broadcasting acceptable stereo. For our location (about twenty miles from the New York Metropolitan Area

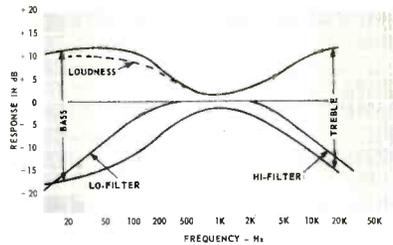


Fig. 7—Tone control and filter characteristics.

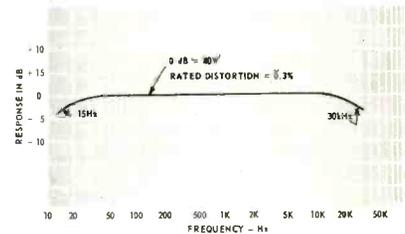


Fig. 8—Power bandwidth.

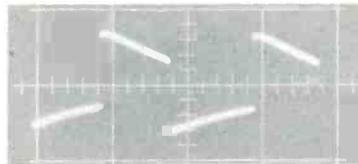


Fig. 9—Square-wave response at 100 Hz (A) and 10,000 Hz (B).

center) this is an extremely good record.

Marantz makes no claims whatever for its AM performance, even excluding all reference to this section in its published specifications. We wonder why, since we found the AM reception to be more than adequate and quite sensitive. Bandwidth seemed a bit on the narrow side compared to quality sets we have tested, but this in turn meant no serious "10-kHz" whistle problems, even during evening listening.

All the while, the amplifier section of this receiver coasted along at all our test listening levels, never breaking up and never tripping the thermal protection circuits, even under extreme dynamic listen-

ing conditions, using two pairs of stereo loudspeaker systems, each rated at 8-ohms impedance and both sets of the low-efficiency variety, at that. Square-wave response at 100 Hz and 10 kHz is shown in the 'scope photos of Fig. 10, confirming the better-than-average transient response which we noted in our listening tests.

In all, it is obvious that Marantz engineering has combined with overseas fabricating facilities to produce a receiver worthy of the Marantz name and tradition, yet within the reach of many more pocketbooks than would otherwise be the case.

Check No. 58 on Reader Service Card

## University "Project M" Speaker System

### MANUFACTURER'S SPECIFICATIONS:

**Speaker Complement:** One 11", high-compliance woofer, one 2½" closed-back, direct-radiator cone tweeter. **Impedance:** 8 ohms. **Power Handling Capacity:** 60 watts music power. **Recommended Amplifier Power:** 30 watts. **Crossover Network:** L-C type, 6 dB per octave. **Crossover Frequency:** 1 kHz. **Enclosure:** 1.324 cubic feet, acoustic suspension principle. **Finish:** Oiled walnut, four sides. **Dimensions:** 23½ in. x 12¾ in. x 11⅞ in. deep. **Suggested Retail Price:** \$99.95.

University's new "Project M" two-way loudspeaker system disproves an old speaker "cliche." Generally, it has been maintained that small, bookshelf speaker enclosure designs embodying acoustic suspension principles are low-efficiency devices, requiring a great deal of ampli-

fier input power to produce high levels of sound. This is just not true in the case of the "Project M" system. A mere ten watts of amplifier power will produce a 102-dB output at a distance of four feet, which is about the equivalent of a loud symphony orchestra, listened to at a distance of about 15 feet. On the other hand, the unique design and construction of the eleven-inch woofer used in this system is such that it *can* handle power inputs far in excess of that modest amount—up to 60 watts of music power without the slightest audible or measured indication of "break-up." If these claims seem a bit far fetched, a look at some of the new concepts embodied in this relatively low-priced system may help to explain how these goals were achieved.

Figure 1 shows the complete system, with neutral beige grille cloth frame in place. The grille cloth is mounted

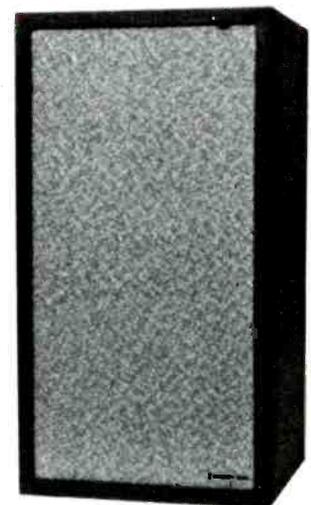


Fig. 1

on an easily removable masonite frame which is retained in place by bits of "zipper" type fabric which engage similar squares of fabric stapled to the main body of the enclosure. Removal of the front grille frame discloses the speaker elements themselves, which are front-mounted, as shown in Fig. 2. The apparent secret of the excellent distortion-free performance of the eleven inch woofer is the four-layer, large diameter voice coil and a soft, rubber surround suspension, to which University has given the name Unirol<sup>®</sup>. This combination of design innovations, along with a suitably heavy magnet structure and four-layer voice coil winding results in the unusually high order of transducer efficiency noted earlier, as well as the capability of the cone to make excursions of over 1/2 inch while maintaining extreme linearity all the way down to about 40 Hz. At somewhat lower power input levels (up to about 10 watts) we were able to measure fundamentals containing little apparent "doubling" as low as 30 Hz! A close up view of the "rubberized roll" suspension employed in the woofer is shown in Fig. 3, while a detail view of the tweeter front is shown in Fig. 4.

This tweeter, according to the manufacturer, has a specially designed cone that has a smoothly and progressively decreasing radiating area as the frequency increases. This is said to result in the tweeter's operating as a virtual point source of sound at all frequencies within its range, giving extremely broad dispersion and no "beaming" effect at any particular frequency. In addition to having a fully closed back, the inside surface of this tweeter is lined with fibre-glass for additional mechanical and acoustical damping. While the cone is only 2 1/2" in diameter, it is mounted into a four-inch frame in such a way as to isolate it completely from the woofer.

Crossover frequency for this system was chosen at 1000 Hz, rather high compared to most two-way systems, although the manufacturer claims that both woofer and tweeter have useful and distortion-free ranges well above and below this frequency, respectively. Our free-air response measurements confirm that the transition from low-frequency element to high-frequency tweeter produces no sudden "peaks" or "valleys" in the unusually flat response curve of the system. Crossover slope is only 6 dB per octave, since the crossover network employs a single L and C only. No controls or high-frequency attenuating switches are provided and, although we found the



Fig. 2—Grille cloth panel removed

system to be in excellent "balance," free air measurements did disclose a somewhat greater output than "flat" from about 3500 Hz and up in on-axis measurements. Some listeners may have preferred to be able to reduce the highs a bit, by means of a two or three position switch such as is found on more expensive systems. Undoubtedly, this omission is a matter of economics and, in any case, off-axis and in our own particular listening room (fairly well "damped"), the balance seemed to be just about perfect, contrary to the measured results obtained with calibrated microphone measurements in free air. That, of course, is one of the troubles with speaker response measurements, whether conducted in free air or in an anechoic chamber—the ultimate test is still the subjective listening test and in that test, University Sound's "Project M" passes, with very high grades.

An electrical test which has assumed great importance in this era of solid

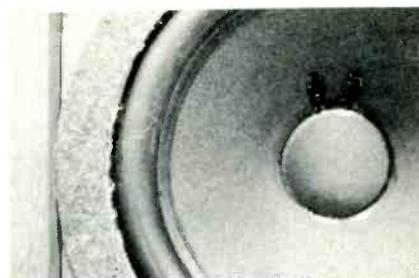


Fig. 3—Showing the "Unirol" suspension



Fig. 4—Close-up of closed-back tweeter

state amplifiers is that of speaker impedance over the entire frequency spectrum. A plot of this characteristic is shown in Fig. 5 and at no frequency does the net impedance of the voice coil go below the "safe" limit of four ohms. Characteristically, the rise in impedance at resonance in air suspension designs is minimal, reaching a peak of only 10 ohms at a system resonance of 57 Hz. The constant-resistance crossover network design is so accurately accomplished that the transition from woofer to tweeter operation (normally obvious in this impedance curve) cannot even be detected.

The size of this speaker system makes it ideally suited for use as a primary system within just about any listening area and with just about any reasonably high-quality amplifier. Its price makes it equally suitable for secondary, "remote speaker" installations, as well!

Check No. 43 on Reader Service Card

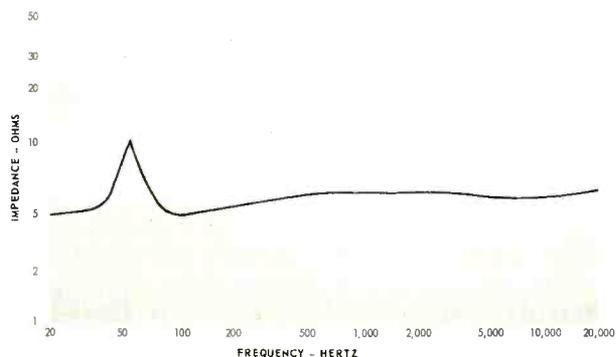


Fig. 5—Impedance characteristics of "Project M" system

## Ampex Micro 52 Stereo Player/Recorder Deck

### MANUFACTURER'S SPECIFICATIONS:

**Frequency Response:**  $\pm 3$  dB, 50 to 10,000 Hz. **Signal-to-Noise Ratio:** 45 dB. **Crosstalk:** 55 dB, side 1 to side 2; 30 dB, left to right channels. **Mic Input Sensitivity:** 0.1 mV,  $\pm 3$  dB. **Mic Input Impedance:** 500 ohms. **Line Input Sensitivity:** .07 V  $\pm 3$  dB to 1.0 V max input. **Line Output Level:** 0.6 to 1.5 V max, 50,000-ohm load. **Speed Accuracy:**  $\pm 1.5\%$ . **Flutter:** 0.25%. **Fast Wind Time:** 65 secs (C-60 cassette). **Dimensions:**  $16\frac{1}{4} \times 10\frac{5}{16} \times 5\frac{1}{16}$  in. **Weight:** 10 lbs. **Price:** \$149.95, including two microphones.

The continually increasing interest in cassette-playing equipment has brought a large number of players and player/recorders to the market, and this recent Ampex model offers its attractive features of convenience, portability, and performance to the cassette enthusiast.

The Micro 52 is an upright cabinet of walnut-finished wood with a satin-finished chrome strip along the top broken by seven "piano-key" controls—PAUSE, STOP, FAST FWD, PLAY/REC, REWIND, the interlocking RECORD key, and EJECT. The next 5-in. section of the front is completely black—the left half opening forward to insert or remove cassettes, and the right half obscuring the VU meters until power is turned on, when they become visible through openings in the dark plastic covering.

The next 2½-in. section of panel space accommodates the various operating switches, controls, the tape counter, and the microphone jacks. Playback output level is fixed, but there are two controls for each channel for adjusting the recording level for microphone and line inputs. These controls are of the linear slide type, and the position of the knob indicates the setting immediately. To their right are two switches—the upper one for recording level control, either manual or automatic, and the lower one for line power. A small panel on the rear accommodates the line input and output phono jacks.

In the MANUAL position, the recording level is controlled by the slide pot for either the microphone input or the line signal. In the AUTOMATIC position, a portion of the output of the recording amplifier section is fed through a diode, filtered, and fed to the base of a transistor which effectively shunts part of the input signal



Fig. 1

to maintain a reasonably constant recording level.

Each channel employs seven transistors, and two additional transistors are used in the push-pull oscillator circuit, which operates at approximately 84 kHz. One additional transistor is used in the power supply to provide a regulated voltage supply to the amplifier stages. The preamp section contains two transistors, with equalizing feedback switched around them in the playback mode. The preamp is followed by a two-stage amplifier and an emitter follower which feeds the output, the VU-meter amplifier, and the automatic-level-control section. Internal adjustments are provided for setting playback level and for calibrating the VU meters, which are set for a "0" indication when the level is 8 dB below the 3-percent distortion point. Adjustments are also provided to set the correct bias level.

### Operation

Depressing the EJECT key opens the left side of the black plastic front to permit inserting the cassette into a space provided on the hinged door. The door is then pressed shut, and the PLAY/REC key is depressed to start the machine. A PAUSE key stops the tape motion, enabling the user to set levels on his projected program material. Another press releases the PAUSE key and the tape moves. REWIND and FAST FWD keys may be depressed while playing or recording, but to go back to playing again, you must press the STOP key, since the PLAY/REC key cannot be depressed while the tape is in motion as it would cause the idler to press the tape against

the capstan, with a possibility of tape breakage. To record, one simply depresses the RECORD and PLAY/REC keys simultaneously, which can be done only if the safety tab on the cassette has not been broken out, or if a piece of cellophane tape has been put over the place where the safety tab normally is. This feature is common to all cassette machines, of course, and is one of the advantages of the cassette system.

It is not possible to record both microphone and line inputs on the same channel mixed together, since plugging in the microphone cuts out the line input. However, one can record from microphone on one channel and from line on the other so that when played back on a stereo system, the effect is the same as though the two were mixed during recording on the same channel. That is, of course, assum-

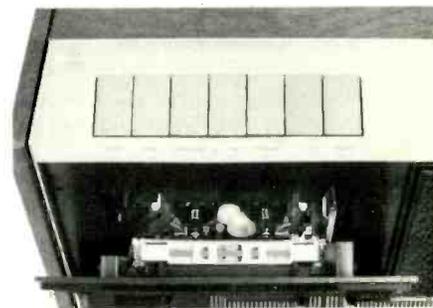


Fig. 2—Showing hinged door open.

ing the stereo system is switched to the mono mode, or that both channels are fed through a "Y" connector to one input.

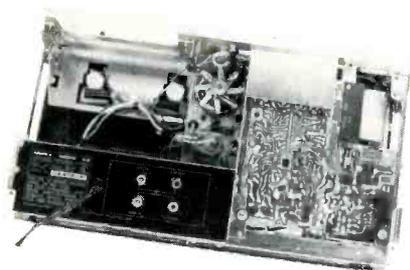


Fig. 3—View of Rear.

### Performance

In order to test out the machine, we used a number of different manufacturers' cassettes, primarily to see how much difference there was in different makes. All were recorded without changing the bias, which probably puts some of them under a handicap, for TDK tape, for example, is said to require slightly more bias than the usual cassette tape. The frequency responses of these five tapes are shown in Fig. 4, and all, of course, reflect the performance of the machine as well as the tape itself.

It is immediately apparent that the bias is not at the optimum value for the TDK

10,000. None of these should be considered specific, since bias was not changed during the several frequency runs. The main result, therefore, is to show that the basic response of the Micro 52 is essentially flat to at least 10,000 Hz, which has to be considered excellent at a tape speed of  $1\frac{7}{8}$  ips. We can easily remember when 50 to 8000 was par for the course at  $7\frac{1}{2}$  ips, but that was before the present-day tapes were available.

Similarly, signal-to-noise ratios were remarkably constant, ranging from 43 dB on the poorest sample to 45.5 on the TDK. Flutter and wow together measured 0.25 per cent in the range from 0.5 to 6 Hz, but reached a maximum of 0.35 per cent in the ranges above 6 Hz.

Considering all of its functions, its convenience, and its appearance, the Ampex Micro 52 is a machine on which the average recording enthusiast could well transfer a lot of musical material that he wanted to keep so as to free his reels of  $\frac{1}{4}$ -inch tape for reuse. That is the main virtue of the cassette recorder, in this observer's opinion. Often one will record something—perhaps off the air or possibly some important family happening—using a typical reel-to-reel  $\frac{1}{4}$ -inch machine. The material may be of sufficient importance that the user does not want to erase it, but he still does not want to tie up all his standard tape reels. We submit that he could well

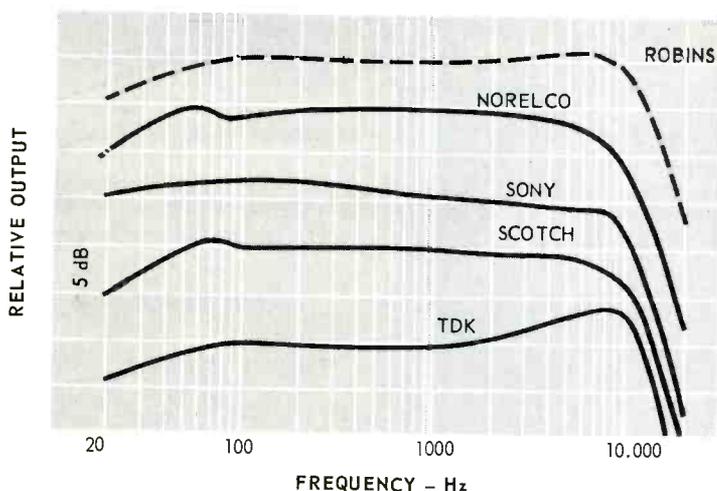


Fig. 4—Record/play response with tapes of five different manufacturers.

tape, which shows a maximum response at 9000 Hz, and a rapid rolloff after 12,000. The tape marketed by Robins Industries shows a flatter response up to 10 kHz, with the rolloff occurring after that frequency. None of the five tapes tested showed a response worse than  $\pm 4$  dB from 20 to 10,000 Hz, with TDK extending to 13,000 kHz, the Robins, Sony, and Scotch tapes to 12,000, and the Norelco to

transfer such material to a cassette, break out the safety tab, and store the compact cassettes for his personal "archives" without the probability of accidentally erasing any material he wanted to keep. To this application we commend the cassette recorder, and the Micro 52 does a great job for just such a use.

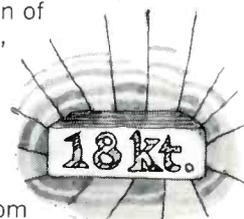
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# THE GOLD-PLATED RELIABILITY FACTOR.

In this age of planned obsolescence, unreliable performance and shoddy workmanship are almost taken for granted. But there are still a few exceptional products that are built to last and one of them is the Revox tape recorder.

Revox dependability is a combination of many factors, but perhaps the most important of them is advanced engineering. Borrowing from space age technology, Revox gold-plates all of the electrical contacts on its plug-in circuit boards, relays and rotary switches. The result: every one of these movable contacts, the ones that usually cause most of the problems, can be depended upon to perform well for the life of the machine. Obviously, gold plating is considerably more expensive than conventional tinning, but Revox thinks it's worth it.

Because Revox engineers demand margins of performance and reliability that far exceed ordinary production standards, you can own a tape recorder that will work perfectly the first time you use it and for years to come. And that's why Revox is the only one to back its machines with a lifetime guarantee.



## REVOX DELIVERS WHAT ALL THE REST ONLY PROMISE.

Revox Corporation  
212 Mineola Avenue  
Roslyn Heights, N.Y. 11577  
1721 N. Highland Ave.  
Hollywood, Calif. 90028

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velous with Brahms, a Viennese transplant like Beethoven) is out of a very different background, Poland, the land of Chopin. Perhaps this quiet, gentle Viennese music is, at last, one too much for him.

Performance: B— Sound: B

**Schubert: Unfinished Symphony; Four Overtures.** Menuhin Festival Orch., Menuhin. **Angel S-36609 stereo** (\$5.98)  
**Schubert: Symphony No. 9, "The Great C Major".** Menuhin Festival Orch. Menuhin. **Angel S-36636 stereo** (\$5.98)

Suddenly—great Schubert.

I did not much like the run of Menuhin disks of past years with the Bath Festival Orchestra. Too many of them were jumpy and poor in ensemble; in particular the Baroque and Mozart-period performances were decidedly inferior to many available from continental sources. That series continued into this cycle of Schubert symphonies (Nos 2 and 6) and I did not even bother to play the music, expecting the usual. But now I have discovered the big change that apparently came with Menuhin's own name-orchestra—or perhaps it is simply that this early 19th century music is more Menuhin's sort.

These recordings are really outstanding. For one thing, the performances are now both relaxed and impeccably accurate, for a much more impressive and natural impact. Real music making. For another, Menuhin has made a really important reevaluation of Schubert tempi—he plays these late and usually ponderous works with the verve which we

Schubert  
The Unfinished Symphony  
Four Overtures  
Yehudi Menuhin



associate with the early "little" Schubert symphonies. For years—for a century—the ponderous approach to late Schubert has been standard, as though to prove how weightily he foretold such as Tchaikowsky and Wagner. Now that, so to speak, we couldn't care less on *that* score, it is high time we took some of the sententiousness out, and that is what Menuhin has done. His late Schubert is brisk and moving, like so

much updated Mozart. Excellent! And more successfully brought off, I think, than Toscanini's high-speed Schubert, which was fast for a different reason, and not at all relaxed. (Toscanini made even Schubert sound Italian; his fast Schubert was for me taut, nervous, and somehow insecure.) Not Menuhin's. Though the Menuhin Ninth goes along at a clip far speedier than the long-standard Bruno Walter sort, it is sprightly, relaxed, and musical and loses no impressiveness at all for being lighter in weight. The same goes for the Unfinished, which so often is heavy and slow to the point of dullness.

The series includes all the symphonies, plus the four overtures that go along with the short Unfinished. All but Nos 2 and 6, on one record, are with either the Menuhin Festival Orchestra, or just the Menuhin Orchestra, whatever difference there is.

Performances: A— Sound: B

**Mendelssohn: Symphony No. 1, Op. 1.**  
**Schubert: Symphony No. 1 in D.** Cleveland Orchestra, Louis Lane. **Columbia MS 7391 stereo** (\$5.98)

These two number-one symphonies haven't often been heard and go beautifully together—Mendelssohn's was composed at fifteen, Schubert's at sixteen, both young men having already had extensive experience in instrumental performance as well as composition, if in very different circumstances. (Mendelssohn's family were wealthy music connoisseurs; Schubert played via a scholarship at an imperial choir school in Vienna.)

Both symphonies are, as you might expect, rather large and important sounding. And, when you get into them, somewhat overblown and repetitive in organization. That is the way with youth, after all, even well-trained youth! Economy comes later. But to criticize them beyond this is impossible—such incredible accomplishments for two mere children! Indeed the Mendelssohn symphony is one of his nicest works of any sort, early or late. He was even more a child genius than Mozart, but for tragic and inscrutable reasons somehow stopped moving forward before he was fairly out of his salad days. Mendelssohn's later frustration—though his composing and performing career continued at a frenzied level—was surely a tragedy for music. His very greatest works came only shortly after this symphony—the Octet, the Midsummer Night's Dream Overture. From thence onwards that endless flow of fussy, almost prissy little tunes,

the eternally jittering violins and the ever-warbling winds, simply wear down the listening resistance. Boxed-in! Rigidly limited, with, so to speak, a horridly fixed smile on the music's face. No wonder the man died early.



The scherzo from the Octet is added to this recording since it was substituted, in rewritten form, in the first performance.

Those who know the later "little" Schubert symphonies, Nos. 2 through 6, will find No. 1 quite similar, but more loosely organized and, oddly, a bit more Romantic. Probably because it tries harder to sound big. Gorgeous Schubert melodies and the same for the harmonies—even at sixteen Schubert was infallible.

The performances by the Cleveland Orchestra under Louis Lane are absolutely lovely, precisely right in spirit and expression.

Performance: A— Sound: B+

**Mendelssohn: Double Concerto for Violin and Piano in D Minor.** Carroll Glenn, vl., Eugene List, pf. Vienna Chamber Orchestra, Maerzendorfer. **Westminster WST 17166 stereo** (\$5.98)

What an astonishingly complex and full-blown piece of music for a fourteen year old! This is one of the unpublished youthful works immured for so long in the State Library in Berlin, now in the East zone. The Lists (Carroll Glenn is Mrs. L.) could not get it out of hock there until the Easterners finally got around to publishing it, though they tried over a long period.

At fourteen, Mendelssohn was well ahead of Mozart at the same age as far as composition was concerned. He had an amazing amount of music already behind him, composed for the splendid performers always ready at hand in his parents' lavishly musical home. But this piece does not compare in real value to the Symphony No. 1 of a year later, which Mendelssohn called, with reason, his Opus 1. (There had been a dozen

or so earlier little symphonies for strings.)

Here, the child composer has learned all the tricks to an astounding degree, but his "soul" isn't really forthcoming quite yet. It blossomed with adolescence. This is a big, sprawling, entirely contemporary work (as of its time, the early 1820s, when the Mozart-Haydn manner was still predominant in spite of Beethoven), treating the difficult problem of joint violin and piano solos with an aplomb that Mozart or Haydn could well have envied. But the whole thing smells, as they used to say, of the lamp. Fugues, cadenzas, busy workings-out, the whole bit. In spite of our awe, we're likely to get bored, over and over, until a new idea comes along to rekindle interest. OK—so he was fourteen. A genius but do I have to listen? I'll admit that the whole thing would be a lot more effective in a live performance, with pianist and violinist right there to watch. That was the idea.

The recording is somewhat unfortunate. Close-up and studio-like in sound, it makes the orchestra's playing appear hectic and poorly blended, though I suspect it was not. And the disk itself is cut at a very high level with a constant hint of overloadish distortion. Rough sound. Gotta be particularly careful, you engineers, about those vigorous violins! With their brilliant overtone coloration they can overload your circuits without the meter even knowing it—as *you* should know.

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Performance: B    Sound: C+

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**Music of the Spanish Theatre in the Golden Age.** New York Pro Musica. Decca DL 79436 stereo (\$5.98)

Like the Don Cossacks, the New York Pro Musica goes on and on. But the Pro Musica has changed, as the Cossacks haven't noticeably. The Pro Musica must be Decca's most valuable classical property by this time, after umpteen dozen LP records one right after another. And composers galore who thought their music long since as dead as themselves are rising up in astonishment from their graves at the wholesale renaissance of such quantities of their best work. The Pro Musica is getting better, in spite of mass production.

The early Pro Musica records (and concerts) were irritatingly uniform, the same too-familiar voices, singing in the same brassy, professional fashion regardless of what music they sang, the instruments, authentic of course, zooming along in that briskly mechanical fashion that passes for

musicianship, alas, among those who think that merely playing an old instrument so the notes are right is miracle enough. It is, to be sure! But there is more to music than playing notes. Or singing notes.

Most of the original voices have now left the Pro Musica and some of the instruments (they were often the same, as is standard practice in most old-music groups). The original leader, Noah Greenberg, is dead. Under John Reeves White's direction a great deal more subtlety has crept in, and more variety, too, not only in the range of vocal and instrumental sounds but, happy to say, in the treatment of the music according to its need. The



present record must stand for many others. An expanded array of instruments, including krummhorns, rauschpfeife and sackbuts, as well as members of the recorder and viol families and the various portable organs (regal), plus bells, drums, miniature castanets, and the usual harpsichord and lute (and no doubt a good many more instruments on a part-time basis) now enliven the sound of performances such as this one. An ensemble of five soloists sings here, including the inevitable countertenor (Ernest Murphy). With a half hundred and more live concerts a year in their schedule, performance is totally precise, out of long practice. But the best part of it is the new mellowness and expressivity, the more human quality of the exposition. An improved Pro Musica, definitely. For which we can probably thank John Reeves White as well as the innate musicianship of his singers and players.

---

Performance: B    Sound: B

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**The Moon Is Down.** Sing-In Boulder. (Boulder, Colo. High School.) Owl ORLP-15 stereo (\$4.98)

A bunch of sixteen high school kids made this one—I tried it just on a hunch,

and the hunch was right. It's good.

To be sure, there are mildly corny moments, and some that are merely amateurish or insecure, in this set of fourteen pop songs, seven to a side in standard LP fashion. But in the main, it is a wonderfully sincere and moving documentary, "sweet sixteen" and a little older getting together to make their own music with surprising sophistication and musicianship. Most of the numbers apparently are done straight from scratch, words, tune, arrangements and all; a few are standard pop items—the Beatles, Joni Mitchell—refashioned into this group's image and thus a good complement to the local product.

The voices are so obviously young, so utterly without guile or commercial taint, that one almost weeps at such untouched honesty expressed so well and with such utter seriousness. The instrumental parts are proficient and interesting, with a lot of gentle but well-managed color. The boys, it must be admitted, generally outdo the girls, as indeed they should, that being the male prerogative in music. (The "cast" lines up in many different combinations, boys and girls.) Two boys in particular, whose numbers open and close the recording, are really superb musicians—Rick and Pat. Those two should stay in music. They're decidedly talented. Also Mel, who sings an absolutely lovely young version of the Beatles' "Hey Jude!" (omitting, wisely, the long coda) to a faultless accompanying ensemble.

If you think kids just make ugly noise, then try this disc—and let *your* kids hear it, too.

---

Performances: B+    Sound: B+

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**Bartok: Piano Concertos Nos. 1 and 3.** Daniel Barenboim; New Philharmonia Orch., Boulez. Angel S-36605 stereo (\$5.98)

Curious. Here we have the famed Boulez, who will soon take over the New York Philharmonic (a part-time jet stop), plus Barenboim, that powerhouse young Argentine "music factory" whose piano records have been coming out faster than most of us can play them; also the world's finest British orchestra, the New Philharmonia. And yet, for my ear, the Bartok isn't good.

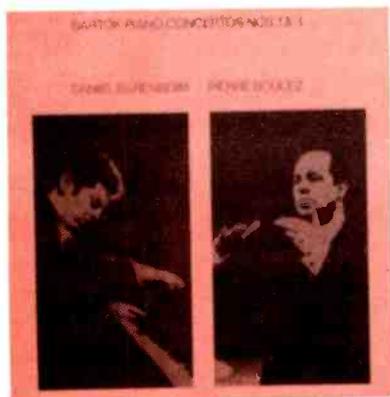
I think I can hazard a guess as to how come. At this late date it is clear that like so many of his contemporaries Bartok was still at heart a left-over Romantic, writing in a fierce modern dissonance that was enough to disguise the fact for those who

heard him with shock and horror, and even for those who loved him. All the basic Romantic traits are still there, the large-scale passion in the expression (fiercer and more passionate than any Romanticist), the elegance of his orchestra, the perfection of large-scale concert-style music architecture, the love of a good tune—and a good harmony, dissonance or no.

Boulez, in his forties, is of the cool generation and from that cool musical climate of satire and anti-Romanticism, France. Temperamentally, he goes along more easily with the Stravinsky outlook, though he conducts all manner of moderns; his Romantic music is neither that of Bartok's generation nor of the new, young generation who wear their passions once more like their long hair. He falls between.

As for Barenboim, I can only suggest that, one way or another, his Bartok is un-Hungarian. It does not seethe and boil and burst into steely, disciplined frenzy, as the passionate Hungarians always play it. The notes are all there, technically well played. But there is a detachment, a sober studiousness, as though the music really didn't quite get through to the pianist's intelligence.

The Philharmonia? Believe it or not, the music, especially the tough first concerto,

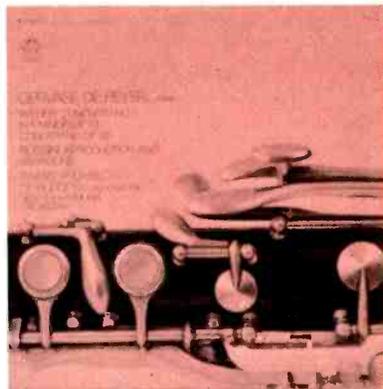


sounds a wee trace unrehearsed—speaking purely relatively, as one must for this world-famed ensemble. I have heard this same music played better, with more ease and enthusiasm, by much less favored orchestras.

So—if you don't know the difference (like most of the people who write publicity for recordings), then you'll "acclaim" this one as another brilliant success for three acclaimed performers, the piano, the conductor, and the orchestra. But I suggest you also look elsewhere for more convincing Bartok.

Performance: B— Sound: B

Weber: Clarinet Concerto No. 1 in F Minor, Op. 73; Concertino, Op. 26.  
Rossini: Introduction and Variations for Clarinet and Orch. Gervase de Peyer; New Philharmonia Orch., De Burgos.  
Angel S-36589 stereo (\$5.98)



Weber loved the clarinet. His numerous works featuring that instrument at its early-19th-century best are a joy to hear. The big ones include two concerti and the shorter, more informal concertino. Though the concerti try for the proper grandiloquence, in such formal-dress music, Weber's ear for a quick, catchy tune or a quirk of melody ensures that solemnity reigns but briefly. And he knows what astonishing things his instrument can do—in its classical phase, that is. No jazz in the 1820s.

F minor is not a joyful key, but after a slightly frowning start this Concerto quickly moves into the limpid Weber style, a songful slow movement and a *finale* rondo that sounds like a jump-dance from a Czech village festival, or maybe a Bavarian beer hall. The Concertino starts slow and serious but all full of stagey drama, and ends like a Strauss waltz in double time.

As for the Rossini—wow! A bravura stage piece with all the clarinet tricks. First it is slow and lavish, the clarinet rolling out those sugary, ornamented tunes that are the despair of today's Rossini opera singers, then it turns fast and fancy, with whirlwinds of clarinet scales and arpeggios. Some showpiece.

De Peyer is a top-notch but very cool clarinetist—in all senses of that useful word. Throughout all the incredible roulades and runs, his face (we can imagine) does not move a muscle. The classical clarinet can be a bit more outwardly emotional, and I prefer it that way, at least in this unabashed show-off music.

Performance: A— Sound: B—

THE BEETHOVEN YEAR  
Beethoven: The Creatures of Prometheus, Op. 43. Menuhin Festival Orch., Menuhin. Angel S-36641 stereo (\$5.98)

The Beethoven Year gets off to a somewhat anticlimactic spring *chez* Angel with this almost-complete performance of Beethoven's only ballet score, put together in 1801 at the end of his "first" or youthful period. There's nothing wrong with "Prometheus," given its purpose and the fourteen items out of 17 in the score (all that would fit on the disc) are impeccably played by the Menuhin orchestra. There just isn't very much to hear—considering that this, after all, is the World's Greatest Composer.

The explanation, I'd say, is in Beethoven's own extraordinary sense of style and occasion, plus his rather keen eye for a good thing in terms of his own betterment. (Not that it did him much good, this last; he was too pugnaciously commercial to get away with it!) "Prometheus" reminds me of much lesser revived Baroque today, well written but empty. To be sure, the score had all the then-modern outward hallmarks of the Beethoven manner, the gruff chords, the loud, rough octave doublings of melodies, the explosive endings—rows of pompous chords. It therefore pleased, because even so it is easy music to hear. The stage show was given thirty times before it wore out its welcome. Not bad. But what the modern ear hears is the deliberately low level of content chosen by Beethoven throughout—as through writing down to his ballet listeners. Though he might deny it, this is exactly what he did.

The tunes are mostly sappy. The developments are rudimentary, if polished. There are numerous important-sounding statements which say nothing much, endless sequences, music exactly repeated at a different pitch level, where, so to speak, with a flick of the wrist. Beethoven could add a bit of variety. He didn't. That wasn't the game.

Only in the last section does interest suddenly rise—for here is the famous "Eroica" theme (the last movement of the symphony) in the second of its four appearances. But that interest is mainly negative; the tune itself is here surrounded with such incredible "nothing music" that one can only marvel at the composer's wisdom in *not* borrowing it for the later and greater expression! The man could really compose, when he had a mind to. But this, very clearly, was not the moment, and no amount of impeccable performance will make it so.

Performance: A— Sound: B+

# Jazz



BERTRAM STANLEIGH

■ One of the handsomest record packages to be presented on the folk market—an area of recording activity that has been notable for its lack of distinctive graphic design—is a new two-disc collection of blues on the brand new Poppy label. The album and record label were designed by Milton Glaser of Push Pin Studios, one of New York's most prestigious design and illustration groups. An examination of the performers listed—Lightnin' Hopkins, Pete Johnson, Juke Boy Bonner, Mance Lipscomb, Joe Turner, Clifton Chenier, Fred McDowell, Earl Hooker, Big Mama Thornton, and more than a dozen other blues singers and instrumentalists, many of whom have never travelled far from the Mississippi Delta and Texas Gulf regions—makes it clear that the origins of the music in the set are from Arhoolie Records, a small Berkeley, California based company.

For ten or more years, Arhoolie's director Chris Strachwitz has been making field trips to those areas of the southern United States where a land-based culture has managed to preserve, unchanged, the musical folk styles of a number of isolated rural communities. The recordings collected on those trips supplemented by work of other collectors and studio-made recordings of professional folk musicians, have resulted in one of the finest archives of published blues and folk music recording.

In selecting material for a set that explores the background of today's rock music, Poppy's founders could not have gone to a better source. The Poppy series, devoted to progressive rock, folk music, and social comment, is aimed chiefly at the college audience, and its recordings are distributed throughout the world by RCA. The sophistication of its packaging is in marked contrast to the more austere, low-budget graphics of the Arhoolie line. But where Arhoolie has supplied extended and scholarly notes about the music and performers on all of its recordings, the Poppy reissues supply no more information than the titles of the songs and the names of the performers.

Certainly, in a set that features 26 different selections by as many sets of performers, it is useful to know that Lightnin' Hopkins, Juke Boy Bonner, and Lil' Son Jackson all represent the old-style Texas blues; that Clifton and Cleveland Chenier are purveyors of a musical idiom called *Zydeco*, an amalgam of blues and Cajun music that flourishes along the Louisiana-Texas Coast; that Big Mama Thornton introduced *Hound*

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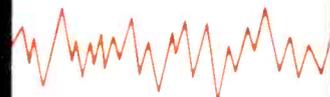
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Big Mama Thornton introduced *Hound Dog* and made it a hit before Elvis Presley; and that Fred McDowell, born in 1904, had worked all of his life in the Mississippi cotton fields until his discovery in 1959 by Alan Lomax. With so many different performers in such a variety of selections, the problems of writing a comprehensive set of notes that cover all styles and artists is tough. But the answer is not to skirt the issue entirely and rely solely on fancy artwork.

The set ducks another issue, too. Nowhere is there a legend that indicates that these recordings are all monophonic. We all know that it's harder to sell mono recordings to a market that is amply supplied with stereo playback equipment, but when the material is only available in mono form, the open, fair, decent thing is to spell it out. RCA does this on all of the mono reissue recordings it produces, and it surprises us that it does not insist on the same frankness of labelling on the part of other producers whose productions it markets.

So much for reservations. The music on this set is the important thing, and there's a lot of it, both in quantity and quality. From the Texas barrelhouse piano of Robert Shaw on *The Ma Grinder* to the urban-blues-rock *Two Bugs and a Roach* of Earl Hooker, this set is all genuine, down to rock bottom blues, the most real, direct, soul wrenching form of music this country has ever produced.

#### Blues Roots

Poppy Mono PHY 60,003

Performance: A                      Sound: B

#### Al Hirt: Paint Your Wagon

GWP Records Stereo ST 2002

While Al Hirt's style of performance has the authentic flavor of his New Orleans origin, most of his recent performances cannot properly be classified as jazz. He is nonetheless a trumpeter of formidable technical prowess with a rich, full tone, and listeners who can overlook a musical backing that includes a vocal chorus, syncopated handclapping, and a lush string section will find a great deal to admire in Hirt's tuneful, straightforward performances of such familiar melodies as *I Still See Elisa*, *They Call the Wind Maria*, and ten more numbers from the Lerner and Loewe musical. Everything about this production, on a heretofore unknown label, is very well handled. If you have trouble locating this recording, GWP Records is at 150 East 52nd Street, New York, N.Y. 10022.

Performance: A                      Sound: A

#### Tony Scott

Verve Stereo V6-8788

Clarinetist Tony Scott tried his hand at Eastern instrumental accompaniments before, but never so successfully as in this delightful experiment that merges John Berberian, oud, Souren Baronian, dumbek, and Steve Pumilia, percussion, with Milt Hinton, bass, Beril Rubenstein, organ and piano, Attila Zoller, guitar, Jimmy Lovelace, drums, and Tony Scott with his clarinet. The music on which this instrumentation is employed consists of *Ode to an Oud*, *Swara Sulina*, and *Homage to Lord Krishna*, on the latter, Collin Walcott joins the group on sitar. These are all original works by Scott. For the balance of the disc, he dispenses with the exotic instruments, and presents very pleasant versions of his own *Blues for Charlie Parker* and such standards as *Satin Doll*, *My Funny Valentine*, and *Sophisticated Lady*. It's a lovely set of performances in elegant stereo.

Performance: A                      Sound: A

#### Bay City Jazz Band: Golden Days!

Good Time Jazz Stereo S10053

The Bay City Jazz Band, one of San Francisco's best New Orleans revival groups, was organized in 1955 and disbanded in 1957. Like the history it sought to recreate, it exists today only on phonograph records. The present set was recorded in 1957, and most of the group's members have since returned to non-musical careers. It's a pity that they couldn't continue, for their music making had a feeling of freshness and genuine emotional involvement that is seldom encountered in groups that imitate an earlier period and style. The dozen tunes on this set include *Riverside Blues*, *Chimes Blues*, *Angry*, *New Orleans Stomp*, *Coal Cart Blues*, and *Skid Da, De Dat*. The sound shows its age, but the stereo is genuine and very nicely spread.

Performance: A-                      Sound: B

#### Paul Horn: Inside

Epic Stereo BXN 26466

Recorded inside the Taj Mahal, a structure which in addition to its fabled beauty must have one of the longest reverberation periods on record, this platter offers flutist Paul Horn in a set of introspective improvisations. Most of the music is for solo flute, but a few of the bands contain a duet for flute and the chanting of a local singer. Recorded at night, by moonlight, the mood of the

performances captures the wonder, mystery, and exoticism quite effectively. Nothing in his earlier recordings prepares one for the poised, shimmering etherealism of this new sonic adventure by a talented and sensitive musician.

Performance: A                      Sound: A

#### Stan Getz: Didn't We

Verve Stereo V6-8780

This set finds Getz doing another of his solo performances against a background of studio strings arranged by Johnny Pate. Whether it was the mood at the sessions, the music selected, or both, these performances emerge with far greater distinction than one would expect from the stereotyped format. Getz finds worthwhile comments to make on tunes such as Benny Golson's *I Remember Clifford*, Johnny Mandel's *The Shining Sea*, and the title song by *Jim Webb*.

Performance: A-                      Sound: A

#### Herbie Mann: The Great Mann

Verve Stereo V6-8784

All of the performances on this set were originally issued on long unavailable recordings of the late 50s and early 60s. In spite of the abundant supply of more recent Mann performances in somewhat richer stereo sound, there is always room in the catalog for such lively, sophisticated performances as these. Included are *Cuban Potato Chips*, *Tenderly*, *Todos Locos*, *The Evolution of Man(n)*, *A Ritual*, *Fife 'n Tambourine Corps*, *You Stepped Out of a Dream*, and *Caravan*.

Performance: A-                      Sound: B

#### Dizzy Gillespie: Soul & Salvation

Tribute Stereo TRI 5001

Ten gospel-style numbers by arranger-conductor Ed Bland serve as a vehicle for Dizzy, saxophonist James Moody, trumpeter Joe Newman, and an assortment of rather distantly recorded, nameless sidemen to play some pleasant bouncy music with a tinge of rock in the accompanying instrumentation. The recording not only places the soloists too far in front of the rest of the group, it seems to drain the music of dynamic excitement. It's clear, however, and the stereo separation is good.

Performance: A-                      Sound: B+

# Light Listening

Sherwood L. Weingarten

Leftovers normally are as appealing as a polluted stream to would-be bathers. But RCA has compiled an album of "rejects" equal in vitality and excellence to any LP available.

DISINHAIKITED (Victor, LSO-1163), in fact, should prove as commercially successful as the musical geyser from which it was extracted, the smash tribal-rock phenomenon, "Hair." Despite the continuation of lyrics that are anti-Establishment, anti-war, pro-sex, and pro-brotherhood. Certainly any who enjoyed the show (a dozen companies have toured the globe), or the off-or-on-Broadway original cast recordings, will marvel—and probably wonder why *any* of the tunes were deleted.

The 45 minutes of pleasure spotlight the talents of the trio most responsible for "Hair"—Gerome (Jerry) Ragni and James (Jimmy) Rado, who wrote the book and lyrics, and Galt MacDermot, who composed the score. The first two fill the roles they played in the Great White Way versions while MacDermot—according to the liner notes—"through it all arranged, conducted and played piano while sweet, straight folks from RCA wandered around wondering what the hell was going on."

The variety offered is as wide as that of the original, which spawned such chartbusters as "Aquarius," "Let the Sun Shine In," and "Good Morning Starshine." So it would not surprise me at all to find "One Thousand Year-Old Man" or "Dead End" riding high on the hit lists once this LP gains airplay.

"The Thousand-Year-Old Man," initially intended to be a sequel to "Let the Sun Shine In," is one of five tracks representing tunes that have never appeared in any performed version of the show. Its theme—"there's a new world a'comin'" is colored with notions of "angel-like superior beings" who inhabit a war-less future. Somehow the piece, the longest cut at 4:05, is reminiscent of the surrealism provided in the film "2001: A Space Odyssey."

The others are "So Sing the Children on the Avenue," a gospel-rock offering with a hint of the schmaltz of sing-a-long ditties; "Reading the Writing," part of a

humorous medley (with "Sheila Franklin") about the wonders of graffiti (with the first part rendered in rhythm 'n' blues style, the second in hillbilly motif); "Mess O'Dirt," a frenzied disembodied scorcher, and "Washing the World," a symbolic but somewhat bland tune once considered as an alternate finale.

All the songs on this LP were part of the original concept of the show, though some were penned as speeches or bits of dialogue. Some were intended for the first version the New Cork Shakespeare Festival production; others for subsequent entries.

The album title, pictured on the cover in the form of two Indians, comments on a social problem—the red man's plight. Social consciousness and a love for humanity (as opposed to *things*), in fact, runs throughout the disc. Perhaps what is sought is the Utopian setup envisioned in "Exanaplanatooch," one of four reprises from the off-Broadway recordings. The ballad, about a planet in another galaxy, showcases soothing strings and lyrics that tell of a world without pollution, with "total beauty, total health. Every man's an artist and a scientist-philosopher. No government and no police; no wars, no crime, no hate. Just happiness and love."

Among the cuts that linger in the mind are "Manhattan Beggar," a comment on life styles influenced by American and East Indian cultures; "Hello There," a gimmicky, old-time two-step reflection that utilizes megaphone and Andrews Sisters-type sounds; "Mr. Berger," a syncopated melody that mirrors the communications gap. It is here rendered by the Vienna Boys Choir directed by Abbie Hoffman); "I Dig," a bluesy winner; "You Are Standing on My Bed," a delightfully complex yet simple musical composite; "Oh Great God of Power," a sardonic, sacrilegious tribal chant to a deity of power utilities, and "Eyes Look Your Last/Sentimental Ending," with the mind-blowing repetition of the phrase "the rest is silence" (perhaps indicative that we're all "hair today, gone tomorrow").

And don't overlook a couple of "oldies" from the show, "Electric Blues" and "The Bed," both zesty numbers with meaty words.

There are those who claim the best songwriters of today are Jim Webb, the Beatle team of Lennon-McCartney, and Burt Bacharach. Others swear by Pete Seeger, Bob Dylan, or Phil Ochs. No matter where your allegiances lie, the hirsute team of Ragni-Rado (plus "square" MacDermot) must rate among the top.

And it's unlikely that *anyone* will come up with a better pop album this year. **Æ**

## Negative Feed Back

(Continued from page 20)

If voltage feedback reduces gain by  $\frac{1}{3}$ , then current feedback needs to take  $20 \times \frac{1}{3} = 15$  reduction. The current feedback AB factor needs to be 14. The total feedback reduction needs to be 20, so the total AB factor should be 19, using the same 'without feedback' reference signal. As 14 of this is current feedback, this leaves  $19 - 14 = 5$  for the voltage part.

Before going to a practical design, let's check our reasoning by seeing what happens when we change the external load from 500 ohms to either open-circuit or short-circuit.

With nominal load, the total feedback factor is  $1 + 14 + 5 = 20$ . How the feedback changes due to change in load will determine how the drive for the output stage changes.

If we open-circuit the output, the current-feedback AB product remains virtually unchanged at 14, while voltage feedback is multiplied by 3 (because collector load changes from 330 to 1K), from 5 to 15. So the total feedback factor is now  $1 + 14 + 15 = 30$ .

Open-circuiting the output will have two effects: the without-feedback gain of the output stage is tripled; while the feedback factor increases from 20 to 30, reducing gain by  $\frac{1}{3}$ . The overall effect is that output voltage doubles, which is what removing a matched load should cause.

Now if we short-circuit the output, the current AB product remains at 14, while the voltage feedback disappears, to make the feedback factor simply  $1 + 14 = 15$ . Thus current gain rises by  $20/15$ , or  $4/3$ . With the 500-ohm load, the load receives  $\frac{2}{3}$  of the current output, the other ceives  $\frac{1}{3}$  of the current output, the other  $\frac{1}{3}$  being spent in the 1K collector resistor. When the output is short-circuited, the short-circuit gets all the current, which is raised by  $4/3$ , or is double that in the 500-ohm load: again the condition of a matched load.

Thus this check supports the theory on which we based out feedback calculations. In the next installment, we'll apply this to completing a workable design. **Æ**

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# Recorded Tape Reviews

BERT WHYTE

**Chopin: The Ballades and Scherzos.** Arthur Rubinstein, piano. RCA R8S5057, 8-track cartridge (\$9.95).

That amazing octogenarian Arthur Rubinstein, "the elder statesman of the piano," continues to play and concertize with the vitality and exuberance of a man half his years. What can be said about this performance, other than to echo the praise so lavishly bestowed by critics everywhere? The maestro literally owns these works and if any recording can be said to be "definitive," this certainly merits that appellation. This is one of those "twin pack" cartridges, equivalent to two stereo discs, and it certainly is a magnum serving of Chopin. In fact it may be too much to digest at one time, unless you are a student of piano or a particular devotee of Chopin. This is one of the best cartridges I have heard. Even at good room-filling level, the hiss was quite low, and dynamic range surprisingly wide. The piano sound was generally very clean and in spite of some hard transients in the crashing chords and huge sonorities generated by Rubinstein, there was little print-through. The cartridge sounded fine in a car and was good enough to withstand the more revealing playback of a top-quality home system.

**Harpistry in Rhythm:** Robert Maxwell, harp; and his orchestra. Ampex/Command X5932, cassette, (\$5.95).

Facile, expert harp playing by Maxwell, along with some fairly elaborate orchestrations in a program of "pop" standards such as "Never On Sunday," "Delicado," "Bluesette," "Harlem Nocturne," etc. This cassette had less hiss level than most, and few dropouts. Low-frequency response was also markedly better than the average "pop" cassette. This is a typical studio multi-mix job. Reverb was not overdone as is the case in so many of these record-

ings. Tasteful directional effects and good center fill. The transients of the harp were sharp and well defined, but the harp needed more projection and "presence." Sound was generally clean except for some high-level trumpet passages which exhibited distortion. Pleasant background music with the harp adding an extra fillip of interest.

**Trouble Is A Lonesome Town:** Lee Hazlewood. Ampex/LHI Records X5111, cassette, (\$5.95).

Probably most people have been exposed to Lee Hazlewood via Nancy Sinatra's recordings, wherein he has accompanied her on certain numbers. Reportedly her "mentor" on the country/western music scene, it seems a strange alliance but apparently effective nonetheless. On this recording Lee displays his dark deeply resonant voice in a varied program of country/western numbers, built around a central theme of a "Town called Trouble." Like many similar personalities, he doesn't really sing in the accepted sense, but in a "speech and song" combination, sort of like a country version of Schoenberg's, "sprechstimme." Some of the lyrics are quite amusing and with the ubiquitous twanging guitars, this should please devotees of the country/western music. Sound is generally good, hiss moderate, some dropouts, and a few other extraneous burbles.

**Liszt: Hungarian Fantasia, Mazeppa, Hungarian Rhapsodies #4 & #5:** Shura Cherkassky, piano; Herbert von Karajan cond. the Berlin Philharmonic Orch. DGG 923 086, cassette, (\$6.95).

Another fine cassette from DGG, that gives us a big helping of some of Liszt's more robust music, including the rarely played, "Mazeppa." Many people consider this kind of music rather "dated," and indeed it is melodramatic and somewhat fustian. I think it would certainly pall if heard frequently. But like a good piece of sauerbraten, it is something to be savored every so often. Especially if the *chef du orchestre* is as talented as von Karajan in keeping a tight rein on the orchestra, maintaining a brisk pace, and avoiding the bombast which can make these works a bore. Von Karajan also establishes a fine rapport with Cherkassky in the Rhapsodies, and they give these hoary warhorses a rousing, ebullient performance. While the sound on this cassette is very good, it poses a problem. The sound is big, with spacious acoustics excellent stereo qualities, good center fill, sharp clean piano transients. It just cries out for power and should be played at a

room-filling level to appreciate the music and the superb playing of the Berliners. Do this, however, and you become all too painfully aware of the pervasive hiss. Turn the level down and the musical perspective shrinks. The tiger has turned into a tabby cat. Hiss is a problem with every type of commercial recording, but with the cassette it is monumental. Until this bug-a-boo of hiss is conquered, cassettes will never realize their potential. Fortunately, progress is being made in this direction and we will soon rid ourselves of this curse.

**J. S. Bach: Harpsichord Concertos #4 and #5: Concerto for Flute, Violin, and Harpsichord:** Ralph Kirkpatrick, harpsichord; Lucerne Festival Strings cond. by Rudolph Baumgartner DGG/Archiv 924 015, cassette, (\$6.95).

This is my first encounter with Deutsche Grammophon cassettes, and I must say I am impressed with the generally high quality of the product. One very welcome feature is the inclusion of notes concerning the music, a practice that the manufacturers of classical cassettes in this country should follow. The tape in these cassettes (BASF?) has a higher lustre and appears to have a smoother coating than our domestic products. In any case, I was pleased to note that the tape had very few dropouts, nor physical defects that would generate various kinds of noise. High-frequency response was excellent and there was a good solid bass, as evidenced in this recording by the well-defined continuo. Hiss level was low for a cassette . . . as good or better than our best domestic cassettes . . . but still too obtrusive. In this recording acoustic perspective is moderately spacious and directional qualities logical for the size of the orchestra. Dynamic range was as wide as the hiss level permits. The transients of the harpsichord were sharp and clean; however, the instrument should have been given more prominence as it is occasionally covered by the orchestra. Other balances were good. Nice smooth string recording and a melifluous flute round out the sonic picture. The music is quite delightful and these are fine idiomatic performances. Ralph Kirkpatrick is, of course, one of the premier exponents of the harpsichord and his superb playing undoubtedly stimulated his fellow musicians to put forth their best. In summation, for the critical audiophile, even these excellent DGG cassettes cannot match the higher quality of the stereo disc or open-reel tape. But for lower level listening . . . say at "apartment house level," these cassettes should win many friends among quality-conscious music lovers. **AE**

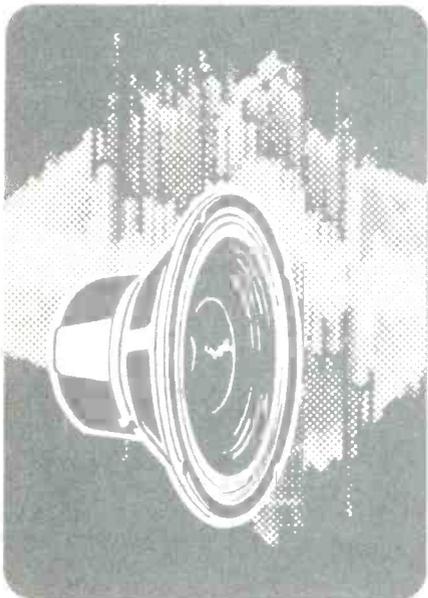
## Loudspeakers—Past and Present

(Continued from page 36)

neers in Chicago, some years ago, the author produced a "Sweet Sixteen" he had built himself, and compared it directly to a Jensen TF-3, with results which had no ambiguity at all. The array was demolished.

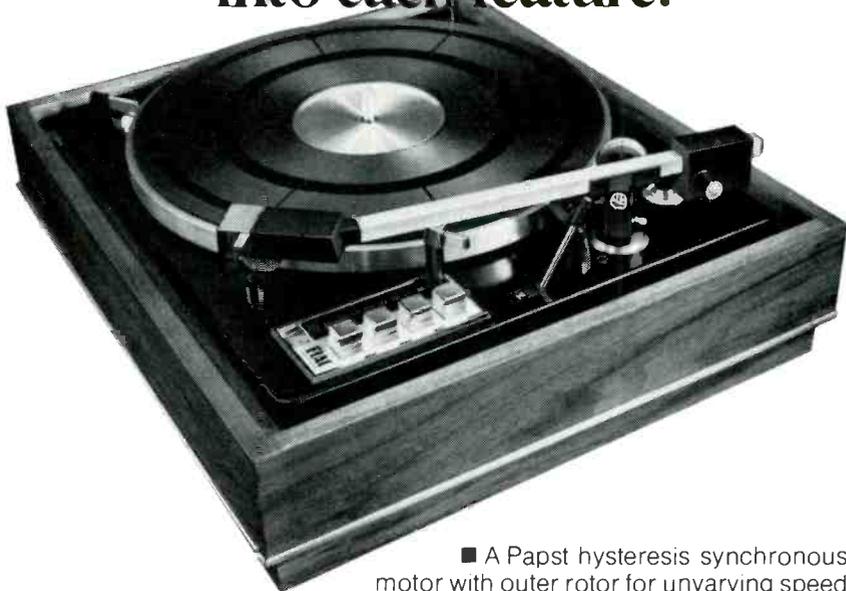
The solution of problems which do not really exist, at least in the sense that at least a few systems are already available which offer a clean, definite solution to the problem, seems to be a recurrent theme in "eccentric" speaker systems. Typically, a statement is made by the designer to the effect that others have sought for years to solve such and such a problem. This may be true, but the author overlooks the fact that a solution is already at hand, and goes on to propose a considerably more complex, often questionable solution.

It is not a matter of engineers vs. amateurs, or of rational beings vs. irrational ones. It is the earnest unrestrained quest for a "feature," for a "break-through" that the independent inventor emerges from his study with an eccentric speaker system design. More often than not, the result is interesting. On occasion, it is even a challenge to analyze the acoustic behavior of the invention. But the basic separation between speaker systems is not into horns, sealed enclosures, and bass reflex; nor is it a matter of large systems warring against small ones. At least not in scientific terms. It is the quest for accuracy, which most designers try to pursue, but which is difficult enough to discourage and sidetrack others. **AE**



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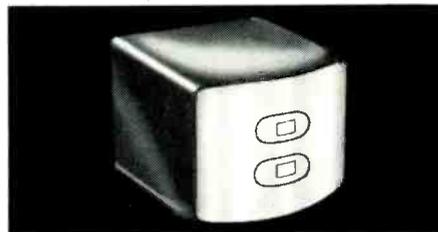
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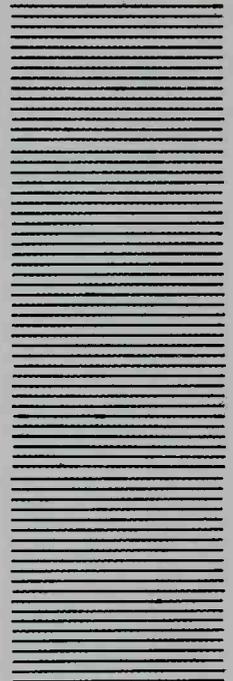
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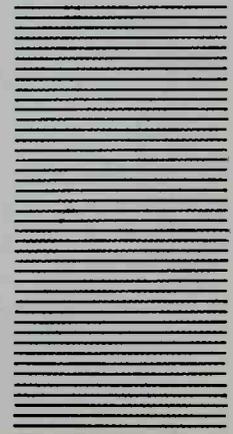
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## You can tell it's the Opéra at Versailles when you listen with a Stanton.

The Opéra at Versailles, completed 1770, scene of the first performances of Jean Baptiste Lully's operas and ballets. (Lully was court composer to Louis XIV.)

PHOTOGRAPH BY FRANZ EDSON

The ultimate test of a stereo cartridge isn't the sound of the music.

It's the sound of the hall.

Many of today's smoother, better-tracking cartridges can reproduce instrumental and vocal timbres with considerable naturalism. But something is often missing. That nice, undistorted sound seems to be coming from the speakers, or from nowhere in particular, rather than from the concert hall or opera stage.

It's easy to blame the recording, but often it's the cartridge.

The acoustical characteristics that distinguish one hall from another, or any hall from your listening room, represent the subtlest frequency and phase components of the recorded waveform. They end up as extremely fine undulations of the record groove, even finer than the higher harmonics of most instruments.

When a cartridge reproduces these undulations with the utmost precision, you can hear the specific acoustics of the Opéra at Versailles, or of any other hall. If it doesn't you can't.

The Stanton does.



# Stanton

**The specifications.\*** Frequency response from 10 Hz to 10kHz,  $\pm 1/2$  dB. From 10kHz to 20kHz, individually calibrated. Nominal output, 0.7mV/cm/sec. Nominal channel separation, 35dB. Load resistance, 47K ohms. Cable capacitance, 275 pF. DC resistance, 1K ohms. Inductance, 500mH. Stylus tip, .0002" x .0009" elliptical. Tracking force,  $3/4$  to  $1 1/2$  gm. Cartridge weight, 5.5 gm. Brush weight (self-supporting), 1 gm. Each Stanton 681 is tested and measured against the laboratory standard for frequency response, channel separation, output, etc. The results are written by hand on the specifications enclosed with every cartridge. The 581EE, with elliptical stylus and the "Longhair" brush that cleans record grooves before they reach the stylus, costs \$60. The 681T, identical but with interchangeable elliptical and conical styli both included, costs \$75.

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