the authoritative magazine about high fidelity

AUDIO

STEREO EQUIPMENT & RECORD REVIEWS

MARCH 1969 60¢

FIVE-CHANNEL STEREO FROM TWO CHANNELS • SOUND & DECOR STYLES • GUIDE TO AMPLIFIER SPECIFICATIONS

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here is tomorrow's!

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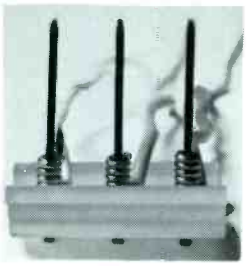

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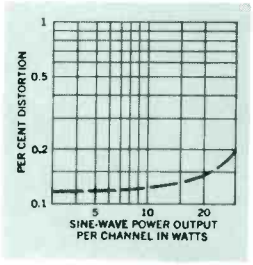

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342C Specifications:

Power: IHF ±1 dB @ 4 Ohms, 100 Watts; IHF ±1 dB @ 8 Ohms, 80 Watts; Cont. Output, single channel, 8 Ohms, 30 Watts; IHF Sensitivity, 1.9 μV; Frequency response ±1 dB, 20-20,000 Hz; Cross modulation rejection, 80 dB; Selectivity, 40 dB; Capture ratio, 2.5 dB. Prices and specifications subject to change without notice. Walnut-finish case optional.

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AUDIO

FEATURE ARTICLES

EQUIPMENT PROFILES

RECORD/TAPE REVIEWS

AUDIO IN GENERAL

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Coming in April 1969

Focus on Speaker Systems

Speaker Systems Buying Guide — Directory of loudspeaker systems with comparative specifications and prices.

Using Electrostatic Tweeters with Transistor Amplifiers — Robert Ehle describes construction of a power supply used to adapt electrostatic tweeters (that do not have a polarizing-voltage supply) to transistor amplifiers.

FM Receiver Alignment — Leonard Feldman details three methods used to align FM circuitry of a stereo tuner or receiver.

EQUIPMENT PROFILES:

Fisher 500T FM Stereo Receiver, **Ampex** 1461 Stereo Tape Recorder, **Empire** 999VE Stereo Cartridge... and more

PLUS: Audioclinic, Tape Guide, Record and Tape Reviews and other regular Audio departments.

ABOUT THE COVER:

Amidst antiques in a 200-year-old Pennsylvania home reposes a modern stereo hi-fi system. Other appealing anachronisms include speakers hidden under antique, skirted tables, as well as a Polar Bear rug and Eales-like reclining chair and ottoman.

Audioclinic

JOSEPH GIOVANELLI

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.

Distortion From Test Records

Q. When using a 10,000-Hz tone of a test record to test my stereo system, I notice an excessive amount of what appears to be scratchiness and interference. The next tone is 8000 Hz, and the interference is a little less, and so on down to 1000 Hz, which is finally reproduced as a pure tone.

This aberration occurs on both sets of speakers and headphones. Hence, I am confident that the speakers are not to blame. Also, I have one of the finest automatic transcription turntables, plus an excellent cartridge. Both are less than three months old.

Can I assume that the trouble lies in the amplifier section of my receiver? If so, what is the cause of the trouble? —B. F. Bucceri, Jr., Van Nuys, Calif.

A. The background sounds which accompany test tones on your disc are probably normal, especially if your cartridge is not tracking with sufficient force. Some cartridges do not track properly with as light a force as claimed for them. A slight adjustment in tracking force might eliminate some of the peculiar sound. The trouble is almost certainly coming from this source and not from trouble within the remainder of your equipment.

Some of this type of distortion is quite normal, as I said. Try recording a similar tone on your tape machine. You will note the same situation, especially if the level of the tone is greater than perhaps minus 10 dB.

You will not be aware of the distortion when ordinary discs and tapes are played. The material making up the program has a character which hides that kind of distortion very well. Further, the velocities of highs recorded on the disc are not likely to be as great on a music disc as they will be on a test disc, designed to check the extent of just such problems as yours.

Basically, try increasing tracking force slightly. That may help quite a bit. Then, do not worry too much about the problem. It is expected that you will get some of this distortion. For greater peace of mind, have your stylus checked for wear or chipping.

Isolation Transformer Operation

Q. How does an isolation transformer "isolate"? I know that it is a one-to-one transformer which prevents shorts to ground and potential shock hazard from equipment which does not have its own power transformer. Could you explain in more detail just how such a transformer can perform this task?— David B. Nelson, Oak Ridge, Tenn.

A. Before understanding how an isolation transformer works, we ought to understand why we can get a shock from certain pieces of equipment.

The power line is a good place to start this discussion. One side of this line is directly grounded. The earth serves as this ground return. Radiators, waterpipes, and the like are at this earth-ground potential, or nearly so. The other side of the line is "live."

We will now talk about the old, ubiquitous, AC-DC receiver. Such sets do not employ power transformers. One side of the line serves as receiver ground, and on some models is connected directly to the receiver chassis. If such a radio is plugged into the wall outlet, and the side of the line which is connected to the chassis happens to be the "live" side of the line, it will be possible to touch the chassis of the set and a radiator *at the same time* and receive a shock because that radiator serves as the other side of the line. Of course, if the chassis side of the line happens to be connected to the ground side of the circuit, there would be no danger of a shock when touching the chassis and the radiator at the same time, because each is at the same potential. You have a fifty-fifty chance of making a wrong connection when inserting the plug into the socket.

Manufacturers try to keep unauthorized persons from touching the chassis by employing such devices as plastic cabinets and plastic knobs.

We are now at a point where we can understand the role played by the isolation transformer in removing this shock hazard. The power line feeds the primary of such a transformer. The secondary of the transformer has no electrical connection to the primary circuit, except, of course, by magnetic induction. Therefore, when we extract our voltage from the secondary of such a transformer, neither side of this winding is connected to ground. The only way to receive a shock when touching a chassis to which an isolation transformer is connected would be to come into direct contact with both sides of the transformer winding.

Capacitor Designations

Q. (1) I recently came across some capacitors with "NPO" written on them. What does this mean?

(2) I notice that some capacitors have a value, slash mark, and another value. What does this mean?—Barry L. Heath AXI, FPO, San Francisco, Calif.

A. 1. NPO means that the capacitor is designed to maintain its capacitance regardless of changes in temperature to which it might be subjected.

Like out of this world...The unfailing accuracy of synchronous speed silently achieved by the entire drive assembly, from the Synchro-Lab Motor™ to the full size, kinetically matched, low-mass turntable. ☐ Like out of this world, the satisfaction of hearing music without distortion, always on pitch as recorded. ☐ Like out of this world, the Garrard SL 95, reflecting the most advanced engineering in automatic turntables.

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This is opposed to some which are designed to *increase* in capacitance as temperature *rises*, and those which *decrease* in capacitance as temperature *rises*.

2. When you see two numbers separated by a slash mark (/), the first number represents the amount of capacitance and the second number represents the voltage rating of the capacitor.

Whistle Interference on AM Band

Editor's Note: The following information was received in reply to a column, "Audioclinic," Jan., 1965. The reader's question concerned a whistle which he heard virtually all across his AM dial.

In your January 1965 column you discuss whistle interference in an AM tuner. I would like to comment. My first impression is that the trouble sounds like simple overload caused by a local station 300 yards away. From the description given ("a loud whistle"), it appears that there is a single, fixed whistle across the band, save for the local station's frequency. If this is correct, then the trouble, and the remedy, is obvious. It is extremely likely that, at 300 yards, this listener is located within the nearby station's "blanket contour," the region throughout which the intensity of the received signal is 1.0 volt or 1,000 millivolts. It is quite common for overload to occur in many receivers without being located in this blanket contour area.

The first thing to try is bypassing audio grids with 500-pF disc ceramic capacitors, using short leads. Remember that tuning the receiver dial will have no effect on r.f. pickup by the audio stages. As you pointed out, an antenna trap may help, but I would add that possibly there is i.f. stage pickup, and that shielding of the receiver may be necessary. Possibly the i.f.'s should be shifted in frequency slightly. It is also possible that this high signal level is causing cross-modulation on the r.f. or converter, and the bias on these stages may have to be shifted. However, a reject trap at the antenna is preferable, tuned to the nearby station's frequency.

One further remedy remains—FCC Rule 73.88: "The licensee of each broadcast station is required to satisfy all reasonable complaints of blanketing interference within the 1 V/m contour." Hence, it is possible for the listener to simply approach the broadcast station's [manager or engineer] and explain the problem. They will usually cooperate.—*Thomas R. Haskett, New York, N. Y.* Æ

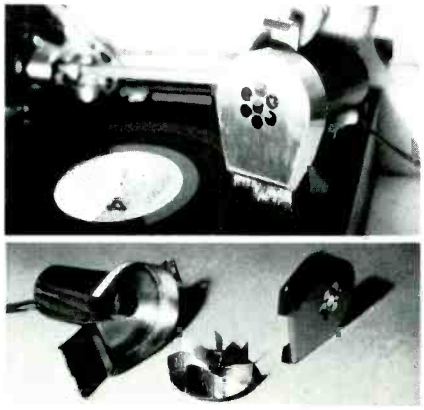
Audio Techniques

JOSEPH GIOVANELLI

Record-Cleaning Device

During the early Fifties I used a liquid record cleaner, which dried up after a couple of years, leaving an annoying residue in the grooves.

Around ten years ago I made a miniature vacuum cleaner, but it did not pick up the microscopic particles in the grooves which are so distracting during soft passages in music. It also pulled up the record.



Then I reversed the procedure, and made a blower with a soft brush attachment. You hold it over the spinning record for a few seconds and it blows the finest dust off without leaving any magnetic static.

I have used it for a few years now and, in my opinion, it does a perfect cleaning because it pinpoints the strong airflow without disturbing the arm at rest. (Greasy finger marks, for which there is no excuse, must of course be washed off.) Now I never have any pops, clicks, or rushing noise. —*E. Kverne, Bronx, N. Y.*

Repairing Scratched Records

Like many others, my records are occasionally damaged so that the needle will skip a groove here and there.

To set the scene, I use as my standard cartridge one which tracks at a few grams. It occurred to me to use my extra shell and an old cartridge I had which must track at 10 grams, and track the offending passages of my damaged records at 10 grams once.

Because the original scratches were made with a comparatively low tracking force, this 10-gram "truck" seems to "plough" through the scratches.

This may sound crude, but I have tried his approach on a number of scratched discs with success in each case. My regular cartridge tracks these passages without skipping, although the "click" is still there.

There will be some deterioration in the fidelity of the passage, of course, depending upon the quality of the heavy cartridge, but this will be a small price to pay for the removal of the "skip" in any case.

Naturally, if you plan to track a scratched disc at 10 grams, be sure your cartridge is capable of doing so, that your stylus has a 1-mil tip radius, and that it is in good condition. —*Gregor Owen, New York, N. Y.*

Hum in Phonograph Systems

I had embarrassing hum when I showed off my music system to my fellow audio enthusiast friends.

After exhausting all the standard remedies, I finally tried these tactics:

1) I oriented the power amplifier at 90 deg. with respect to the preamplifier. This orientation eliminated practically all of the hum. However, if the power amplifier was rotated 180 deg. from this position, the hum was not at a minimum, even though the preamplifier and power amplifier were still oriented 90 deg. to one another.

2) The only thing I could think of which was not already shielded was the short portion of the cartridge leads between the exit on the tone arm and the terminal strip, a matter of an inch or so.

I covered these leads with a tin can, tacking it to the mounting board and with a hole punched in it to allow the leads to the preamplifier to be brought out. I then ran a ground from this can over to the preamplifier. This did it!— *H. E. McAllister, Santa Barbara, Calif.*

Phono Oscillator Use

A few years ago, in Lansing, Michigan, a lawn party was held, with each person bringing his own radio and extension cord. The host had a phono oscillator over which he transmitted music to everyone present, plus his announcements. It was quite an experience to hear three or four dozen radios in unison.

Perhaps, a public library, in "sidewalk cafe" style, could hold a music appreciation program in the summer by means of such a setup. This sort of thing would surely whet the interest of young people in electronics, in addition to audio and music—a most delightful combination.—*Lewis O. Ernst, Ann Arbor, Mich.* Æ

This is the world's finest cartridge. Ask anyone.

Ask Stereo Review.

Their latest cartridge report rated it #1 in lightweight tracking ability.

And charted its frequency response as virtually flat.

With a picture-perfect square wave.

Ask England's HiFi Sound.

They call it "a remarkable cartridge . . . a real hi-fi masterpiece."

And find it "unlikely to wear out discs any more rapidly than a feather held against the spinning groove."

Ask High Fidelity.

They know the 999VE needs "only 0.8-gram stylus force to track the demanding bands 6 & 7 of CBS test record STR-120, and the glide tone bands of STR-100."

And gives a frequency response flat within "+2.5, —2.0 dB from 20 to 20k Hz" on both channels.

Ask England's Records and Recording.

They say it's "a design that encourages a hi-fi purist to clap his hands with joy"

Ask Popular Science.

Their ultimate stereo 'dream' system, created by Electronics Editor Ronald M. Benrey, features a 999VE.

Why? Because "its performance is impeccable."

Ask any stereo expert.

Then ask yourself what you've been waiting for.

THE 999VE • $74.95

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What's New In Audio

Servo-Controlled Turntable

Sony Corp. of America introduces the PS-1800, a turntable system which uses a slow-speed, servo-controlled d.c. motor to drive the turntable. Sony reports that this eliminates much of the noise and rumble that originates in mechanical speed-reducing systems. The servo system also compares motor speed with a stable frequency reference, so any error in motor speed results in a correction in the current supplied to the motor. The speed reference is independent of outside influence.

The PS-1800 offers 33⅓ as well as 45-rpm speeds, and has a speed control range of ±4%. Wow and flutter is reported to be less than 0.08% rms and the S/N is better than 60 dB (NAB Standard), says Sony. The tone

arm, which is static-balanced, is the tubular type with tracking error reported at 1°4′, a stylus force adjustment range of 0 to 3 grams and an acceptable cartridge weight of 4.5 to 11 grams. Its shell is a Universal plug-in type.

Other features of the PS-1800 include a new sensing device, called SMD (Sony Magneto-Diode), to lift the tone arm, return it to its rest position and turn off the unit when the record is finished. The SMD is said to add no mechanical load to the tone arm. The pause system is activated by a push-button control on the outside panel. The PS-1800, which is priced at $199.50 (including base and dust cover, but minus cartridge), measures 19 5/16" W x 7 1/16" H x 16¼" D and weighs 20 lbs., 14 oz.

Check No. 127 on Reader Service Card

Bandstand Mike For Folk, Pop

The AKG D-1000E is designed for bandstand rock 'n roll, soul music, and folk-rock amplification. According to the company, this microphone handles the tremendous sound pressures generated by this type of music. The new unit is the close-talking type, eliminating instrumental interference that would annoy vocalists. The D-1000E system and capsule are suspended to resist shock and high impact. A mode-selection switch (sharp, medium, bass) can be used to attenuate the microphone's response. For the professional user, the price is $60.00 net or $75.00 net with transformer and silent on/off switch. Distributor in U. S. is North American Philips Co., Inc.

Check No. 128 on Reader Service Card

Pioneer Stereo Headset

Pioneer Electronics' two-way stereo headset, SE-50, employs a 3-in. cone-type unit for bass and mid-range, and a miniature-type with Mylar diaphragm for treble. According to Pioneer, this offers a smooth response from 20 Hz to 20,000 kHz. A maximum of 0.5 watt on each channel is said to allow the SE-50 to be used with any amplifier, regardless of power.

Contour-designed ear cups are made of molded vinyl. Each earpiece has its own volume and tone controls. Standard equipment with the SE-50 is a 12-ft. coil cord and a three-conductor stereo plug. The SE-50 is priced at $49.95, which includes a storage case.

Check No. 129 on Reader Service Card

New Connector Adaptors

Four new audio connector adaptors from Switchcraft interconnect audio equipment with dissimilar terminations: 383P1; 384P1; 386P1; 387P1. Part numbers 383P1 and 384P1 both accept standard two-conductor phone *plugs*. While the former adapts to a

No. 387P1 No. 386P1 No. 383P1 No. 384P1

three-pin audio receptacle, 384P1 adapts to a three-contact audio connector. The other two connect to a standard two-conductor *jack*: 386P1 uses a three-pin audio receptacle and 387P1 uses a three-contact audio receptacle. All four have Switchcraft's "Quick-Ground" connector line features: separate ground terminal electrically integral with the connector shell and ground contractors that provide ground continuity between mating plugs.

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This and That

The *L. W. Erath Co.* plans to make available its feedback system in combination with its room gain control for other loudspeaker systems. Updating kits, which will include parts and instructions to adapt networks and controls through existing loudspeakers, and adaptors for the amplifiers, will be available soon. . . . *Transcriber Co., Inc.* announces availability of three head-cleaning cartridges for 4-track, 8-track, and cassette cartridge machines. Price is $2.49. . . . Inventory/file system by *APSCO*, called "Fill n' File," is a reusable, see-through plastic dome on a heavy-duty index card, with a sliding (self-stopping) card insert. A part (or parts) is thus inventoried with the file card that records the number and other pertinent information. . . . Joseph S. Tushinsky, president of *Marantz Co. Inc.* and of its parent company, Superscope Inc., announced plans to open a 20,000-sq.-ft. facility for Marantz at Sun Valley, California. The plant will produce medium-priced non-r.f. components, such as stereo preamplifiers and power amplifiers, while the company's East Coast plant in Woodside, N. Y., will make higher-priced stereo receivers and tuner components.

Industry Notes

The last half of 1968 showed many top management changes: ■ The Telex Communications Division appointed John S. Arrington vice president of marketing and John S. Boyers vice president of engineering. ■ TEAC Corp. of America named Hiram Oye executive vice president and general manager. ■ Akio Morita, executive vice president and co-founder of Sony Corp., Tokyo, became president of Sony's subsidiary, Sony Corp. of America. He succeeds Ernest B. Schwartzenbach, who died recently. ■ Bogen Communications Division of Lear Siegler, Inc., appointed John T. Morgan president. ■ Eli Passin became national sales manager of Gotham Audio Corp. ■ BASF Computron, Inc. named Dr. Diete H. Ambros president. He replaced Claus Schneider, who assumed new responsibilities at the parent company, headquartered in Ludwigshafen, West Germany. ■ Lawrence LeKashman was named president of Electro-Voice, Inc., from vice president in charge of marketing. ■ The Institute of High Fidelity named John H. Hollands, vice president and general manager of BSR (USA) Ltd., to its Board of Directors. ■ Saul B. Marantz, founder of Marantz Co., Inc., and two engineering associates formed Ferrodyne, Inc., Long Island City, N. Y., to subcontract and custom-manufacture electronic equipment and sub-assemblies.

unique: revolutionary Sound Effect Amplifier.

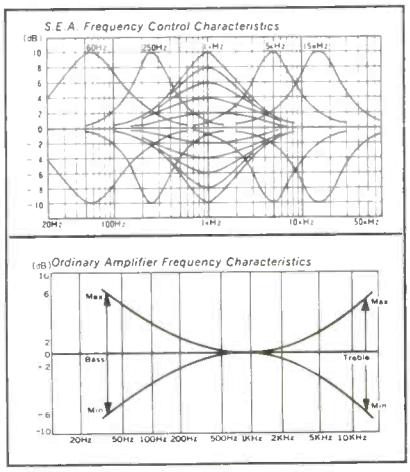
Unique "S.E.A." Sound Effect Amplifier tone control system of models 5001 and 5003 eliminates conventional bass and treble controls. Provides individual control of the five different frequencies that comprise the total tonal spectrum; 60, 250, 1000, 5000 and 15000 Hz.

In introducing the striking all solid state 60 watt 5001 and 140 watt 5003 AM/FM Multiplex Stereo Tuner Amplifiers, JVC brings the stereo fan a new dimension in stereo enjoyment—the complete control of sound effects.

This exciting innovation is made possible through the incorporation of a built-in Sound Effect Amplifier (S.E.A.), a versatile component that divides the audio range into five different frequencies. It enables the 5001 and 5003 to be tailored to the acoustical characteristics of any room, or to match the sound characteristics of any cartridge or speaker system, functions that were once reserved for expensive studio equipment. But even without the built-in S.E.A. system, the 5001 and 5003 would be outstanding values. They offer improved standards in FM sensitivity and selectivity by utilizing the latest FET circuitry with four IF limiters in the frontend of the 5001 and five in the 5003. They both deliver a wide 20 to 20,000Hz power bandwidth while holding distortion down to less than 1%. They feature completely automatic stereo switching with a separation figure of better than 35dB. They allow two speaker systems to be used either independently or simultaneously. Indicative of their unchallenged performance is their refined styling. All controls are arranged for convenient operation. The attractive black window remains black when the power is off, but reveals both dial scales and tuning meter when the power is on. For the creative stereo fan, the JVC 5001 and 5003 are unquestionably the finest medium and high powered receivers available today.

How the SEA System Works

Glance at the two charts appearing on this page. In looking at the ordinary amplifier frequency characteristics where only bass and treble tone controls are provided, you can see how response in all frequency ranges at the low and high levels is clipped off. Compare this chart with the one showing the SEA frequency response characteristics, and the difference is obvious. No clipping occurs in the SEA system. It offers full control of sound in 60, 250, 1,000, 5,000 and 15,000Hz frequency ranges from −10 to +10db. For the first time ever, you have the power to determine the kind of sound you want to hear.



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JVC

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BEHIND THE SCENES

BERT WHYTE

In the Fall of 1968, the incoming class at a major university gained some unwelcome notoriety when it was reported in the nation's newspapers that a large proportion of the freshmen had hearing deficiencies resulting from exposure to loud rock n' roll music. And articles published in various lay journals noted a dramatic rise in hearing impairment which was attributed to increasing "noise pollution."

While some of the stories are probably apochryphal, there is little doubt that we are undergoing an auditory assault of unprecedented and ever-increasing intensity. That some sort of control of noise is necessary is stating the obvious. Thus some of the more enlightened municipalities are enacting stringent anti-noise laws and revising building codes to provide better acoustic isolation between the walls and floors of apartments and offices. All this concern with noise raises some interesting questions as to acoustic measurement standards. The classic work that established the criteria of decibel levels for various noise-generating sources is now quite old. You have seen these decibel reference charts that tell us that on a typical day at noon in New York's "Times Square" the sound level is 95 dB. Or that loud conversation is 65 dB, and so on. While most of the data in these charts still seems to be valid, there appears to be some disagreements as to the decibel level of sound that causes various degrees of psychological and physiological discomfort in people.

There is always the problem of subjective evaluation of sound. How loud is "too loud"? Since noise per se is any unwanted or unorganized sound, you could say that all noise is too loud. But what about those who enjoy "distinctive" noises, such as the snarling exhaust note of a high-revving Ferrari? Who is the arbiter who says some hot-rodder's muffler is "too loud," considering that said rodder has spent his money to achieve an exhaust "rap" that he enjoys as a veritable symphony of power?

In music, subjective phenomena are even more complex. In live music, the conductor follows the dynamic markings in the score. Yet he must decide what loudness levels to use for these markings. How soft is his triple *pianissimo* and how loud is his triple *forte*? This is a discretionary thing, influenced by experience, personal preferences and by hall acoustics. With recorded music, whatever the medium, the dynamic range is a fixed quantity. However, the listener can control the overall loudness level of his playback. If the dynamic range of a phono recording is wide enough and the playback level is low, the *pianissimo* on the disc may be inaudible or lost in a sea of surface noise or hum or other extraneous noises. If the record playback level is high, the *pianissimo* is grossly swollen out of proportion and, of course, when the *fortes* occur the auditor may find the speaker cone in his lap. To all this we must add the individual's taste and preference in music. Many people enjoy the crashing discords and dissonances of Stravinsky's "Rite of Spring," while others consider it sheer cacophony. How do we categorize electronic music or musique concrete? Can we really call it music, or is it "organized noise"?

"The threshold of pain in human hearing is...around 125 dB."

How loud is "too loud" becomes an academic question when actual physiological discomfort or damage to the auditory system occurs. The threshold of pain in human hearing is usually stated as being around 125 dB. But this figure can vary considerably. Some people notice a "tickling" sensation in their ears at levels as low as 105 dB, with pain becoming apparent at 115 dB. Instantaneous auditory damage can occur in special situations. Explosions in war or peacetime, when ears are accidentally unprotected during range firing of large-calibre artillery or a jet plane launching from steam catapults, can rupture ear drums. When I was in England during World War II, a research program was undertaken, due to extensive bombing, to determine the effects of what was called "blast" syndrome." In an isolated area, 500-lb. bombs were detonated. At 1500 ft. from the explosion, technicians measured 150 dB. Anyone exposed to this would suffer ruptured ear drums. With actual bombing victims who survived the initial explosion, many other pressure and intensity effects were noted, such as capillary rupture, damage to the spleen and other internal organs. Many bizarre things happened—people literally had every stitch of clothing (including their shoes) blown off them, yet they were unharmed. Inexplicably, people who were relatively close to an explosion did not suffer ear damage, while others at a much greater distance had ruptured drums. Since artillery and bomb explosions measure at 150 dB, and because this is a transient noise, one can readily understand why the earth trembles and buildings shake from the *sustained* 175 dB said to be produced by the "Saturn 5" rocket at lift-off!

It is generally conceded that most auditory damage is caused by *prolonged* exposure to high decibel levels of sound. The freshmen who had hearing deficiencies were habitues of discotheques. In many of these places as much as 122 dB has been measured. And you must remember that this is at a fairly sustained level since most operate on an almost non-stop basis. "Boilermaker's disease" has become a sort of general term for any of the hearing deficiencies suffered by industrial workers exposed for long periods of time to high noise levels. One authority stated a few years ago that continuous exposure to as little as 95 dB was sufficient to cause hearing impairment. The usual level to which riveters and jack-hammer operators are exposed is more on the order of 110-120 dB. The hearing deficiencies caused by this are recognized medical entities and are covered by workmen's compensation. One of the peculiar things about "boilermaker's disease" is that it seems to be frequency selective. The hearing impairment is not merely in the high frequencies, but in almost random groups of frequencies.

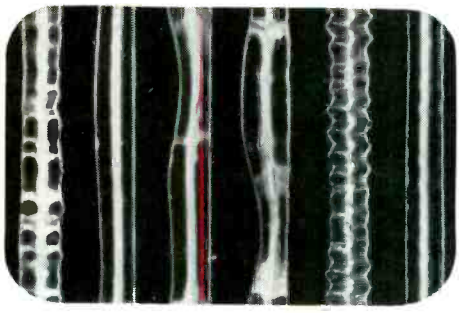
The higher frequencies seem to play a prominent role in the hearing impairment caused by prolonged exposure to high sound levels. Mr. Bob Fine, the recording engineer whom we had the pleasure of interviewing for the November 1968 issue of AUDIO,

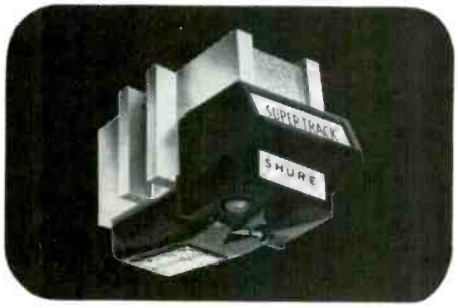
(Continued on page 10)

CLOSE THE TRACKABILITY GAP

(AND YOU'LL HEAR THE DIFFERENCE)

The photomicrograph above portrays an errant, hard-to-track castanet sound in an otherwise conservatively modulated recording. The somewhat more heavily modulated grooves shown below are an exhilarating combination of flutes and maracas with a low frequency rhythm complement from a recording cut at sufficiently high velocity to deliver precise and definitive intonation, full dynamic range, and optimum signal-to-noise ratio. Neither situation is a rarity, far from it. They are the very essence of today's highest fidelity recordings. But when played with an ordinary "good" quality cartridge, the stylus invariably loses contact with these demanding grooves—the castanets sound raspy, while the flute and maracas sound fuzzy, leaden, and "torn apart." Increasing tracking weight to *force* the stylus to stay in the groove will literally shave off the groove walls. Only the High Trackability V-15 Type II Super-Track® cartridge will consistently and effectively track all the grooves in today's recordings at record-saving less-than-one-gram force . . . even with cymbals, orchestral bells, and other difficult to track instruments. It will preserve the fidelity and reduce distortion from all your records, old and new. Not so surprisingly, every independent expert and authority who tested the Super Track agrees.





SHURE V-15 TYPE II

SUPER TRACKABILITY PHONO CARTRIDGE

At $67.50, your best investment in upgrading your entire music system.

Send for a list of Difficult-to-Track records, and detailed Trackability story: Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois 60204

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BEHIND THE SCENES

(Continued)

feels that the rock n' roll orchestras and those who listen to them in discotheques are sustaining damage to the cochlea in the ear due to high-level, high frequencies. He thinks that the great transient "spikes" and their harmonics, produced by the "rock" guitars with their monster-sized amplifiers and speakers, must be causing auditory damage. Some years ago when I was an audio consultant with a New York firm, I was contacted by a medical researcher who was looking for special microphones which would respond to very high frequencies (some of the B & K mikes have response to well over 100,000 Hz). This man had the interesting theory that very high frequencies, from 50-kHz upwards at high-intensity levels, woud cause hearing impairment if the exposure was sustained for long periods of time. He said that sparkplugs, especially poorly shielded types, produce a great deal of high-frequency sound up to 200 kHz, and that people, like truck drivers, who are under this bombardment for years show definite hearing losses.

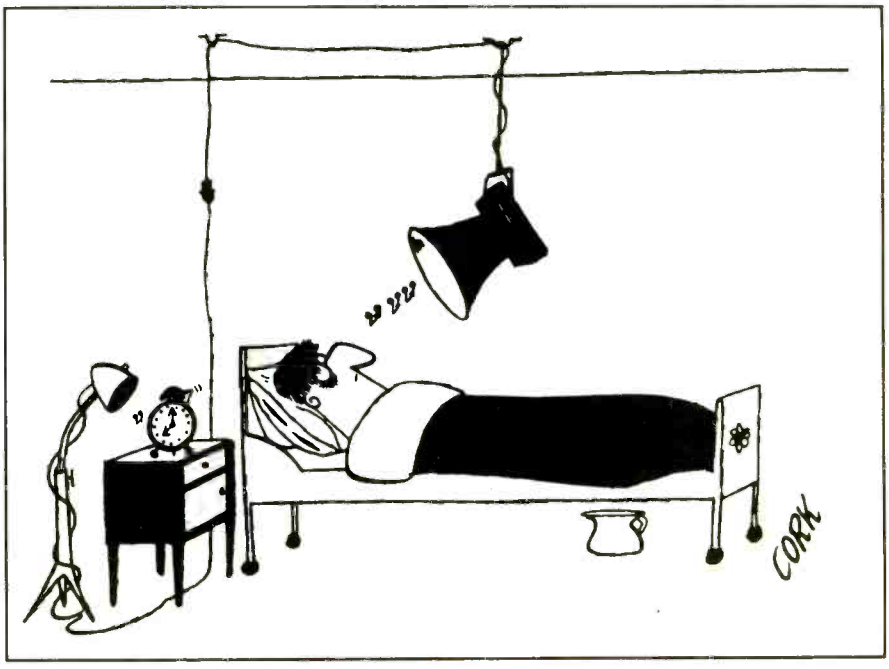
To prove out his theory, he was subjecting monkeys to very high high-frequency sound for varying periods of time at specific intensity levels. The animals were killed. Tissue sections of their auditory nerves were prepared for microscopic examination. He said that if the myelin sheath of the nerve was damaged this would be evidence of hearing impairment. His results showed that there was progressive demyelinization of the nerve with each monkey who was exposed for increasing periods of time. How valid his tests were I do not know. I do know that people and animals subjected to ultrasonic sounds at high-intensity levels become disoriented and dizzy since the sound upsets the equilibrium of the inner ear. Continued exposure causes extreme nausea and various psychic phenomena. At one time the Army was experimenting with high-intensity ultrasonic generators, and it was reported that a "concentrated beam" of high frequencies could kill birds up to the size of pigeons at a distance of 100 yards.

Well, let us leave such esoterica as "death rays" that kill birds and get back to music. The decibel reference charts usually list the output of a symphony orchestra in a triple *forte* at 110 dB. During recording sessions I have had the unique opportunity of measuring the sound level *at the conductor's podium*. The orchestras were large ones of over 100 men, and with a General Radio sound level meter I measured *pianissimos* so soft that they were barely over the ambient noise in the hall, and massive *fortes* for full orchestra that measured between 105 to 115 dB. Thirty feet back in the hall the same *forte* was down to 90-95 dB. What about our symphony conductors who are exposed to these tremendous outpourings of sound? Are they too subject to hearing damage? It would appear not, probably because the full output of 115 dB occurs only as momentary and intermittent peaks. My good friend Leopold Stokowski has been conducting well over 50 years now, and at a hale and hearty 86 years of age shows no sign of diminished aural acuity.

The level at which we listen to stereophonic sound in the home is subject to many variables. There is, for example, the level at which you would like to hear your music, but must reduce your gain control because of thin-walled apartments and intolerant neighbors. In private dwellings there is the matter of room size and room acoustics. Recently, some "authority" stated that a level of 85 dB should suffice for home listening. There was nothing said about dynamic range or peak levels. I for one take exception to this arbitrary control. I have a fairly large living room and it is very quiet in my suburb, especially at night. The ambient level in my room measured at 38-40 dB. With master tapes or copies of masters which have very wide dynamic range, if I adjust the gain so the *pianissimos* are just above the ambient level, I find that the peak output of the great *fortes* reaches 100-102 dB. I do not find these peaks too loud. In fact I find such a level necessary to give me a psycho-acoustic approximation of concert hall level. The ambient level in a city apartment rarely is less than 50 dB, and usually closer to 55-58 dB. As a consequence, dynamic range suffers, especially with the usual restrictions on high sound levels in apartments.

Can hearing impairment result from listening to stereo in the home? Highly unlikely under normal circumstances; certainly not with classical music where we have the "protection" of wide dynamic range and levels of over 100 dB being reached only on intermittent orchestral peaks. It is conceivable, however, that some far-out addict of rock recordings (which have a dynamic range on the order of 20-25 dB) could play his recordings in a small room at continuous levels well over 100 dB, possibly causing auditory damage.

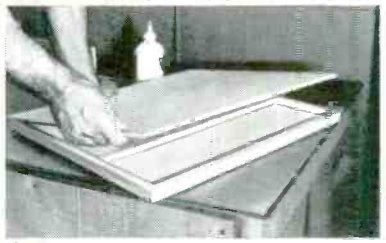
It is hardly necessary to remind readers of AUDIO Magazine that hearing is one of our most precious gifts. Thus it is just plain common sense to protect our hearing and to counsel our young on the perils of over-exposure to loud rock music. In addition, your hearing can be affected by many other things, some of which you would never suspect. For example, certain people are especially sensitive to anti-biotics, and if I remember correctly, neomycin and streptomycin can (in large doses) cause *irreversible* auditory damage. So it behooves us to be careful. Æ



Does WHARFEDALE still use sand in its speaker systems?

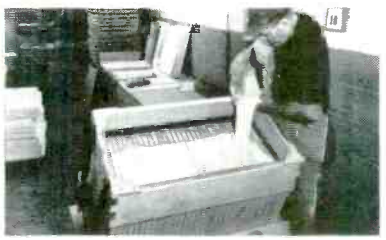
YOU BET WE DO! For example, you'll find over 7 pounds of fine, white sand densely packed between layers of hardwood in our W70D speaker system . . . even more in the W90D . . . a little less in the W60D. Why sand? Because to create the famous Wharfedale *Achromatic* sound, we know a speaker cabinet must remain absolutely inert. It must be more than just hardwood, for even the thickest wood baffles can resonate. The Wharfedale sand-filled construction damps all vibrations and eliminates spurious resonances, no matter how deep or intense the bass energy. The result is distortion-free, superior sound. Rap the back cover of a sand-filled Wharfedale and hear the low, dull "thud" in contrast to the resonant sound of equally large plywood panels normally used in other systems.

MORE COSTLY TO BUILD . . . AND WORTH IT!

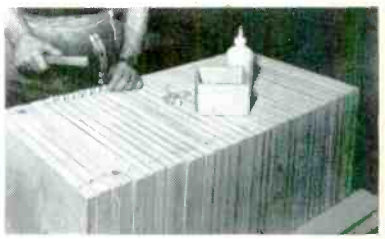


1. Cabinet back cover being assembled. Heavy plywood walls are further strengthened by thick wood braces, forming a strong, rigid panel with cavities.

2. Panels are stacked on specially designed vibrating machine. Note small, round openings on top edges, for fine-grain, cleansed white sand.



3. Sand is poured on, filtering slowly through small openings into panel cavities. Vibration machine eliminates air pockets, insures maximum compression.



4. Feed holes are sealed with wood plugs. Panel becomes totally inert to the back waves of sound which will be projected against it in the speaker enclosure.

HEARING . . . AND SEEING . . . IS BELIEVING. Once you hear the sound of Wharfedale *Achromatic* Speaker Systems, you will understand why Wharfedale has earned the loyalty of the most knowledgeable listeners in music and audiophile circles. Achromatic sound is rich, full, realistic sound reproduction, uncolored by extraneous modulations. The speakers and cabinet perform together as a single unit in correct acoustical balance to provide a truly faithful duplication of the original performance. It's the result of unique and exclusive construction features and techniques developed by Wharfedale.

What's more, you'll be delighted by Wharfedale cabinets: decor-conscious proportions; fine furniture finish; tasteful grille fabrics, removable at will; design that is a refreshing departure from conventional "boxy" shapes.

Wharfedale
ACHROMATIC SPEAKER SYSTEMS

Write for Comparator Guide and dealer list to: Wharfedale Div., British Industries Corp., Dept. HF-2, Westbury, N.Y. 11590.

Letters

Audio Careers

• I am curious about the field of audio engineering and believe I would like to have a career in the audio industry. My problem is that information about careers in audio engineering is difficult to find. I would appreciate it if you could help me out.

BEN WILSON
Davis, Calif.

Unfortunately, the field of audio engineering has not been recognized as a specialized field by colleges and universities. But there was a time when few credits in an electrical engineering curriculum were devoted to electronics. So this can change with respect to audio.

The relatively small field of "audio engineering" is further divided into a number of specialties, including: audio design engineering, recording engineers, broadcast studio engineers, and commercial sound engineers. Except for the former, a baccalaureate degree is not necessarily required. A First-Class FCC license is needed for broadcast work, however.

*Information about careers in audio —*real *information—is limited. One can contact the Institute of Electrical and Electronic Engineers, or the Electronic Industries Association, of course. But without recourse to educational courses devoted to the subject, much more than advice to contact the personnel department of a manufacturer should not be expected. The IHF does have available a text on careers in high fidelity, which gives some insight to opportunities in the hi-fi component industry.*

We regularly receive inquiries concerning education in the field of audio. Of course, the various associations noted above have informative meetings and, at times, seminars. For example, the 1969 Midwest Acoustics Conference will be held at Northwestern University in Evanston, Ill. A seminar on audio applications will also be held in July at Brigham Young University, Provo, Utah. With on-campus room and board, cost is reported to be $80. (Contact Dean Van Vitert for more information.) The most hopeful sign to date is a move toward carrying out provisions of C. J. LeBel's estate to establish a chair in audio engineering at the Massachusetts Institute of Technology. Mr. LeBel, as many Audio readers know, was one of the founders of the Audio Engineering Society and vice-president of Audio Devices, Inc. —Ed.

Kudos

• Thank you for January's "Layman's Guide to Tape Recorder Specifications." The topic has been covered before, but never in so valuable and useful a fashion.

A. C. NUESSLE
Willow Grove, Pa.

Tapes for Troops

• We would like to solicit your help in informing your readers of a chance to strengthen the morale and provide relaxation for the servicemen in Vietnam. "Tapes for Troops" is a program whereby people in the U.S.A. donate tape recordings for the listening pleasure of the American servicemen in Vietnam. The tapes are shipped to 1st Logistical Command and are distributed to each Corps Area, where they are further disseminated to units and clubs that have tape equipment. The types of tapes we receive cover many musical areas: classical, jazz, pop, country and western, religious, radio and TV programs, etc. They can be stereo or monaural; 3¾ or 7½ speed; and 3-, 5-, or 7-in. reels. Because this is not a funded program of the Department of the Army, the cost of mailing the tapes must be borne by the sender. Once the tapes are received by the servicemen they become the property of the recipient and will not be returned to the sender.

If your readers wish to contribute tapes to the "Tapes for Troops" program, the address is "Tapes for Troops" Hq. 1st Logistical Command, Attn: Special Services, APO San Francisco 96384.

BEN KVITKY
Special Services Officer
APO San Francisco, Calif.

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PIONEER SX-1500T

AM-FM STEREO RECEIVER • 170 WATTS, FET AND IC'S

(The SX-1500T Price, only: $360.) Shown with PIONEER CS-88 Speaker Systems at $175. each.

What can we say after we've said "It's the Greatest"?

JULIAN HIRSCH, in STEREO REVIEW, said:

"If anyone doubts that moderately priced integrated stereo receivers are capable of really top-quality performance, let him examine, as we have, the specifications — and the actual performance — of the Pioneer SX-1500T. This import outperforms, both in its audio and FM aspects, most of the components we have tested in recent years. Die-hard advocates of vacuum-tube design should ponder the fact that *no* FM tuner of pre-solid-state days matched the overall performance of the SX-1500T, and only the costliest vacuum-tube amplifiers approached its high power output with such low audio distortion."

This is what AUDIO MAGAZINE had to say:

"The engineers at Pioneer must belong to the 'wide-band' response school for, although we suspected that the Pioneer Bandwidth published specification might be a misprint, it actually *does* extend from 17 Hz (they claim only 20 Hz) to 70 kHz! You'll never lack for 'highs' with this one!

If you crave lots of power and don't want to get involved with separate pream-amps and tuners, the Pioneer SX-1500T AF/FM stereo receiver certainly has enough power and enough true component features to make it very worthy of consideration at its remarkably low price of $360.00."

After you've heard it, we're reasonably sure what you're *going to say.*

Because you want a better receiver, *don't be misled*-pick the one with the optimum features at an honest price. You owe it to yourself to evaluate the SX-1500T against any other receiver on the market, regardless of price. What more can we say?

Write Pioneer for reprints of the entire reviews from *Stereo Review* and *Audio Magazine* and the name of your nearest franchised Pioneer dealer. PIONEER ELECTRONICS U.S.A. CORP., 140 Smith Street, Farmingdale, L.I., New York 11735 • (516) 694-7720

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AUDIO MUSIC REVIEW

Classical Record Reviews

EDWARD TATNALL CANBY

Approaches to the Modern

Elgar: Enigma Variations. Respighi: Feste Romane. NBC Symphony Orch., Toscanini (1951, 49).
RCA Victrola VICS 1344(e) electr. stereo ($2.50)

Some years ago in a New York broadcast I played a 78 side from the old Toscanini "Enigma Variations" and observed that it was one of his finest recordings and, one day, surely would be reissued. Here it is (though I am not entirely sure it is the same performance — he often recorded his favorite items more than once). And it is good. So is the obverse, the noisy, brilliant "Roman Festival," third of the three Roman portraits Respighi composed over a dozen-year stretch.

The "Enigma Variations" are Elgar's masterpiece, a youthful work but the best he ever did. Elgar was so much of the Victorian era, his music so emphatically British, that even his best tends easily to go lush and sentimental. The over-ripeness is inherent in these "Variations" but can be avoided via a taut, disciplined performance that also manages to preserve the sweetness and honesty of the music. Who but Toscanini could do that job so well?

As for the festival at Rome, it is admittedly more modern for its day (1929) than many of us would have remembered it. The twentieth-century intensity, the highly complex technological skill in orchestration, like a telephone switching office or the design of an automobile engine, is of our century. But the basic language is still Very Late Romantic, and far riper than Elgar; it is an Italianate version of Richard Strauss yet, oddly, not warmer, as of the Italian temperament, but chillier. Respighi is a cold fish, for all his calculated orchestral brilliance.

RCA's progress in recording over the transition years from the old 78-rpm wax process to tape and LP (with 45 rpm in between) was erratic to an extent the Company would surely like to forget, and cannot. Here, in 1949 and 1951, we have some surprisingly good sound, very well restored and given a modestly helpful stereo spread to help the effect on stereo machines. Only a slightly deadish acoustic (the same old Carnegie Hall but differently miked than now) and a tendency to mild high-volume distortion, notably in loud string passages, mark the recordings as a couple of decades old. The tonal range is wide, from bass to treble, instruments are clean in impact and cymbals sound like cymbals, not like thuds—or broken glass. A bit of poor transient response (compressor circuits?) mars the drum beats, which go ker-thump. They often did in those days.

Are these from 78-rpm masters? Could be, in 1949. Tape? RCA isn't saying and so we have the nice privilege of guessing on our own. Not easy to tell. Whatever the original, the restored sound is highly listenable and Toscanini's Carnegie Hall recordings were his most relaxed and mellow performances of the period.

Performances: A— *Sound:* C+

John Cage—Variations IV; Vol. II. Assisted by David Tudor.
Everest 3230 ($4.98)

Volume II! Did you, by chance, get to hear Vol. I? This is more of the same—much more.

Cage's "Variations" are more literal than the term usually implies; each of them is its own large-scale chance-performance or happening, a grandiloquently staged and carefully planned montage of totally accidental sounds, in all the jarring confusion that is Modern Life. Radios blare, batches of them; TV images and film clips flash and flow in wild distortion, oddly placed microphones pick up all sorts of extraneous noises from the surroundings—a local bar, street traffic—and snatches of tapes and recordings mix into the general uproar.

It's all in sonic stereo, if you can call it that. Better say two-channel. Each channel emits its flood of ear-splitting sound-mix via a speaker set-up on a "live" stage, one on each side. The whole thing goes on—and on, *and on*, for Cage isn't going to let anybody off easy, you may be sure. The captive audience that submitted to "Variation IV" in California must have been a collective wreck at the (indeterminate) end of this affair. We are lucky, maybe. Only the sound element reaches our pair of stereo speakers (via mikes apparently set up in front of the stage speaker systems) and it is conveniently divvied up into nice, long LP sides—four of them altogether. You'll do well if you can take five minutes at a sitting but, of course, you *should* listen to the whole. Vol. I *and* Vol. II. Dare you to try.

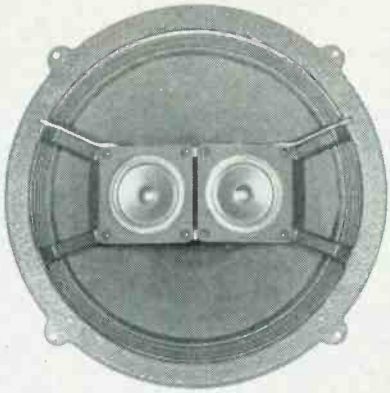
Vol. II—just in case you thought there had been some mistake—begins with an extended spoken explanation as to what the noise is all about, spaced off on a separate band. The rest is chaos—deliberately. At the beginning you hear a fearsome blast of assorted static and distant bits of radio program along with a sedate waltz on the piano. From then on, through talks, shouts, screams, squawks, bangs and what-have-you, the din never lets up (except for side changing) until the "end," which is signalized by a bawdy folk-

(Continued on page 58)

B-199A Bass Speaker

B-209B
Midrange Speaker

B-200Y
Treble Speaker Pair



B-207B Two-Way Coaxial Speaker

These **BOZAK** loudspeakers re-create all music precisely

Just as a fine orchestra is composed of outstanding musicians with fine instruments, so Bozak loudspeaker systems are comprised of the finest component speakers available in each sound range. Which is why Bozak speaker systems are unsurpassed in their ability to re-create music realistically.

The very same component speakers used in Bozak's Concert Grand — the ultimate in home loudspeaker systems — are available individually for building into existing furniture or even into walls.

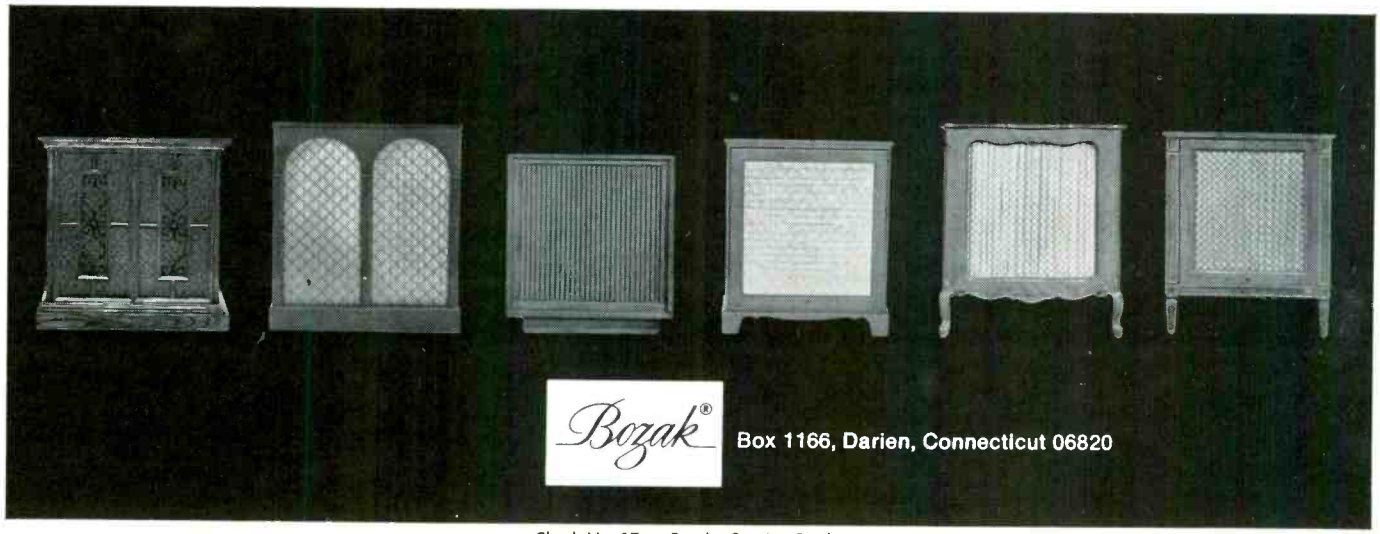
For Bass with a sense of feel, there is the Bozak B-199A with its variable density cone which has a 50% wool content.

For Midrange with tones essential to the identification and timbre of sound, the B-209B is unique in both design and construction. A patented laminated neoprene-and-aluminum diaphragm eliminates the coloration usually associated with the "break-up" of speaker cones.

For Treble with sweetness and warmth, the Bozak B-200Y uses an aluminum diaphragm nested in a bed of rubber which prevents spurious peaks and ringing, and assures smooth, broad response.

A Basic System complete in itself is the Bozak B-207B coaxial two-way loudspeaker which combines a B-199A bass speaker and a B-200Y treble speaker on a single mounting frame. It need only be installed in one of the Bozak fine furniture enclosures shown below, an existing cabinet or a wall to become the foundation from which a larger, more complete speaker system can "grow" by the addition of components in logical steps in the future.

Complete descriptions of these Bozak component speakers, panel-mounted speaker systems and complete systems in fine furniture enclosures are included in our catalog. It's free.



Check No. 17 on Reader Service Card

EDITOR'S REVIEW

The Power Output Race

An industry furor is churning over an audio power amplifier rating used by a few major manufacturers of high fidelity components. Called IHF *±1 dB*, it stands alongside existing power rating standards—RMS power, IHF power, EIA power —to befuddle buyers, together with per channel power, total power, and peak power versions of each, not to mention different output powers with four- or eight-ohm impedances.

The Institute of High Fidelity, which developed a method of measuring power output of audio amplifiers (IHF Standard IHF-A-201), disavows the practice of using the IHF standard with a qualifying phrase that is not part of its power-rating standard.

The newly used power rating (by some domestic manufacturers who report its use by some non-domestic manufacturers as the reason for employing it) means that a power amplifier, integrated amplifier or receiver that would be rated as, say, 100 watts IHF ±1 dB, would meet its spec even if it measured 79 watts. Further, it is unlikely that, in the course of events, units will really be off-the-shelf at the +1 dB mark. (This would make the above example ring the bell at 126 watts.) In practice, the ±1 dB figure would probably degenerate to +0 dB, −1 dB. In addition,it is conceivable that a progression to a nebulous "within 2 dB" could occur after a while, meaning −2 dB. In this manner, an amplifier's IHF power rating need only be 62 watts to be inflated to 100 watts. And the race is on.

In our view it's the "numbers game" all over again, which we regret. If more manufacturers adopt the ±1 dB tolerance, we fear that a confusing situation (for most consumers) would be worsened. Without a common standard, power-rating figures would become meaningless, much as speaker system measurements are (where manufacturers do not use the same ASA measuring techniques, and where some speaker manufacturers measure woofer resonance in free air, while others determine it in the actual system).

To avoid spiraling of output power figures, we do hope that *all* stereo component amplifier/receiver manufacturers will be persuaded to stick to the IHF power-rating standard and/or the continuous power rating, unless another commonly acceptable rating displaces them.

Radio Theatre in Stereo

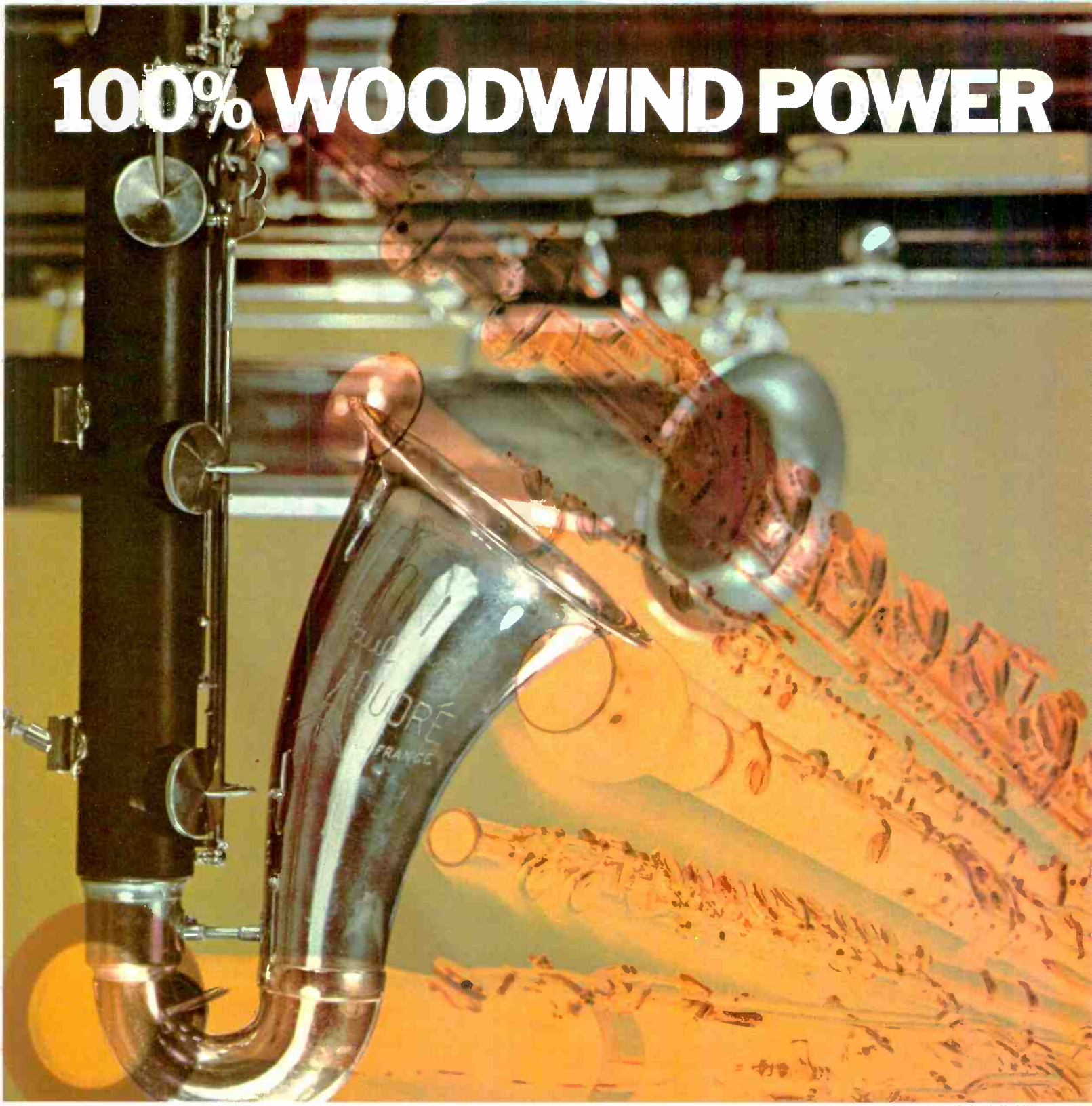
Remember when radio drama enthralled so many of us over-30 people? Well, take heart. TV has not yet dealt the death blow. A radio drama comeback is underway, using stereo recordings. More than 150 non-commercial radio stations across the country are expected to broadcast the best productions of the Radio Drama Development Project, which was backed by combined government and private funds (1 year, $114,000). Project Director Lyon Todd of Boston's WGBH-FM, states: "For sheer flexibility, radio drama in stereo is unequalled, allowing shifts in time and space and point of view which otherwise belong to the imagination. . . ." We listened to the Project's sampler record album, *Ten New Plays in Stereo*, which contains excerpts from plays that took top honors in the script contest. We liked both the sampler and the overall concept.

California FM

Two California FM broadcast stations netted awards for 1968. The "Maker of the Microphone" Award for 1968 was presented to the KTBT Radio-Telaudio Centre complex in Garden Grove, Calif., for an outstanding contribution to the world of sound. The award is presented annually by Oliver Berliner, grandson of inventor Emile Berliner, in whose name the trophy award is given.

The "101 Strings Award" given annually to one FM station in the nation that is judged to have outstanding programming was awarded to KBMS-FM. The broadcast station is said to present good music for adults. *A.P.S.*

100% WOODWIND POWER



PHOTOGRAPH BY FRANZ EDSON

Words are inherently limited in stimulating the emotions aroused by music. This is especially so in describing how high fidelity components perform.

With cartridges, for example, we speak of flat frequency response, high compliance, low mass, stereo separation. Words like these enlighten the technically minded. But they do little or nothing for those who seek only the sheer pleasure of listening.

We kept both aspects in mind when developing the XV-15 series of cartridges. We made the technical measurements. And we listened.

We listened especially for the ability of these cartridges to reproduce the entire range of every instrument. With no loss of power. In the case of woodwinds, this meant a cartridge that could recreate the exact nuances that distinguish an oboe from an English horn. A clarinet from a bass clarinet. A bassoon in its lower register from a contrabassoon in its higher register.

We call this achievement "100% woodwind power."

When you play your records with an XV-15, you won't be concerned with even that simple phrase.

Instead, you'll just feel and enjoy the renewed experience of what high fidelity is really all about.

PICKERING

THE NEW PICKERING XV-15/750E.

PREMIER MODEL OF THE XV-15 SERIES. TRACKS AT ½ 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.

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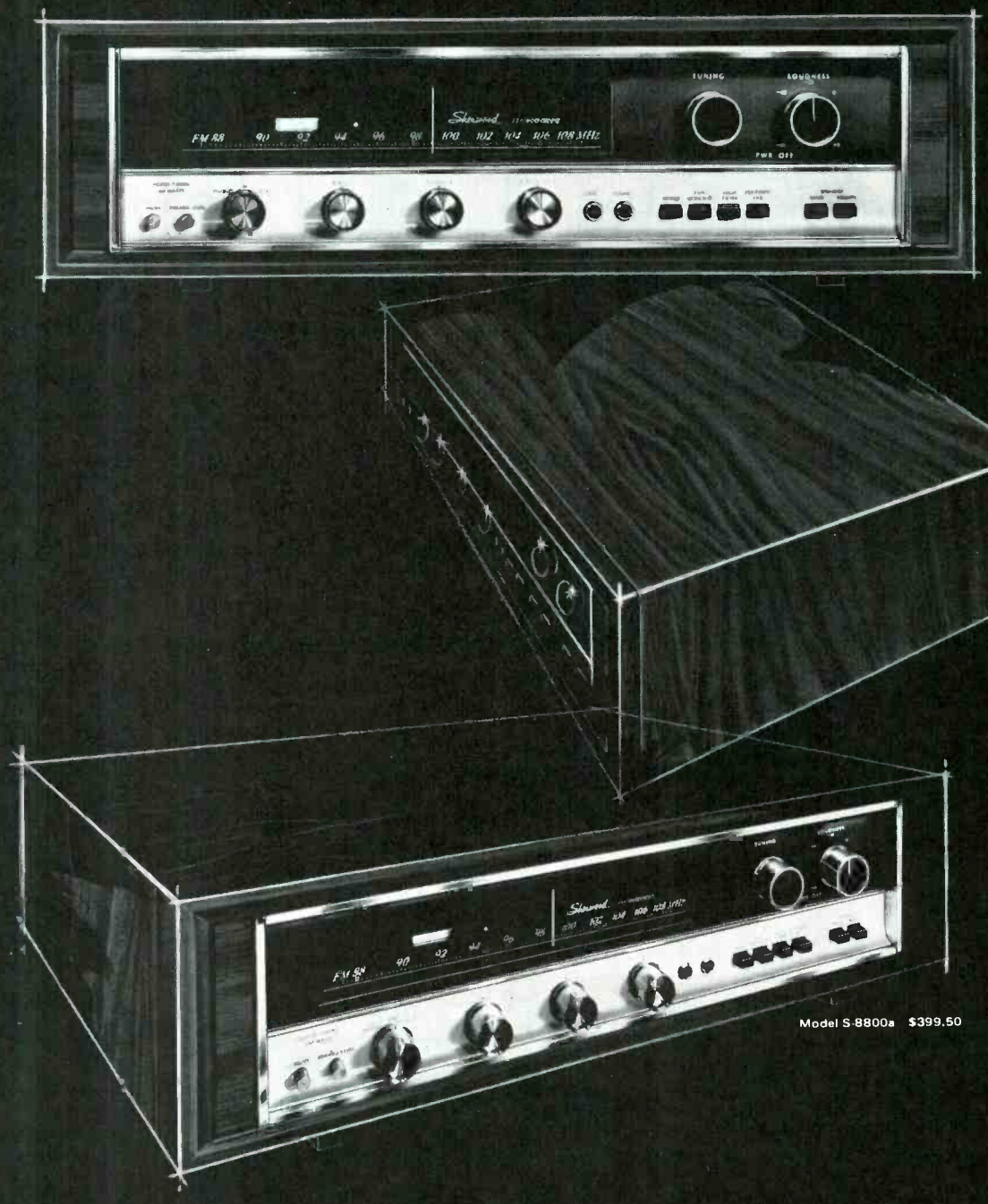
First of a new breed -from Sherwood

This is what high performance is all about. A bold and beautiful new FM Stereo Receiver bred to leave the others behind. 160 crisp, clean watts—power in reserve. Up-front, ultra-now circuitry featuring Field-Effect Transistors and microcircuitry. Front-panel, push-button command of main, remote, or mono extension speakers and loudness contour. Sherwood high-fidelity—where the action is—long on reliability with a three-year warranty.



Model S-8800a $399.50

Sherwood

Sherwood Electronic Laboratories, Inc. 4300 North California Avenue, Chicago, Illinois 60618 Write Dept. 3-A

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Five-Channel Stereo at Home

from ordinary stereo disc, tape, or broadcast

ERNST BAENNINGER

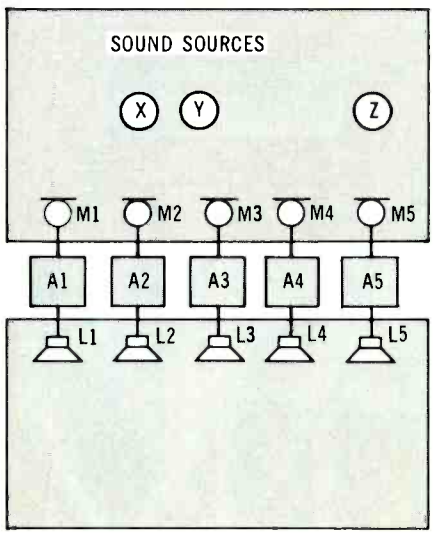
WHEN we start to discuss five-channel stereo we first need a definition of what we are talking about. If we had to deal with multi-channel communication systems in general (as an example, telephony) the five channels would have to be completely independent. That means that each channel must be able to transmit information which is in no way related to and influenced by the information carried in the other channels. As an example, channel 1 may have to transmit a conversation while channel 2 may carry some kind of popular music and so on. Nothing that happens in channels 2 to 5 should have any influence on channel 1. The light music on channel 2 must not be heard together with the discussion in channel 1, and vice versa.

In the case of a two- or more-channel stereo system the conditions are quite different. The stereo channels are never really independent—they always have to represent different aspects or views of one single event, and the purpose of the two is only to reproduce one single sound (which in itself may be a very complicated signal, of course) more faithfully than by a single channel.

Let us see what happens in a five-channel stereo reproduction system. Figure 1 shows the principle of such a system. Five microphones M1 to M5 are located in front of three sound sources X, Y, and Z, which are three instruments or singers. (The use of five directional microphones concentrated at one place would not make an important difference for the following discussion, as important and interesting the difference may be for other problems.) Each microphone has an amplifier, A1 to A5, and there are five respective loudspeakers L1 to L5. If everything is right we do have five-channel stereo reproduction in the second room. It is of no importance for our problem whether we have an actual live reproduction or any kind of recording on tape or film or a radio transmitter between the microphones and the speakers provided they do not introduce any interfering distortion which will affect our problem.

Now let's analyze what happens with the microphones and loudspeakers when the three instruments X, Y, and Z are played. Instrument X is closest to microphone M2, more distant from microphone M1 and M3 and even further away from M4 and M5. If we ignore all secondary effects, such as reflected sound and so on, microphone M2 will receive the loudest sound, M1 and M3 something less, M4 still less and M5 only a small amount of sound. If all microphones, amplifiers, and speakers are identical, the sound reproduced by the loudspeakers will have a similar distribution. Figure 2 shows the sound-intensity distribution of the five loudspeakers.

Fig. 1. Diagrammatical representation of the author's five-channel stereo system.



The black bars represent the volumes of the five speakers, the dotted line the sound distribution some distance in front of the speakers where the sounds of the five speakers form a smooth distribution pattern.

The exact shape of the distribution curve depends on the distance of the sound source and its sound radiation pattern, but the curve in Fig. 2A is representative for usual cases.

The sound distribution of instrument Y is quite different. It is shown at B in Fig. 2, and the one for instrument Z at C.

If all three instruments are played at the same time we will have a combined sound distribution as shown in Fig. 3.

The listening effect if we sit at a certain distance in front of the speakers is that we hear instrument X from half left, instrument Y from the right and instrument Z from the center. That is what we call stereophonic reproduction.

A five-channel stereo system has some important advantages compared with a two-channel system. That point will be discussed later.

A five-channel stereo system with five microphones, five amplifiers, and five speakers can be built at home, but our sub-title claims that it can be done with any ordinary stereo source, such as discs, tapes, and broadcasts, all of which have only two channels.

Impossible? Let's investigate the problem without prejudice.

What we need is some kind of a black box with two inputs for sources 1 and 2 and five outputs whose respective powers or volumes are similar to those in Fig. 1. (See Fig. 4) That must be the case for any possible sound distribution in Fig. 1, as an example for any of the three instruments X, Y, and Z separately or combined as in Figs. 2 and 3.

To understand the proposed new system it may be necessary to repeat some mathematical rules. These perhaps new and unusual applications form the basic background of the solution to be given later.

We all know what a sine curve is. The graphical representation is shown in Fig. 5 as a full line.

On the X-axis we may have the time, an angle, a distance, or anything else. The Y-axis usually represents the value of another quantity which is a function of the former. The most common application is the representation of a voltage or a current distribution along an antenna.

Figure 5 also shows a dotted line. It is a cosine curve which in fact is nothing else than another sine-curve which is displaced on the X-axis by one quarter. This displacement is often and for many applications called the phase angle.

For our problem we need only the first part of the diagram. It is repeated at A in Fig. 6. But now we need another trigonometric law, which states that the sum of two sine-functions (of the same wavelength) is again a sine-function. That means that if we add the thin full line (sine) at A in Fig. 6 to the dotted (cosine) curve we will get another sine-curve. This sum-curve is shown as a heavy full line. Now there is something very interesting: the peak of the sum-curve occurs at a point where neither the sine-curve nor the cosine-curve has a peak.

The sum of two sine-curves of the same wavelength is always a new sine-curve whether the two original sine-curves are of the same or of different heights and whatever will be their respective displacement on the X-axis. As we are only interested in the sum of a cosine and a sine-curve the displacement on the X-axis will always be the same in our following discussion, but we want to know what happens to the sum-curve when the peak amplitudes of our sine- and cosine-curves are different.

In Fig. 6B, the cosine-curve has a maximum amplitude, say 100 per cent, the sine curve is absent, or 0 per cent. The sum-curve consequently is identical with the cosine-curve. In C, we find a somewhat smaller cosine-amplitude (92 per cent) and a small sine-amplitude (38 per cent). The resulting sum-curve now has a peak of the same height as at B but the peak is displaced somewhat to the right. In D, both the cosine- and the sine-curves are of the same height of 71 per cent and the peak of the sum-curve has again the same height (100 per cent) but is shifted to the center of the figure. At E, the amplitude of the cosine-curve is still smaller (38 per cent) and the one of the sine-curve higher (92 per cent). The peak is shifted to exactly three quarters and finally at F, there is only a sine-curve of 100 per cent and consequently the sum-curve is identical with the sine-curve and has the peak at the very right.

Remember: We have only two well defined geometrical lines, a cosine-curve and a sine-curve with their peaks invariably at the extreme left and right respectively. By varying only the relative amplitude of both of these lines and adding them, we receive a sum-line with a sine-shape whose peak is always the

Fig. 2. A, B, and C show the sound intensity distribution from the five loudspeakers for the three separate source points.

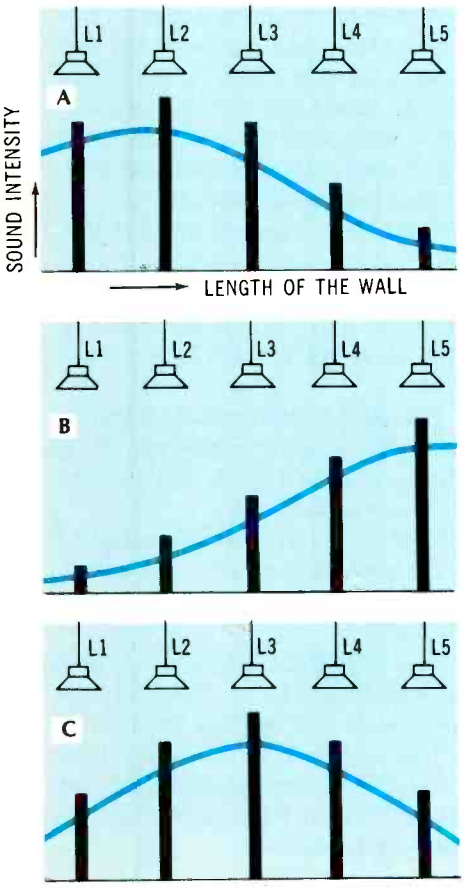
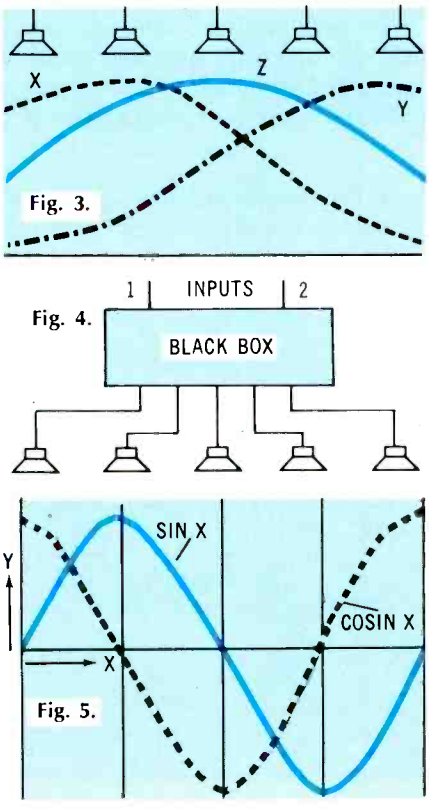


Fig. 3. Combined sound distribution patterns for the five loudspeakers.

Fig. 4. The "black-box" concept from the two-channel input to the five-channel output.

Fig. 5. Sine and cosine curves used to develop the theory of five-channel stereo.



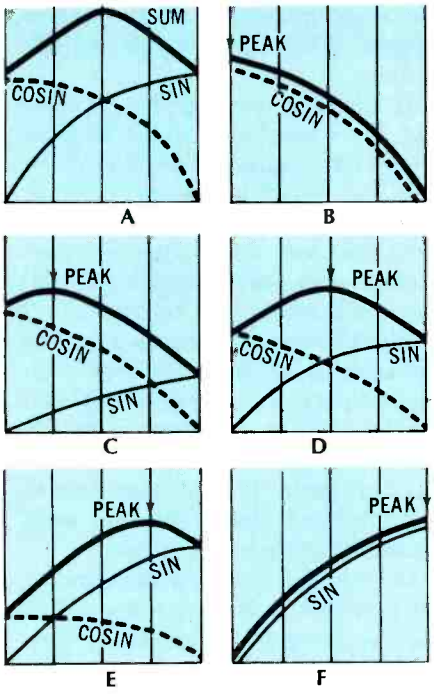


Fig. 6. Continuing the development of the sine-cosine theory, where the summation is shown at A, with the remaining figures showing the sound distribution over the separate speakers.

same but *is shifted from the extreme left to the extreme right* through all the intermediate positions.

1) We interpret what we called the cosine-curve (dotted line in the

Now what have all these mathematical things to do with five-channel stereo? We need only apply our theoretical and seemingly pure mathematical knowledge to the field of sound reproduction:

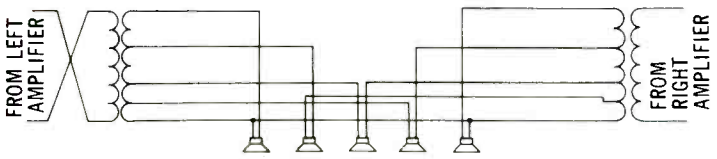


Fig. 7. Concept of using transformers to obtain the desired output voltages from two amplifiers to feed five speakers.

diagrams) as the left channel, the sine-curves (thin full lines) as the right channel of our sound system.

2) Identify the basic width of the six parts of Fig. 6 with the geometrical basis of our loudspeaker system. That means the horizontal basic lines of the diagrams shall represent the length of the wall in our room where the stereo speakers have to be placed.

3) Place five similar speakers equally distanced along that wall, the position of each is represented by thin vertical lines in Fig. 6.

4) Feed the five speakers in accordance with the cosine- and sine-curves. That is: Speaker 1 (the first from left) will be fed with the full signal of the left channel only. Speaker 2 (second from left) is fed with only 92 per cent of the left signal plus 38 per cent of the signal of the right channel. Speaker 3 (in the middle) will receive 71 per cent from the left and 71 per cent from the right channel. Speaker 4 (second from right) is rated at 38 per cent of the left and 92 per cent of the right-channel signal. Speaker 5 (first from right) receives the full right-channel signal.

The simplest way to realize such a voltage distribution of the signals of the two amplifiers would be to have output transformers with the necessary taps, but as no such output transformers are available we have to use separate transformers as shown in Fig. 7.

Separate transformers are also needed with solid-state amplifiers which have no output transformers at all. Auto-transformers may be used to simplify the installation. These transformers must have very low primary and secondary impedances and thus need only few turns but they must be of good quality to give truly hi-fi reproduction.

If the taps of the two output transformers are determined correctly, we will have a sound distribution in front of the five speakers which is for the left channel more or less similar to the cosine distribution in Fig. 6 and with the sine distribution of the same figures for the right channel.

If now some signal appears only in the left channel (which will only be the case with a source close to microphone 1 in Fig. 1) the left output transformer only has voltage. Then speaker 1 gets the full voltage, speaker 2, only 92 per cent, speaker

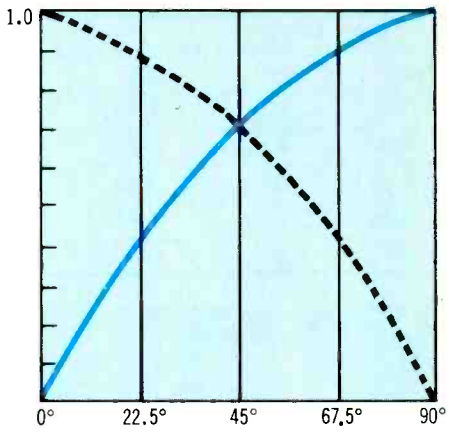


Fig. 8. Chart used to determine relative inputs for the five speakers.

3, 71 per cent, speaker 4, 38 per cent and speaker 5, no voltage at all. The sound source seems to be at the left.

If the left channel still carries most of a certain signal, but the right one has also a small amount, as is the case for instrument X (see Fig. 3) than the voltages of the two output transformers are similar to C in Fig. 6, and the sum of the two voltages is the highest for speaker 2, it will be the loudest.

The determination of the correct taps of the output transformers is quite easy: they should follow as closely as possible cosine and the sine-curves as shown in Fig. 8.

If we have five equally distributed speakers, they correspond with the angles 0, 22½, 45, 67½, and 90 deg. in a trigonometric table and the appropriate figures are those in the following table:

Angle	Cosine	Sine
0°	1.000	0.000
22½°	0.924	0.383
45°	0.707	0.707
67½°	0.383	0.924
90°	0.000	1.000

If as an example the secondary of the transformer has 100 turns there should be taps at 38, 71, and 92 turns.

As clearly follows from the explanations given, it would be wrong to choose equally distributed taps. Such a distribution would not represent a sine-curve but a straight line and the sum of two straight lines will never have a peak between

TABLE I

Output Voltage		Speaker Power				
E_{Left}	E_{Right}	P_1	P_2	P_3	P_4	P_5
1	0	**1.00**	0.85	0.50	0.14	0
0.92	0.38	0.85	**1.00**	0.85	0.50	0.14
0.71	0.71	0.50	0.85	**1.00**	0.85	0.50
0.38	0.92	0.14	0.50	0.85	**1.00**	0.85
0	1	0	0.14	0.50	0.85	**1.00**

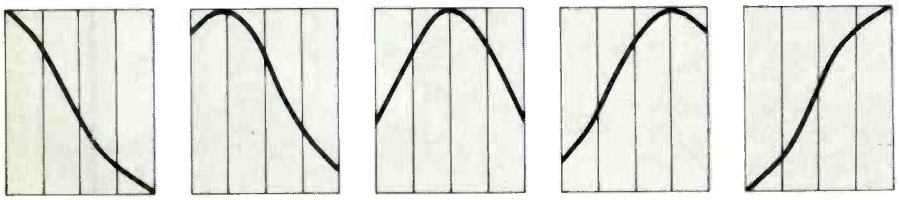


Fig. 9. The power curves show greater peaks than were present in the voltage curves.

the two extreme ends. The voltage distribution must follow as closely as possible the trigonometric functions. However, that does not mean that we have to deal with half or quarter turns.

The given figures for the taps result in corresponding voltages and until now we only talked about voltages. But it is the acoustic power which is really interesting. And here again a mathematical law improves what we already have found.

The electric power is

$$P = EI$$
$$I = \frac{E}{R}$$
$$P = \frac{E^2}{R}$$

where P = power (watts), E = voltage, I = current, and R = resistance.

For the present investigation we do not need to bother about the power factor, cos ψ. We can forget the efficiency of the speakers and assume that the resistance of the speakers is independent of the frequency, and to simplify it even more assume the speaker resistance to be 1 ohm. These simplifications are justified because we are not dealing with the behavior of our equipment for different frequencies; all we need is the relative power for the five speakers which, of course, must be similar.

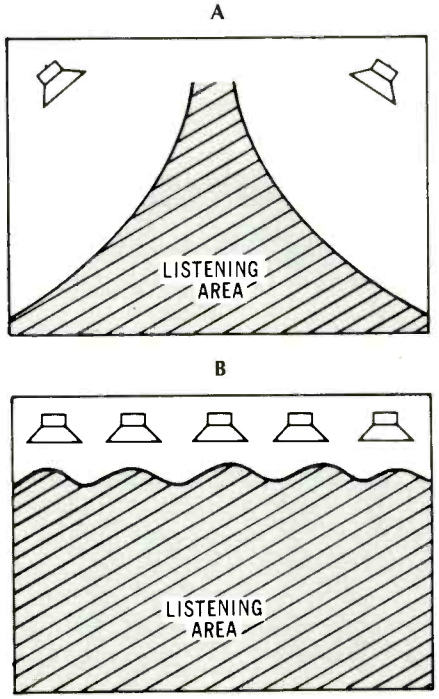
The simplified formulas for the power of the five speakers are:

Speaker 1: $P_1 = E_L^2$
Speaker 2: $P_1 = (0.92\ E_L + 0.38\ E_R)^2$
Speaker 3: $P_3 = (0.71\ E_L + 0.71\ E_R)^2$
Speaker 4: $P_4 = (0.38\ E_L + 0.92\ E_R)^2$
Speaker 5: $P_5 = E_R^2$

The above table contains, as a result of the above formulas, the relative power for some different output voltages of the two amplifiers.

In Fig. 6, the sum line represents the voltage for the five speakers in the five different cases. The appropriate powers are shown in Fig. 9.

Fig. 10. Normal stereo listening areas (A), as compared to the five-channel arrangement, (B).



Note that the peaks are much more accentuated, and the slopes steeper. That is, of course, an advantage.

If we now compare Fig. 9 with Fig. 2, we must admit that we have a very close approach to the system with five complete and independent channels in spite of the fact that we here have only a two-channel stereo sound source such as a stereo broadcast, or a stereo disc or tape.

What is the advantage of such a five-channel system compared with the ordinary stereo system with two speakers? It is well known that a two-speaker system has a very serious drawback: The listening area is restricted as shown in the well-known diagram of Fig. 10A.

Outside the listening area one of the speakers is so predominant that the stereo effect is completely lost. It is obvious that these conditions are far from ideal and make stereo listening in many cases difficult and troublesome.

With the five-channel stereo system, the listening area is extended, and there is only the small area close to each speaker, which gives a wrong impression and is not usable.

The listener is free to move almost anywhere within the room and more listeners can be placed to hear stereophonic sound correctly.

The five-channel system also makes it possible to extend the angle of the two extreme speakers viewed from the listener. There will never be a "hole in the middle." Of course the principle explained above is not restricted to five channels, it is applicable to any number of speakers and channels. The only difference is the number and appropriate calculation of the taps of the transformers. For a three-channel system, taps and speakers 2 and 4 have to be omitted.

The system can be tested readily with minimal cost by using two inexpensive home-made transformers and five identical, inexpensive speakers. That may not bring high-fidelity into the room, but it is sufficient to demonstrate the improved stereo effect and the extended listening area produced by a five-channel system.

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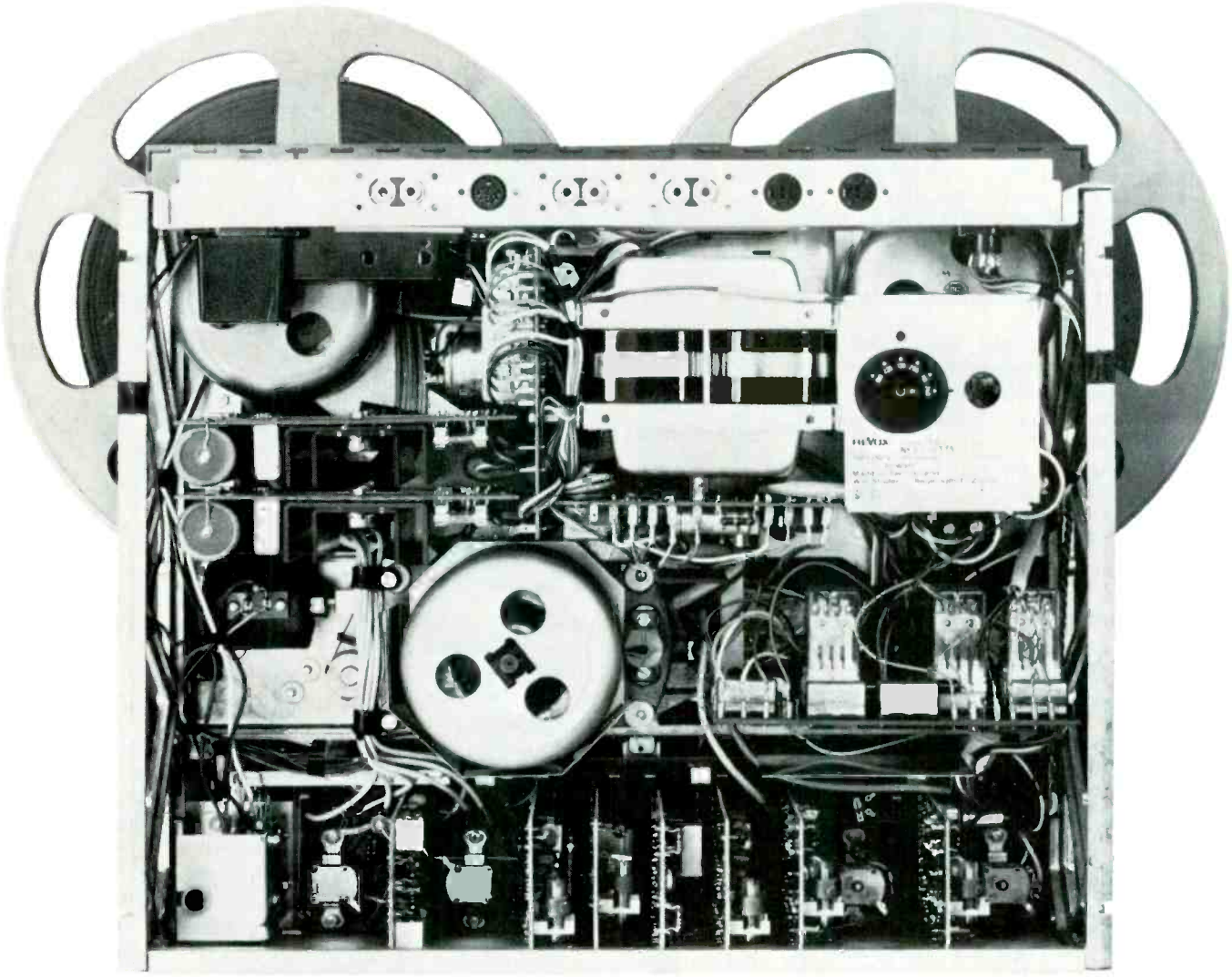

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Layman's Guide to Amplifier and Receiver Specifications

IN LAST MONTH'S issue, we covered IHF specification requirements for FM tuners—both mono and stereo—and we learned that there are fourteen specifications which must be given when complete specifications are to be published. Amplifiers are similarly covered by the requirements of the IHF. Five basic specs are required for a minimum and ten for a complete job on mono units, while five basics and twelve additional specs are required for a complete listing.

Since a receiver consists of a tuner and an amplifier combined, the reader is cautioned to look for a total of twenty-six types of specifications when he begins to compare receivers. He will, therefore, look in last month's issue for the tuner-section specs for a receiver, and in this article we will give those applying to amplifiers, and to the amplifier section of receivers. Specifications for AM tuners or tuner sections are much simpler, and will be covered in a future issue.

Amplifier Specifications

Continuous Output and Distortion (rms Output at Rated Distortion). Since an amplifier's prime function is to take minute electrical signals and amplify them until they are capable of pumping energy into a loudspeaker, the most basic specification that can be applied to this component is its maximum power-output capability. Akin to the "horsepower" rating of an automobile, this spec is also accompanied with ambiguities and misconceptions. For one thing, to say that an amplifier has a maximum power output capability of 30 watts (or 30 watts per channel in the case of stereo) is almost meaningless unless one states several other conditions. How badly is the signal distorted when producing the stated power? At what frequency is the power being produced (amplifiers generally have an easier time putting out power at mid-frequencies)? Lastly, is the power being pumped out continuously, or in spurts?

To standardize the specification, IHF standards require that the frequency be 1000 Hz, that the distortion be specified (and thereafter called "rated distortion") and that the power be continuously generated. Thus, the specification given by a manufacturer may read: "30 watts per channel at less than one per cent Total Harmonic Distortion."

The 1000-Hz signal is understood, as is the fact that it is to be applied and measured continuously rather than intermittently. Now, what makes this spec a little difficult when one is comparing one amplifier with another is the fact that the manufacturer has the option of deciding what the "rated distortion" shall be. Thus, a more conservative manufacturer may rate his amplifier as having a power-output capability of 30 watts at 0.3 per cent distortion while a less conservative one may rate his as 30 watts at 1.0 per cent distortion. Obviously, the former unit is the better of the two—at least in power rating. It should be noted that in the case of a stereo amplifier, *both* channels are to be driven to full power output, while one is measured. This is a more stringent test than if only one were driven and measured because the requirements on power supply and the rest of the circuits are more demanding when both channels are working.

While many manufacturers state rated continuous power and distortion as a pair of numbers, a really thorough presentation (and one mentioned by IHF) involves a graph which not only shows distortion at rated power, but distortion at low listening levels and at power somewhat higher than rated. This is the technique AUDIO uses, as shown in Fig. 1. Note that in this illustration, rated power is 19.5 watts at 0.5 per cent distortion, but that at more usual listening levels (say, 1 watt average), the distortion is less than 0.1 per cent. Some solid-state amplifiers exhibit a *rising* distortion at lower power due to crossover or notch distortion in the output stage. Without this graphic presentation, you would never know it.

Dynamic Power Rating (Music-Power Rating). On the theory that music is not a monotonous, continuous tone but rather a series of dynamically changing tonal complexes, many amplifiers are able to produce somewhat more power output with music than they can when subjected to a constant-tone input. This is because the power supplies have less of a tendency to "collapse" when short bursts of power are demanded of the amplifier.

In theory, if power supplies were *perfect* (such that one could draw unlimited current from them with no decrease in the available voltage), continuous power rating and "dynamic" or "music-power" rating would be one and the same thing. In most cases, this is not true. Accordingly, two methods have been developed to approximate "musical" conditions. The simplest involves the use of an external power supply, fully regulated, to act as a substitute for the built-in power supply of the amplifier. This approach presumes that the internal power supply would not have time to change significantly when subjected to short pulses of high-power output characteristic of musical programming. With a fully regulated external supply, measurements are made in exactly the same manner as for continuous power—but the results will usually be a higher power output.

An alternative method involves the use of very special equipment which actually sends through audio pulses of 10 to 20 milliseconds. These are supposed to approximate musical conditions and to facilitate making measurements of distortion and power output. Theoretically, the results should be the same as with the use of an external controlled power supply, or very nearly the same.

Our own view is to emphasize the continuous power rating of an amplifier, rather than the dynamic power. In specifying the "dynamic" or music power, however, we are able to get at one piece of information—if only indirectly. The closer the "dynamic" power rating is to the continuous power rating, the more rugged the built-in power supply is likely to be—and that is worth knowing about.

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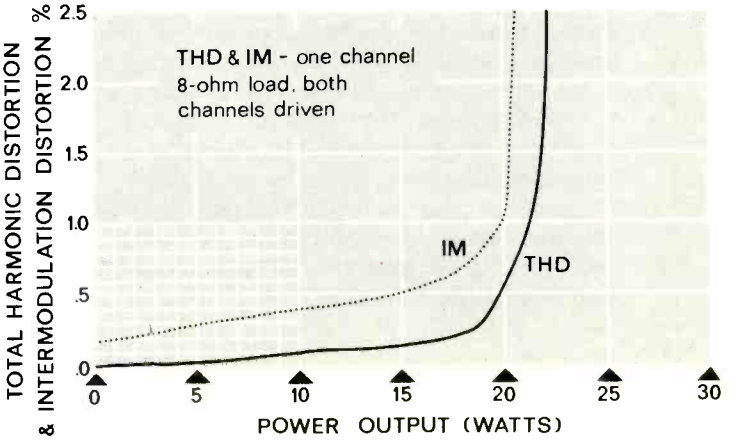

Fig. 1 – Typical power output vs. Total Harmonic Distortion curve for an amplifier. To conserve space, the corresponding Intermodulation Distortion curve is shown on the same graph.

The great hall of the Hammond Museum. This room is the location of the organ played by Richard Elsasser on Nonesuch H-71200 ("Yankee Organ Music") and H-71210 (Organ Symphony No 5 by Charles-Marie Widor)

AR-3*a* speaker systems were designed for home music reproduction. Nonesuch Records uses them as monitors at recording sessions.

Nonesuch Records recently recorded several volumes of organ music played by Richard Elsasser at the historic Hammond Museum near Gloucester, Massachusetts. To make the recording, Marc Aubort of Elite Recordings, engineering and musical supervisor, used Schoeps microphones, and Ampex 351 recorder, Dolby A301 Audio Noise Reduction apparatus, and several pieces of equipment which were custom made. To monitor the input signal and to play back the master tape, Aubort used an AR amplifier and 2 AR-3a speaker systems.

The AR-3a speaker system is priced from $225 to $250, depending on finish.

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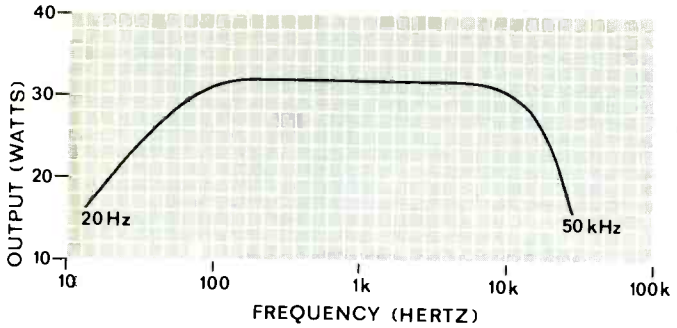


Fig. 2—Power-bandwidth curve showing the limits of frequency response at which the output drops to one-half the rated power.

Another specification being used by some manufacturers is IHF Power ±1 dB. This rating puffs up the IHF Power figure by about 26 per cent. Thus, a receiver that could deliver 79 watts IHF power could be rated at 100 watts IHF Power ±1 dB.

The "appliance" manufacturers, on the other hand, have their own set of power ratings. Following the standards set down by the EIA (Electronic Industries Association), which are entirely different than those of the IHF (Institute of High Fidelity), power is measured with a standard frequency of 1000 Hz at *5 per cent distortion.* Naturally, by driving the amplifier up to such a high order of distortion, this "Music Power Output" rating for "packaged" equipment gives a much higher power value than that reached when using the IHF tests. Furthermore, this rating is generally doubled, and called "Peak Power."

One final thought on power and power ratings, in the light of today's solid-state amplifiers. These amplifiers, unlike their tube-type predecessors, put out their greatest power when feeding a speaker load of four ohms. Most good loudspeakers intended for high-fidelity use have nominal impedances of eight or even sixteen ohms. When driving such speakers, the power capability will be less than the manufacturer has specified for four-ohm operation. How much less? There's no hard and fast rule—but in our AUDIO lab measurements we always use an eight-ohm load to ascertain maximum power output — since it's more realistic in terms of actual use by the consumer.

Power Bandwidth. Demands for high power are made upon an amplifier not so much at mid-frequencies, but rather at low bass frequencies. Think of the power generated by a low organ tone —you almost "feel" the vibration in addition to hearing it! For this reason, it is important to know the range of frequencies over which the amplifier can produce its "rated" power (and here we're speaking of *continuous* power). Power bandwidth is defined as the range of frequencies (from lowest to highest) over which the amplifier is capable of producing at least one half its rated power at its rated distortion. Ordinarily, this "half-power" element in the definition might be thought of as a severe compromise, but actually, "half power" represents a decrease of 3 dB, which is not a very great *audible* difference at all. A typical power-bandwidth curve is shown in Fig. 2, in which the defined extremes are seen to fall at 20 and 50,000 Hz.

Sensitivity. This specification serves as more of an aid to the consumer attempting to match up a set of components than as a figure of merit (or *demerit.)* If the preamplifier (phono) section of an amplifier has a rated sensitivity of 5 millivolts input (to produce rated output), one would not purchase a phono cartridge having an output of only 2 millivolts, for such a cartridge would prevent the user from ever getting full available power from the amplifier. In other words, sensitivity merely tells you how much signal voltage you have to feed into the low- and high-level inputs of an amplifier to produce full output.

Hum and Noise. Hum and noise may really be thought of as other forms of "distortion," if we define distortion as any sound which was not present in the original program. In this case, however, the source of the "distortion" is the amplifier itself — hum being caused by output signals related in frequency to the power-line frequency (60 Hz, 120 Hz, and so on) and noise being a product of the active and passive components of the amplifier itself (tubes, transistors, resistors, and so on). Hum and noise are measured as so many dB below rated output, but in the IHF standards an additional psychoacoustic phenomenon is brought to bear in the specification. Since human hearing is less sensitive to very low and very high tones than it is to mid-range frequencies, a weighting factor is introduced in the measurement. Thus, if you see a reference to "C" weighting in a hum-and-noise spec, this simply means that hum-and-noise frequencies below 20 Hz and above 10 kHz are effectively discounted from the overall measurement since they do not contribute materially to the *sensation* of audible hum and noise.

As a guide, high-gain phono and tape-head inputs in high fidelity equipment will have hum-and-noise figures anywhere from 50 to about 70 dB below full output, while high-level inputs such as tuner, aux, and tape recorder will generally be better, having a hum-and-noise figure of anywhere from 75 to 90 or 100 dB below rated output.

Frequency Response. This specification is somewhat of a misnomer. It really should be called *amplitude response* for varying frequencies. Ideally, every frequency applied to an amplifier should be amplified by the same amount, providing the tone controls are set to their "flat" or uniform-response positions. The *deviation* from flat response over the useful frequency range is stated in "plus or minus" (written ±) dB. Frequency response is most easily represented by a graph, as shown in Fig. 3, and while the IHF requires that the frequency range measured be only from 20 Hz to 20,000 Hz, many manufacturers feel that a wider range is of some significance and it is not unusual to see specifications justifiably claiming response from 10 Hz to 100,000 Hz, ± 1 dB.

Major peaks or dips in the response are, of course, more serious if they occur in the 20-20,000 Hz range than if they occur outside the audible range— all of which makes the graph a bit more meaningful than the mere statement of response. This same graph (Fig. 3) lends itself to a simultaneous presentation of tone-control action and it is the practice of AUDIO, in its reviews, to show maximum boost and attenuation characteristics of both the bass and treble controls on the same plot with frequency response. It is understood that all intermediate positions between the extremes are attainable by means of the tone controls. In some instances, loudness/contour response is

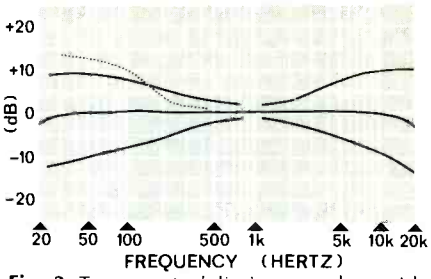


Fig. 3—Tone-control limits, together with the overall frequency response—the center line—with the controls in the "flat" position. The dotted line shows the effect of the loudness/contour control, and filter responses are often plotted on the same graph.

OUR NEWEST PREAMPLIFIER

The transistorized PAT-4 is almost two years old and we still can't fill the demand.

Our newest preamplifier doesn't replace our earlier ones, so you can now have Dynaco performance with either tubes or transistors. Our mono preamp is still selling after 12 years, and the unbeatable PAS stereo series is going strong after 10.

This unprecedented longevity is explained by Dynaco's unswerving devotion to performance, reliability and unmatched low cost. The PAT-4 is only $89.95 as a kit and $129.95 factory-assembled. At one-third the cost of other units, such consummate value just naturally gets around.

Dynaco introduces new products only when they fill a real need. They never render previous models obsolete.

We can't promise that the transistorized PAT-4 will still be our newest preamplifier 10 years from now.

But we do know it won't be out of date.

DYNACO, INC., 3060 JEFFERSON ST., PHILA., PA. 19121

also shown—in this case as a dotted line. Filter response is shown where applicable.

Maximum Input Signal. This specification, like the sensitivity spec already discussed, serves as an aid to the prospective purchaser in matching his various components. While the main volume or level control in an amplifier can always be used to reduce the power output to distortion-free levels, its relative position in the amplifier circuit is usually beyond the first low-level stages of the circuit. These low-level stages, therefore, might well be overloaded to the point of severe distortion if fed with too great an *input* signal and there would be no way of attenuating these input signals.

As an example, suppose you have a tape deck whose preamplifier, during playback, puts out 2 volts. Suppose, too, that the high-level tape input of your proposed amplifier will accept voltages only up to 1.5 volts before becoming distorted significantly. These two products would definitely not be "meant for each other." In providing maximum input levels allowable, the manufacturer wishing to tell the whole story should give maxima for *each* low- and high-level input, since often they will be different from input to input.

Stability. It is common practice today to run long lines of speaker cables to auxiliary sets of speakers in other rooms, often hundreds of feet away from the amplifier. Such long cables look like sizable capacitors at times, and the presence of a capacitive load on the speaker terminals of some amplifiers may cause instability in the form of super-audible oscillations which could damage speaker and/or amplifier. Further, electrostatic speakers present a large capacitive load to an amplifier. In addition, certain complex multiple-speaker crossover networks (to feed correct bands of tones to woofer, mid-range, and tweeter elements) may present inductive loads to amplifiers which can also cause forms of instability or oscillation.

A series of rigorous tests has been developed and prescribed by IHF to determine an amplifier's stability. If you find the statement about an amplifier that it is "unconditionally stable," chances are no amount of unusual loading will cause any problem. If an amplifier does reach instability with some unusual load condition, the manufacturer is supposed to state that condition. Few manufacturers have bothered too much about this spec, because most amplifiers built today are quite stable and generally will not oscillate under any condition.

Input Impedance. This specification is another one of the "matching" specs designed to assist you in selecting your equipment initially. As a general rule, all you have to remember about it is that if product "A" is to feed its signal to product "B," the *input* impedance of product "B" should be equal to or greater than the *output* impedance of product "A" if no undue "loading" or deterioration of either signal amplitude or frequency response is to take place. Exceptions include cartridges and loudspeakers. In the case of cartridges, their recommended "load impedance" should, if possible, be exactly met by the input impedance of the phono input of the amplifier. In the case of loudspeakers, their input impedance *must* lie within the output load requirements of the amplifier.

Damping Factor. This specification is often confused with the *load impedance* requirements of an amplifier because it is said to be related to the amplifier's own "output impedance." Actually, it is merely a measure of the amplifier's own *regulation,* or ability to maintain constant output voltage with varying speaker loads connected. In practical terms, some speaker manufacturers recommend minimum damping factors that should be used with their speakers for best results. Others leave this matter completely open. Today, the trend seems to be in favor of higher damping factors (advantages claimed are "tighter" sounding bass response, less "muddiness" of low tones, and so on, but we can remember when amplifiers featuring "variable damping controls" were in fashion, whereby the user adjusted the damping factor to suit his pleasure. Where fixed damping is provided, if it is anything above 8 or 10 you're not likely to have any problems with damping factor.

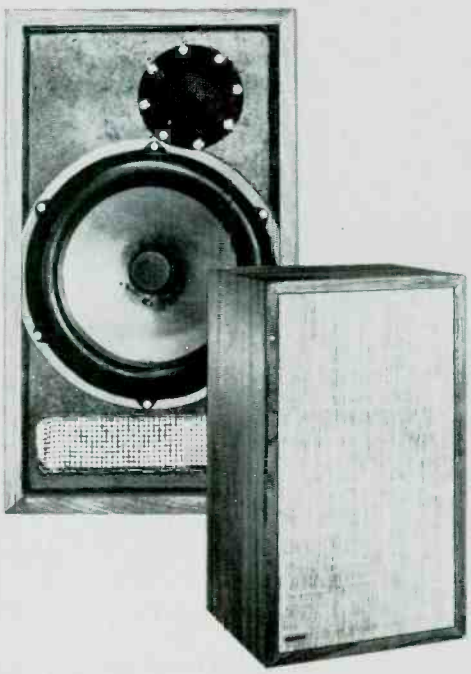
Tracking Error. This specification applies to stereo amplifiers only and has to do with the accuracy of "tracking" of dual volume controls. Most stereo amplifiers have a single knob for controlling the volume of both channels but, as you may have surmised, when you turn this knob you're really turning *two* volume controls mechanically connected to each other. Obviously, if you were to turn down the volume control, say, to the "10-o'clock" position and your left channel volume was suddenly 10 dB lower than the right volume, you'd be unhappy, to say the least. Excellence of tracking of a pair of mechanically coupled volume controls takes individual selection by the control manufacturer and that means a more expensive dual volume control. To rate tracking error it is necessary to establish first an acceptable or rated value. Suppose an error of 3 dB is considered by a given manufacturer to be acceptable (that is, the maximum tolerable error is 3 dB less gain from one channel than from the other). The next thing that needs to be specified is how far down you can rotate the control without exceeding that specified error.

The lower the first figure and the greater the second figure (in dB), the less the tracking error. Thus, a control having a tracking error of 2 dB down to −60 dB is better than one having an error of 3 dB down to −60 dB, while in another comparison, a control having a rated tracking error of 1 dB to −70 dB is better than one having an error of 3 dB to −70 dB.

Separation and Crosstalk. Applicable only to stereo amplifiers, again, this spec is almost completely analogous to the separation spec discussed last month in connection with stereo FM. It is a measure of how much left-channel information appears at the right-channel output and vice versa. As in stereo FM, the greater the figure (expressed in dB), the better the separation characteristic of the amplifier. Separation in a stereo amplifier may be expected to be far superior to that encountered in the stereo circuitry of an FM tuner, with figures of 50 and 60 dB not at all uncommon. As is true with stereo FM, however, separation tends to deteriorate with amplifiers as higher frequencies are applied.

Intermodulation Distortion (IM Distortion, or just plain IM). While IHF discusses standard tests for measuring IM distortion (a form of distortion which results in the production of extraneous signals which are the sum and difference of two or more desired tones), for some reason they have seen fit to omit this specification as a *required* listing on the part of an amplifier manufacturer. Surprisingly, most amplifier manufacturers continue to publish IM specifications anyway, for they, like AUDIO, deem it a rating of paramount importance. Audio experts have long believed that the presence of a given amount of IM distortion can be more offensive to the listener than harmonic distortion which, after all, has a harmonic relationship to the fundamental desired tone.

Following the manufacturer's lead, AUDIO, therefore, always measures and publishes a curve of IM distortion vs. power output. For simplicity, this curve is shown on the same graph as THD, as in Fig. 1. While it appears to be very similar to THD curve, no constant relationship exists between harmonic and intermodulation distortion in an amplifier, for they arise from completely different causes. For instance, we have seen amplifiers in which IM is actually lower than THD at most power output levels. Æ



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This new **aperiodic** loudspeaker system is just $79.95, compact (20"x11½"x10" deep), and particularly easy to drive. We call it **aperiodic** because the Dynaco A-25 is almost literally without resonance, thanks to an acoustic impedance system which provides variable volume action rather than the sealed acoustic suspension box. The aperiodic design contributes markedly improved low frequency transient response, reduced Doppler effects, and a substantial improvement in effective coupling of the speaker to the amplifier. The A-25's ten-inch extended excursion woofer crosses over at 1500 Hz to a new dome tweeter with a five-step level control.

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Electronic Organs

NORMAN H. CROWHURST

PART 7 of a series. Vibrato, Tremolo, & Percussives

Acoustic Methods

IN THE OLD wind-blown home organ that some of us remember from when we were young, a form of tremolo was achieved by a rotating vane in the output from the organ's sound box (Fig. 7-1). Nowadays a somewhat similar means of achieving vibrato uses the Leslie speaker.

The original idea behind the Leslie speaker rotated the speaker, so that sometimes it would be pointed toward you, sometimes away from you. The difference in time taken for the sound to reach you resulted in a pitch change due to Doppler effect. The Leslie speaker simplifies this by keeping the speaker still, but varying the path by which the sound gets out into the room, with a rotating vane structure (Fig. 7-2).

Wurlitzer uses a mechanical method in which the speaker is actually moved (Fig. 7-3) to create an additional vibrato (one that is added to sound from stationary sources). As this small speaker cannot handle the lower registers, an electrical tremolo is added to continue an equivalent effect down to these frequencies, with a smooth transition from one to the other.

Vibrato or Tremolo?

Before leaving this question of vibrato or tremolo, perhaps we should discuss the distinguishability between the two forms of modulation. Obviously, if you turn the gain up and down slowly, or vary the frequency up and down slowly (from a variable oscillator) you will know the difference.

But when the change is faster, and rhythmic, the comparison of electrical outputs resembles the difference between amplitude and frequency modulation. As mathematical analysis shows, for a given modulation frequency, each produces the same sidebands of the carrier frequency, but in different phase relations, which can be seen best by vectors (Fig. 7-4).

Thus if a note of 261 Hz is being

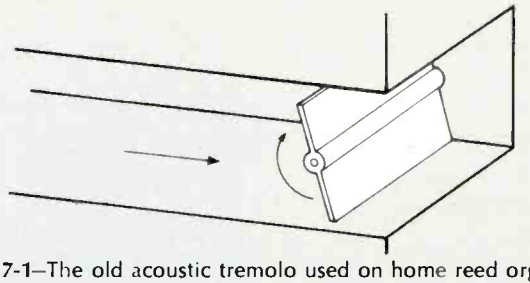
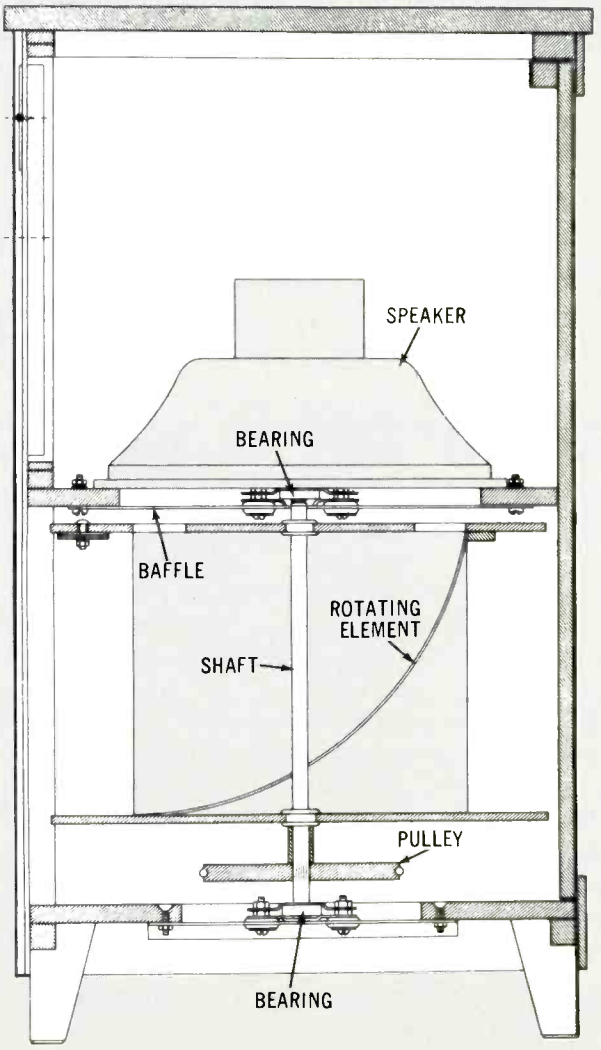


Fig. 7-1—The old acoustic tremolo used on home reed organs.

Fig. 7-2—The Baldwin-Leslie rotating mechanical-vibrato system.



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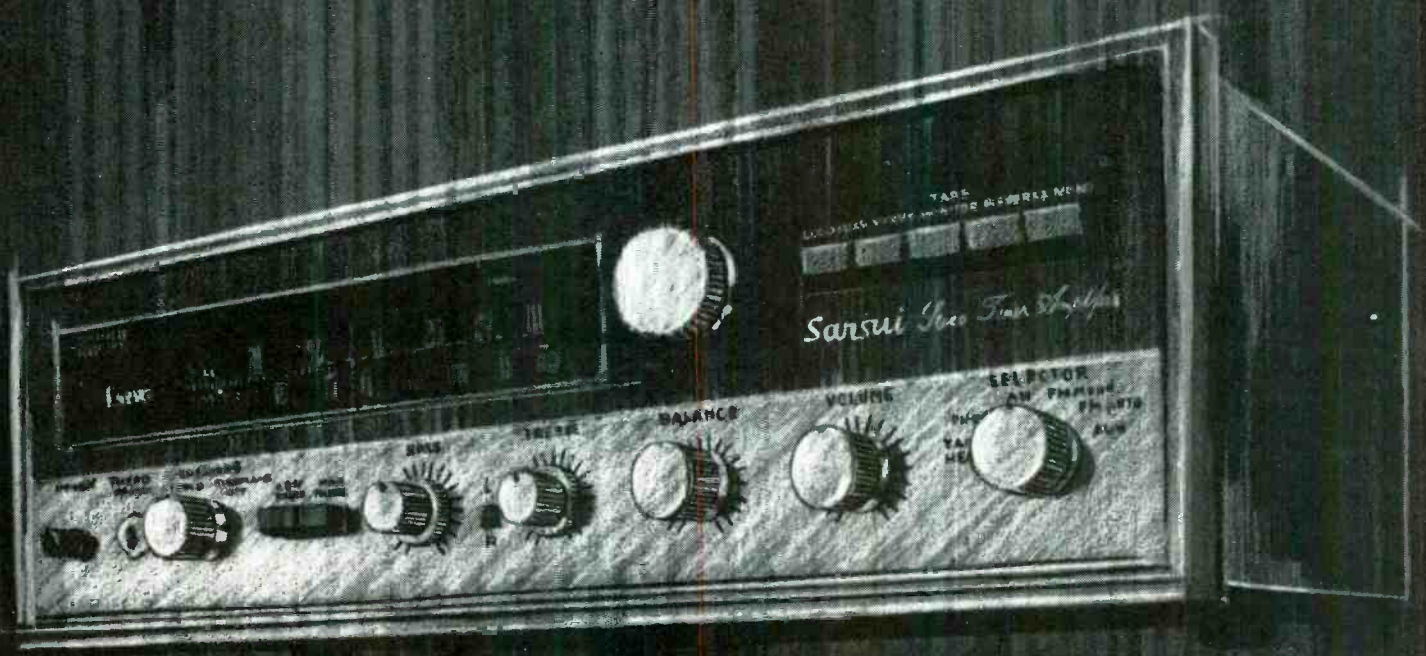

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ously, as if those notes were played on a marimba with mallets held in the same hand.

Chords

At one time, before the advent of diode or transistor keying, chord buttons operated the various notes contained in the chord by a somewhat complicated mechanical coupling, like that in the bass end of a piano accordion. But diode keying makes this much simpler, so that it can be achieved with only one contact for each button, which also makes operation more reliable.

Each contact energizes the necessary notes through diodes arranged so that any button or key that requires that note to play applies the voltage needed, without communicating it to all the other notes that may at different times be played with it.

For example (Fig. 7-6), when the C key is played, it energizes only the C diode. When the C-major button is played, diodes pass energizing voltage to C, E and G, without allowing it to pass through to any other chord circuit. If the G-major chord button is selected, the voltage is passed to G, B and D, which is quite a different combination. And if C minor is selected, the diodes feed C, D♯ and G.

This construction allows inexpensive diodes to replace multiple contacts and coupling bars to any desired extent. Possibilities become virtually unlimited.

Automatic Chord and Bass Features

This whole idea is taken a step further in the "automatic orchestra" feature incorporated in some Lowrey organs. Notes pressed on the lower manual, when this feature is in use, energize the whole range of those notes (through all octaves) as a basic chord for orchestration purposes, but the voltage does not reach any of the keying diodes yet.

Then the arpeggio keys, of which there are four per octave, twelve in all, each covering four notes (one overlap). Each arpeggio key will play any of the four notes within its range among those held down on the lower manual, but in the octave at which that particular arpeggio key is located. In this way the arpeggio keys play the correct notes to correspond with orchestrations of that chord, merely by sweeping a finger in "random" fashion over them. The skill in playing is relegated to diodes, so the player can easily avoid mistakes.

An additional feature is called the chromatic keyboard. This is really an extension of the upper manual in which

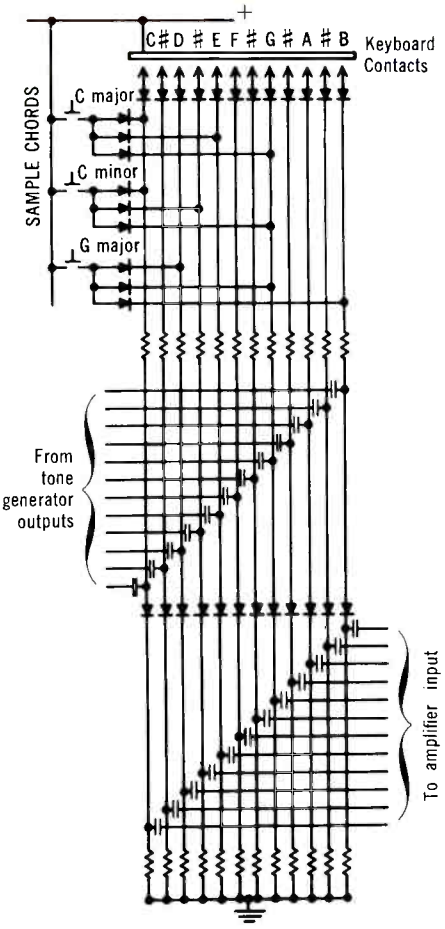

Fig. 7-6—Using diodes for coupling notes played by chord buttons.

the black notes are level with the white, so a sweeping motion can perform a chromatic "run" with the tip of the middle finger.

For arpeggios, the requisite chord is selected on the lower manual, with the left hand, and held steadily, while the right hand, or a finger of it, sweeps over the arpeggio keys. Playing three arpeggio keys together will make a three-note chord that is always correct. Many of the relatively difficult musical forms are thus made extremely easy to execute with this combination fingering.

One of the inexpensive Hammond organs, using electronic tone generation instead of the electromechanical type used on the larger Hammonds, employs another way of achieving chord and bass effects. As in many other chord organs, the left hand plays chord buttons that select designated chords by key, and by musical color—major, minor, diminished, and so on.

Then to make the footwork easier, the organ has only two bass pedals, rather than the minimum of 13 on any regular pedal organ (to get an octave full of bass notes). These two pedals automatically play the bass and counterbass to suit the particular chord selected with the left hand. The circuit-selection mechanism is a little simpler than the arrangement in the automatic-orchestration feature of the Lowrey, because each chord button also directly selects the two bass notes to be connected to the bass pedals.

Before going into the more sophisticated effects added to many of the newer organs, such as drums and other side effects, a recent addition to the variety of methods for achieving vibrato and chorus effects deserves attention, as follows:

Delay-Line Vibrato

Whether an organ uses electro-mechanical generators, master oscillators with dividers, or individual oscillators for each note, a problem that organ designers have lived with for a long time is that the easiest way to apply vibrato is to apply it to the whole organ output. All the notes in all their stops are "warbled" together.

It would be much nicer if different stops, or different manuals, could use or not use vibrato at the same time, and possibly if more than one vibrato could be made available at the same time. This suggestion is not to be confused with the provision of more than one vibrato, in the sense of changing the speed of the same one.

Nor should this be confused with the two ways of achieving vibrato used by Wurlitzer or, in slightly more elaborate systems, by manufacturers who employ electronic vibrato and a Leslie speaker system. Although it is possible to use either of these so that some parts of the music come through the moving speaker and some through stationary speakers, it is not quite the same.

This new approach uses phase variation, with a difference. The signal is fed along a delay line, tapped at each step, and with the taps brought out to a scanner, which is driven mechanically. It uses capacitive "contacts" to pick off the signal successively along the line and back, and thus shifts phase a few periods back and forth with each rotation of the scanner (Fig. 7-7).

The newer Hammonds employ this method. Instead of having a full set of tone-wheel generators, one for every note, they employ a master set of tone wheels to generate only the top octave by means of precision, silent-operating gears, and then multivibrators divide to get the lower octaves, as in organs using the electronic master method.

By having two sets of rotating contacts on the scanner, dual vibrato output is available, which can be fed via

IF THE CROWN CX822 IS JUST ANOTHER TAPE RECORDER

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"Tape threading is delightfully simple."
"Editing facilities are great."

"We found the tape motion command system to be as foolproof as Crown says it is, and could not beat the computer by design or by accident."

"The CX822 is a serviceman's dream, considering the unit's inherent complexity."

"Playing back first-generation transfers from original masters, the sound produced through the Crown CX822 was peerless. When recording and playing back from records and FM broadcasts, there was absolutely no aural difference between the original and the copy at 15 ips. The same held true at 7½ ips, though theory says, there should have been."

"Construction appears to be rugged enough to withstand parachute drops."

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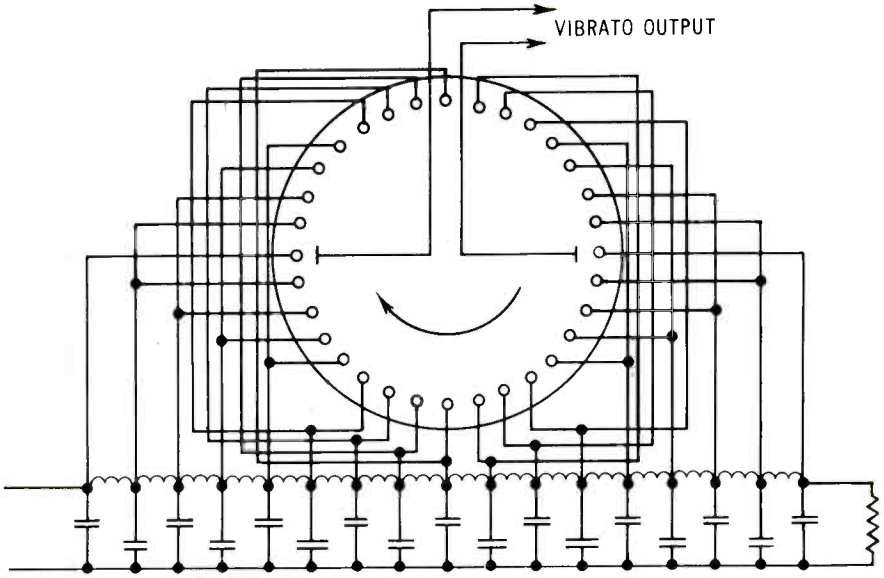


Fig. 7-7—Delay line and scanner of the relatively new Hammond dual vibrato unit.

separate amplifiers to two sets of speaker systems, which gives an exaggerated vibrato effect, by employing the stereo principle to get a spacial shift as well as a time shift. Because the pickup points are diametrically opposed, one output is fully advanced in phase when the other is fully delayed, and vice versa.

If the vibrato signal, applied to the output from one manual, is combined with unvibratoed signal from the other, a much greater variety and body of sound is possible than can be achieved with organs where vibrato is applied to the generators themselves, so that the whole organ "wavers" together, or not at all.

Percussive Electronics

These divide into musical and so-called non-musical. Electronic imitation of marimba, vibes, chimes, etc., is musical. A sound resembling plucked string bass, or other plucked strings (pizzicato) is also musical. It has notes in the scale, like any other instrument, and melody or accompaniment can be played with it.

The non-musical include drums—although they have a resonant tone, they are not usually identified with a particular note—blocks, triangle, cymbal and brush, castanets, etc. Each of these has a characteristic sound, which can be developed electronically.

While much has been done to produce more sophisticated sounds of these kinds, this is an area in which the field is virtually wide open for improvements.

Sound resembling marimba, vibes, etc., may be produced by carefully controlling the envelope of the tone generated. Where this is governed by keying the oscillator itself, the envelope is controlled by the variation in supply voltage to the oscillator.

In this case, the oscillator circuit needs carefully designing, so it responds to varying voltage in a realistic manner. Rising voltage and falling voltage should not cause the oscillator frequency to go "off key." Usually a rising voltage raises frequency a little, as the tone grows in amplitude, while the tone drops in frequency when the amplitude is falling, due to a drop in supply voltage.

Only careful experimentation can produce a circuit where the change in frequency is acceptable under these

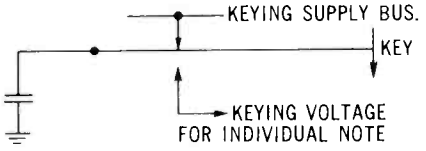


Fig. 7-8—Keying for percussive sounds, with simple "one-shot" playing.

circumstances. It should change a little. Electronic circuits tend to change too much for realistic effect.

Taking an alternative approach, it is much easier to use the varying voltage obtained from keying circuits, to control envelope from a square-wave input waveform (obtained from an appropriate place on the oscillator output, or from multivibrator dividers) and then to apply formant to get the requisite tone quality. But the absolutely constant pitch that results is not quite realistic, either. However, it may be closer than easily obtainable by using switching on the oscillator itself.

In an earlier installment, we mentioned the addition of initial 'blow' sounds and other transient effects that can be applied at the beginning of notes to add realism. These help considerably. With a little more sophistication, many more things are possible, such as changing the whole harmonic structure of the note as its tone develops and dies away. Here is another area for interesting development.

Sustain, associated with percussive effects, can work several ways. In the earliest type, of which many organs are still in use, sustain is the only so-called "percussive" effect available. When the key is first pressed, the note speaks in exactly the same way as without the effect: there is no special attack. The difference is that the tone "hangs on" after the key is released.

The only way to get anything that approaches percussive sound with this kind of organ is to play the keys with a staccato touch. Strike them as you would a piano, and lift your keys immediately, as if the keys are hot, so the tone starts the decay of its sustain effect without any duration at constant intensity.

If you hold the key down at all, the organ produces a steady tone while the key is held, and thus is the most noticeable effect about the music. The fact that the note sustains, after you release the key, gives an impression not unlike reverberation, rather than sounding percussive. There is a difference, of course, between reverberation and percussion, but it's not easy to hear on this kind of organ.

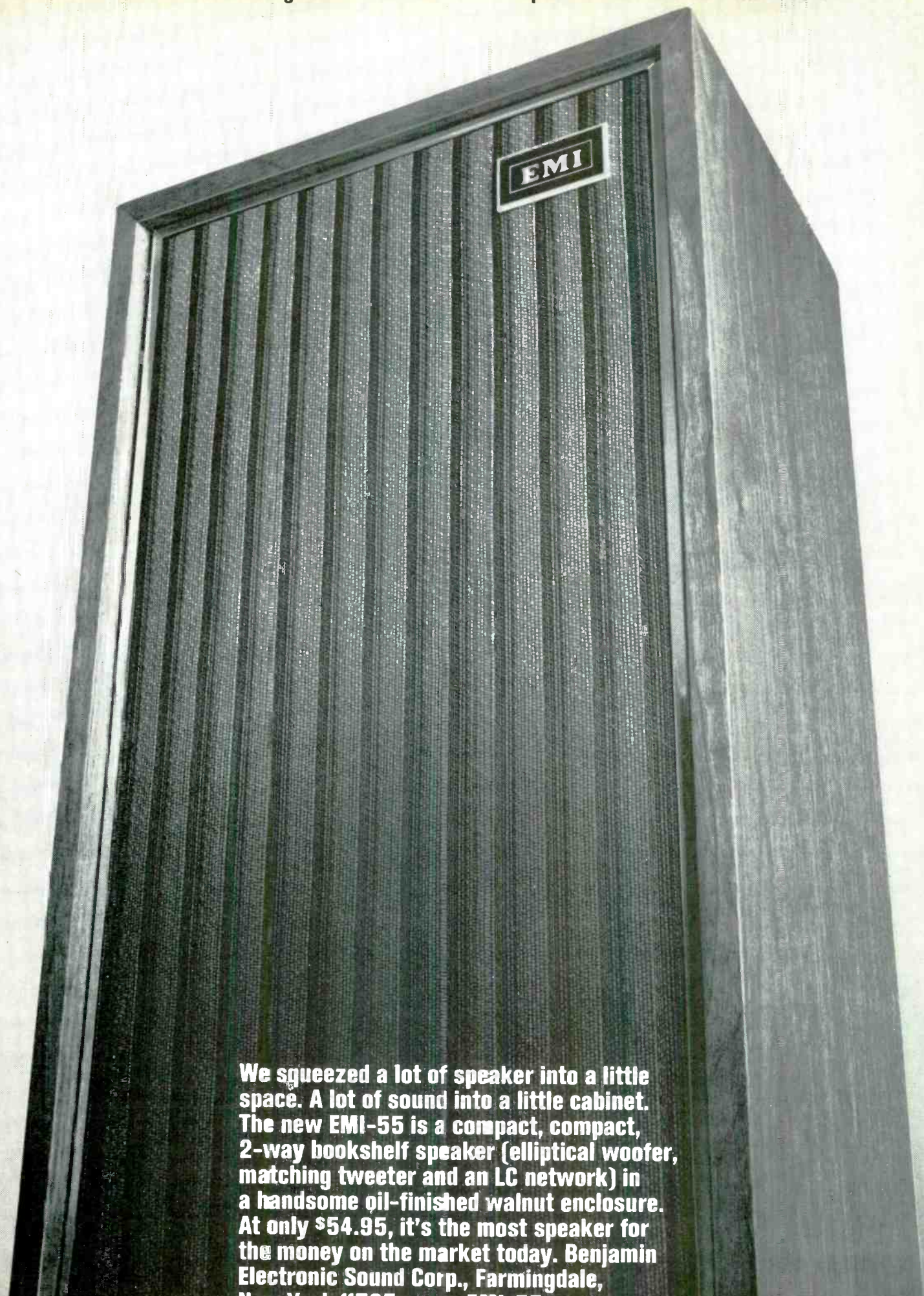
A truly percussive keying produces an over-amplitude attack. It may die away completely after that, requiring the key to be released and pressed again for the note to speak again. This is achieved by using the charge on a capacitor to effect the keying (Fig. 7-8.) When the key is released, the capacitor is charged up, and when it is pressed, this charge is transferred to the keying circuits.

Previously we showed a generator that could produce repetitive percussion effects. This requires use of a tab to change from the one shot, every time you press the key, to repetitive, that keeps striking as long as you hold the key down.

A more sophisticated keying may provide for "one-shot" when the key is pressed normally, with an extra movement, usually against slightly harder spring pressure, so consciously more effort is needed to push the key down that far, that allows the repetitive effect to be brought in by additional contacts. Æ

(To Be Continued Next Month)

Introducing the 18 x 10-1/4 x 7-1/2" speaker that fills an entire room



We squeezed a lot of speaker into a little space. A lot of sound into a little cabinet. The new EMI-55 is a compact, compact, 2-way bookshelf speaker (elliptical woofer, matching tweeter and an LC network) in a handsome oil-finished walnut enclosure. At only $54.95, it's the most speaker for the money on the market today. Benjamin Electronic Sound Corp., Farmingdale, New York 11735 – new EMI-55.

ABZs of FM

LEONARD FELDMAN

Tuning Aids in FM Receivers

WITH THE TREND in FM receiver design tending to veer away from AFC circuitry (at least in the more expensive FM units), a visual tuning aid to assist the user in proper, exact center-of-channel tuning has become increasingly important. There are three devices used to provide a visual indication of correct tuning—the old "tuning eye" or vacuum tube containing a fluorescent target, the tuning meter, and the small cathode ray tube (similar to those used in oscilloscopes). "Tuning Eyes" and tuning meters have been used in FM tuners and receivers for over two decades. The use of a 'scope tube as a tuning indicator is a much more recent innovation and one which, to date, will be found only in very expensive equipment, since it entails the addition of a considerable amount of extra circuitry just to activate the cathode ray tube.

"Tuning Eyes"

The first popularly used "tuning eye" tube was the 6E5. This tube, like many of its later variations, contained a triode section which functioned as a d.c. amplifier whose plate was directly coupled to a rod, The rod is known as the ray-control electrode, which governs the flow of electrons to the fluorescent screen. A schematic representation of such a device is shown in Fig. 1.

With positive or slightly negative voltage applied to the control grid, a large shadow area will be present on the visible face of the tube, as shown in Fig. 1A. As negative voltage is applied to the grid, the shadow width will decrease (Fig. 1B). If a sufficiently large negative d.c. voltage is applied to the grid, the shadow area will disappear completely, and an actual overlap of fluorescence will occur, as in Fig. 1C. In actual use, the listener would tune to a desired station and adjust the setting for maximum fluorescent area (or minimum "shadow"). With weak stations, the shadow area will be greater than when tuning in stronger stations, but in either case a "null" will occur, indicating correct point of tuning.

There are other forms of tuning eyes. The "bar" type operates on essentially the same principle as the 6E5, except that the fluorescent area is now a set of fluorescent bars which move closer together as negative voltage is applied to the control grid. Visually, this form of tuning indicator is a bit easier to use since center-of-channel indication is very precise and well defined. As the "vacuum tube" era in FM drew to a close in the late 1950's and early 1960's, an ultra-miniature tuning indicator known as the DM-70 was developed and extensively used. Operating with a filament voltage of only 1.4 volts and a B+ requirement of about 90 volts or so, this sub-miniature tube had a fluorescent pattern shaped in the form of a variable "exclamation point." So small was this little indicator tube that many manufacturers used it as a travelling dial pointer and tuning indicator combined.

Tuning Meters

Fluorescent indicator tubes and tuning meters co-existed for many years. The ascendancy of the tuning meter in recent years is due largely to the almost universal transition to solid-state or transistorized circuitry. Power-supply voltages in solid-state equipment (even in powerful all-in-one receivers) seldom exceed 50 to 75 volts d.c.—not enough for use as "target" and plate voltage with any of the fluorescent indicator tubes. Meters, on the other hand, are strictly current devices; very *low* current, at that. It is not difficult to design a small meter with a full-scale sensitivity of 100 or even 50 microamperes, for example.

A circuit using the above meter type as a "signal strength" indicator is shown in Fig. 3. Note that once again the limiter input serves as the "take-off" point, but this time, since we are dealing with a transistor stage, no "grid-leak" voltage is involved. Instead, a small r.f. coupling capacitor (2.2 pF) feeds some of the 10.7 mHz i.f. voltage to a diode rectifier. The resultant d.c. voltage is fed directly to the meter movement, after suitable voltage-divider action. As in the previous case, this meter is a "peak signal" indicator, reading higher up-scale for greater signal strengths. There is one disadvantage to this type of indication. As you can see in Fig. 2, the i.f. voltage amplitude in wide-band i.f. systems remains at its peak value over a rather large frequency range. As a result, a meter connected in this manner will rise to a peak reading as station frequency is approached and remain there over a rather large span of dial pointer movement (particularly if the incoming signal is a strong one). It is difficult, under these circumstances, to determine where exact center-of-channel really is. Tuning to a center point of the "highest reading" area is no easier than tuning to the center of "best sound," which can be done with no meter present in the first place. For this reason, many manufacturers prefer the use of a "center-reading" or "center-zero" meter. Such meters are identical to the other types, except that with no voltage applied, the pointer comes to rest at the exact center of the meter scale. With positive voltage applied, the meter point will swing to the right and with negative voltage it will swing to the left, or vice versa, depending upon circuitry.

Such positive and negative swinging voltage is, of course, readily available at the output of the FM detector (either a discriminator or a ratio detector) and, in a properly aligned set, is the best indicator of center-of-channel tuning. That is, zero volts d.c. at the audio take-off point of either a ratio-detector or a Foster-Seeley Discriminator means that the set is perfectly tuned to center of channel. (It also means that there is no station at that point on the dial *altogether,* but

Fig. 1—Schematic representation of a 6E5 tuning-eye tube is shown here. The width of the "shadow" on the "magic eye" tube varies with the amount of negative voltage applied to the grid. No signal is illustrated in (A), while a moderately strong signal is shown in (B).

Fig. 2—With strong signals present, typical wide-band limiter response makes it difficult to use a meter for "maximum" indication.

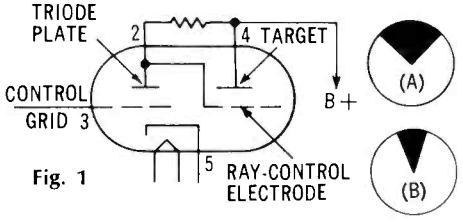


Fig. 1

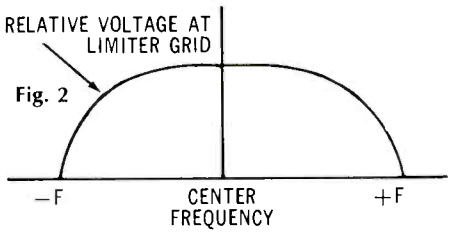


Fig. 2

It's also a tape recorder.

At a glance you can see that this Fisher compact stereo system will play records and receive FM-stereo broadcasts. (FM sensitivity: 2.0 microvolts, IHF.) But look again. Built into the Fisher 127 you'll find our RC-70 cassette deck. So this system will also let you tape records and FM-stereo broadcasts on a tiny cassette. And it'll also play them back anytime through the XP-55B speaker systems. Also, the cassette deck in the Fisher 127 has separate VU meters for left and right channels. Clutched record-level controls (they work together or separately). A digital counter with pushbutton reset. A pair of professional-quality microphones, and many other professional features. The price of the Fisher stereo system that's also a tape recorder is just $449.95. And if you already own a record changer, receiver and speakers, you can still own the new Fisher cassette tape deck. It's also available separately, for just $149.95.

Mail this coupon for your free copy of The Fisher Handbook 1969. This reference guide to hi-fi and stereo also includes detailed information on all Fisher components.

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11-35 45th Road, L.I.C., N.Y. 11101

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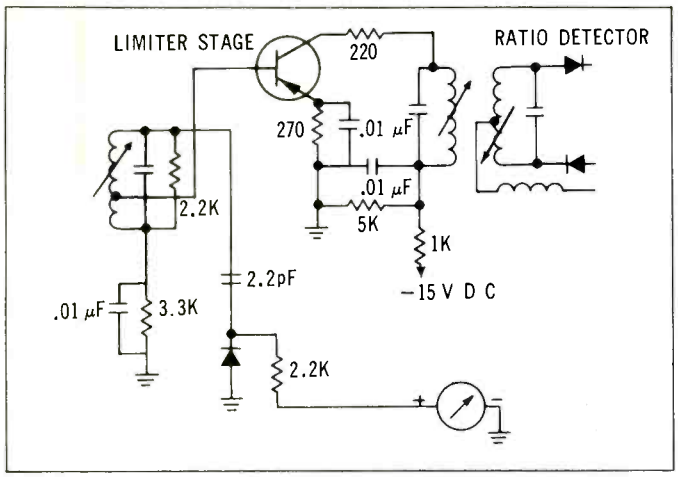


Fig. 3—A peak-indicating meter used as a tuning meter is illustrated connected to the limiter stage of a typical solid-state receiver.

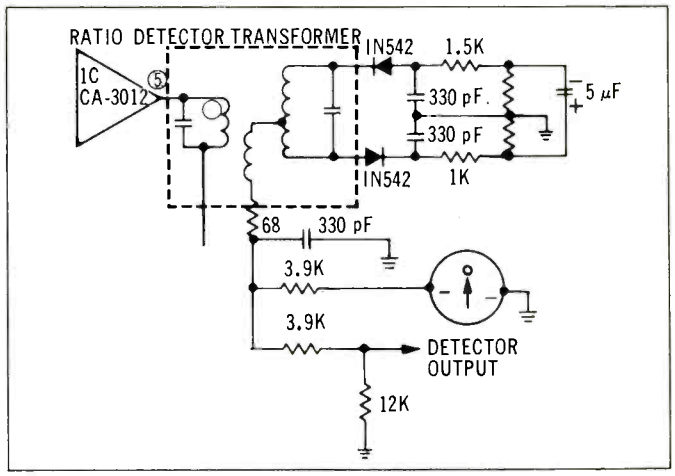


Fig. 4—The ratio-detector stage of a modern receiver shows a "zero center" meter connected for center-of-channel tuning indication.

that is certainly no problem for the listener.)

In Fig. 4 such a "zero-center" meter is shown connected at the output of a conventional ratio-detector circuit. All that is needed is one resistor for dropping the voltage swings to correct value, based upon the sensitivity of the meter movement. The action of the meter is such that upon approaching a station signal, the meter pointer will first swing sharply to one extreme or the other (depending upon whether you're coming up in frequency or down-scale). As the tuning knob is tuned further, the meter pointer follows the familiar "S" curve of the detector, first approaching "zero" and then, if center is inadvertently passed, swinging off in the other direction. The user can, therefore, literally "zero in" on the center of the channel. The indication is positive and precise, and there's no guesswork about it. On the other hand, this form of meter can tell you nothing about relative signal strength of a given signal since *all* stations, weakly or strongly received, will cause the meter to indicate zero when they are properly tuned in.

The signal-strength type of meter discussed before has the advantage of serving as an aid in orienting your receiving antenna. All you have to do with that type is have someone rotate the antenna while you observe the meter for highest indication when tuned to your desired station.

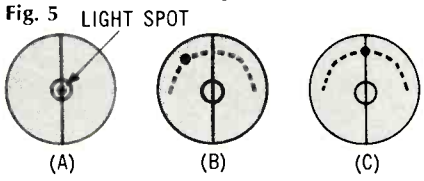
'Scope Tube Indicators

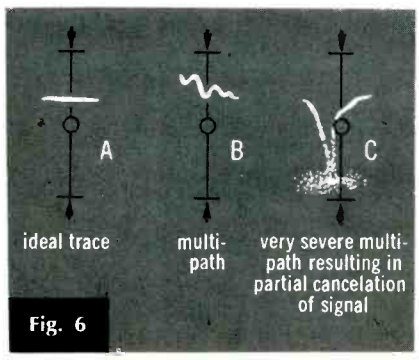
Combining the best of both types of meter indicators and adding some features of its own not present with either type, a small cathode ray tube (usually 1 or 2 in. in diameter) has found its way into a couple of recently manufactured tuners and receivers. At least one other manufacturer, reluctant perhaps to penalize its less demanding customers with the high cost of such an addition, has made external provisions on some of his units for connection of the horizontal and vertical inputs of any oscilloscope that the user might have. Here's how the 'scope tube works:

The voltage that would normally have been applied to a "signal strength" type of meter is applied to the vertical plates of the cathode ray tube. Again, the source of this voltage may be the first or second limiter stage in the tuner's i.f. section. The voltage corresponding to the "S" curve of the detector—normally equal to "zero" when a station is correctly tuned—is applied to the horizontal deflection circuit of the 'scope tube. Fixed voltages are applied to both sets of plates so that, in the absence of a signal, a "spot" of light appears in the exact center of the 'scope viewing area. This condition is shown in Fig. 5A. As a station frequency is approached, the spot darts to the left (caused by, say, high negative voltage from the detector output). At the same time, as station frequency is approached, the spot moves up vertically because of the limiter voltage rise and continues to move back toward horizontal centering, as shown in Fig. 5B. As you tune further in the same direction, the light spot moves off-center to the right and, finally, dips down towards vertical center, as station signal is lost altogether. In reality, the light spot is tracing a very good replica of the entire i.f. response curve.

Fig. 5—An oscilloscope tube is shown here as used for a tuning aid. With no signal applied, the spot is centered at (A). As a signal is approached by tuning, the spot traces the i.f. response of the tuner (B). At (C), the station is correctly "tuned in."

Fig. 6—A 'scope display can serve as an aid in orienting an antenna to receive the best signal.





We mentioned that the 'scope tube indicator has uses beyond even both types of meter indicators. One of these is the ability to indicate the presence or absence of "multipath," a condition analogous to "ghosts" or reflections in TV reception. In the case of FM, and more particularly, stereo FM, the presence of undue amounts of "multipath" (usually caused by reflections from nearby structures, passing aircraft, mountains, etc.) can cause severe distortion, noise, and even cancellation of the stereo-separation effect.

Since "multipath" represents a form of cancellation of signal, and since that signal cancellation will occur at particular frequencies within the pass-band and not at others (because of angular phase-shift relationships), the effect of multipath may be observed on the 'scope tube. In Fig. 6A we see the trace caused by audio modulation. Remem-

(Continued on page 74)

DO YOU NEED $2,100 WORTH OF SPEAKERS FOR GOOD STEREO?

Lots of people don't. But if you do a lot of listening—and want your recorded music to sound like the original—$2,100 for Klipsch Wide Stage Stereo is a bargain price.

What's in it? Two KLIPSCHORNS for flanking speakers and a CORNWALL as center speaker. Ideally the flanking speakers should be in the corners of your longest wall. Then, with Paul Klipsch's circuit for the center speaker, you have true stereo geometry as well as the finest sound reproduction. (See technical papers by Paul W. Klipsch on Wide Stage Stereo.) And stereo geometry is the whole point of stereo—to put the piccolo player in front of the drums back where he was in the first place.

Any Klipsch speakers may be used for Wide Stage Stereo. If you don't have flanking corners available for KLIPSCHORNS, use three CORNWALLS—

or two CORNWALLS and a MODEL H.

They are all compatible with each other, having closely similar frequency response and lower distortion than any other speakers of similar size.

But, here's a warning! After you've listened to Klipsch Wide Stage Stereo, you'll become a snob. Not because you own high priced equipment—but because it spoils you for anything else. Once you discover how near reproduced music can be to the original you won't want to turn back.

Send $3.50 for a complete set of 17 technical papers on sound reproduction and stereo. This includes a reprint of Bell Telephone Laboratories' "Symposium on Auditory Perspective," 1934, which is the basis for all present knowledge on stereo.

KLIPSCH & ASSOCIATES
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Please send me complete information on Klipsch speakers and Klipsch Wide Stage Stereo. Also include the name of my nearest Klipsch Authorized Audio Expert.

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Address_____
City_____ State_____ Zip_____
Occupation_____ Age_____

Check No. 43 on Reader Service Card

Equipment Profiles

- NordMende 8001/ST FM Stereo/ Multi-Band Receiver
- Tandberg 1241X Stereo Tape Recorder
- Dual Model 1212 Automatic Turntable
- Sennheiser HD-414 Stereo Headphones

NordMende Model 8001/ST FM Stereo/Multi-Band Receiver

MANUFACTURER'S SPECIFICATIONS:

Tuner Section. Frequency Ranges: FM, 108.5 to 87.5 MHz; AM, 515 to 1650 kHz; LW (Long Wave), 160 to 400 kHz; SW (Short Wave), 5.1 to 9.8 MHz. FM Sensitivity (IHF): 2.2 μV. FM Total Harmonic Distortion: 0.6%. FM Signal-to-Noise Ratio: 64 dB. Alternate Channel Selectivity (IHF): 60 dB. Spurious Response Rejection: 90 dB. Image Frequency Rejection: 74 dB. IF Rejection (@ 100 MHz): 90 dB. Capture Ratio: 2.5 dB. FM Stereo Separation (@ 400 Hz): 35 dB.

Amplifier Section. Power Output (rms): 30 watts/channel. Total Harmonic Distortion: 0.5%. IM Distortion: $<$ 0.7%. Power Bandwidth (IHF): 17 to 32,000 Hz. Sensitivity: Low Input, 4 mV; High Input, 600 mV; Tape Head, 450 μV. Frequency Response: 30 to 20,000 Hz $\pm$2 dB. Tone Control Range: Bass, $\pm$16 dB @ 50 Hz; Treble, $\pm$11 dB @ 10 kHz. Rumble Filter: —11 dB @ 50 Hz. High Filter: —15 dB @ 10 kHz.

General. Dimensions: 19½" W x 6" H x 15" D. Weight: 26.5 lbs. Supplied with metal cover and ebony side panels. Price: $429.95.

The audio enthusiast intent upon listening to short-wave broadcasts from around the world usually makes a second investment in a multi-band receiver manufactured by a specialist in that field. Among the receivers that combine both broadcast formats is the new NordMende HiFi 8001/ST, distributed by Sterling High Fidelity.

Resplendent with just about every feature imaginable in a high fidelity stereo receiver, this new unit from West Germany offers a "band" for short-wave listeners as well as a "long wave" band for weather reports and marine communications covering frequencies from 160 kHz to 400 kHz. The short-wave band, spanning frequencies from 5.1 to 9.8 MHz, includes the popular 31-, 41-, and 49-meter segments that are used for long-distance communication. More about results obtained with these extra bands later. First, let us consider this receiver in terms of its high fidelity uses.

At first glance, the front panel of this receiver, shown in Fig. 1, seems like a lot to digest. Careful examination, however, discloses a logical arrangement of controls and dial scales.

The lower left edge of the chrome-finished panel has five horizontally mounted push buttons of the interlocking type. The extreme left button turns off power, while the other four select Tape, Crystal Phono, Magnetic Phono, and Radio. Running vertically along the left side of the panel are five similar push buttons for controlling secondary features—Rumble Filter, Scratch Filter, Presence Control, Mono/Stereo, and a button marked "Flat" (for disabling the variable tone controls when absolutely flat response is desired). This latter feature is usually found only in the most expensive separate preamplifiers or integrated amplifiers. Above these buttons is the stereo indicator light.

The four primary rotary controls (Treble, Bass, Balance, and Volume) are also arranged vertically, next to the aforementioned push buttons. Balance, Bass, and Treble potentiometers have an interesting feature: You can "feel" the center mechanical position of each of these controls because there seems to be an actual "notch" or physical depression at the point of rotation that corresponds to "flat" or center (in the case of the tone controls) or "equal gain" in the case of the balance control. Very handy!

Nearly all the rest of the front panel contains a huge, brilliantly illuminated dial glass, behind which are the four dial scales and a peak-indicating tuning meter which works for all bands—not just for FM. Four push buttons at the right of the glass select LW, AM, SW, or FM, and two separate flywheel-controlled tuning knobs do the station selecting (AM, LW, and SW with one, FM with the second).

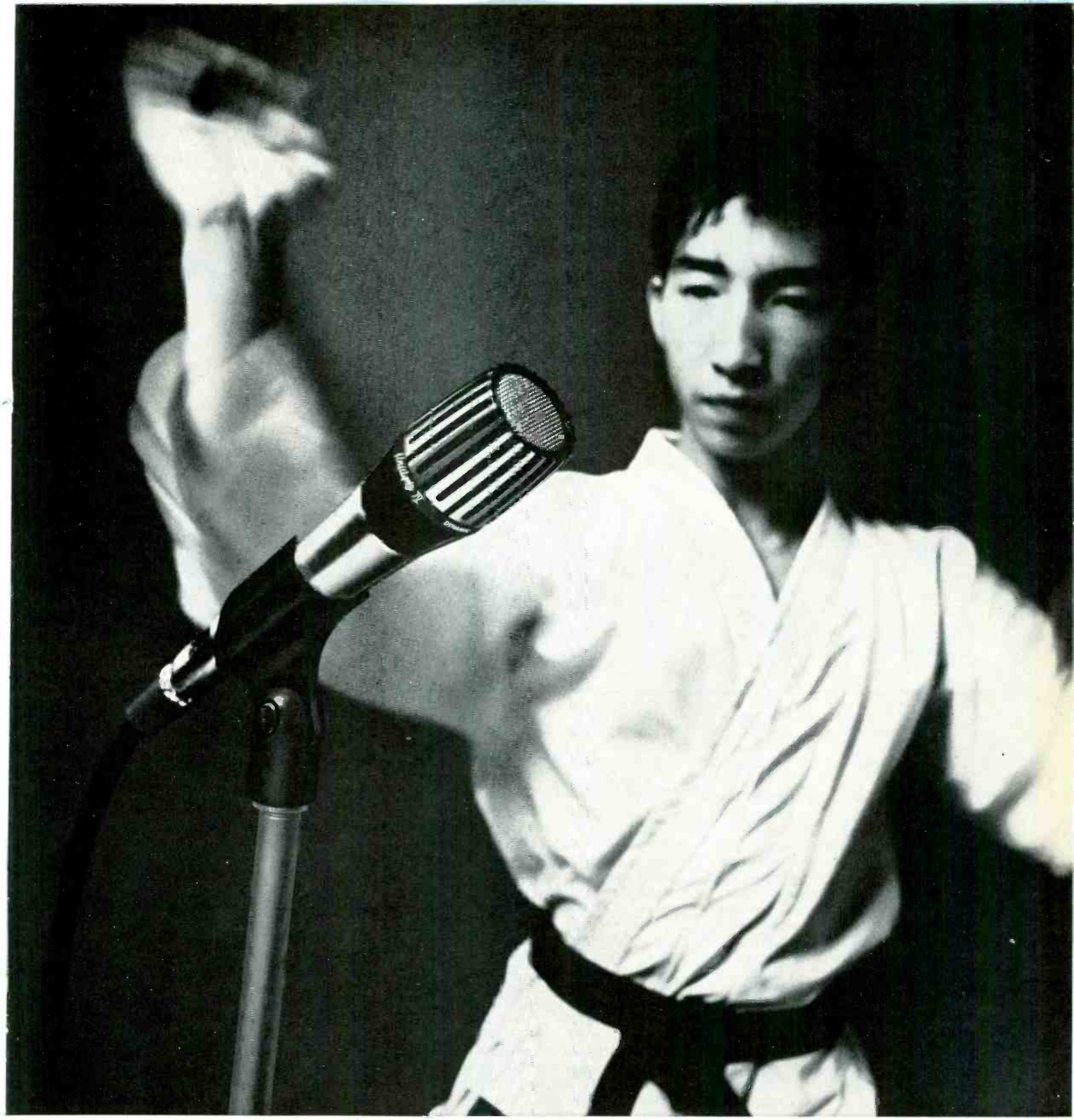
At the lower left of the glass area are five more miniature dial scales, running vertically up the panel and placed side by side. Associated with these scales are six combination miniature controls. Five of these enable you to pre-select your five favorite FM stations. That is, when any one of these five buttons is depressed, the main FM tuning dial is defeated and a pre-set frequency is selected. Each of the desired stations is pre-set by means of a rotary control concentric with each of the five push buttons. The sixth button is pushed when normal, continuous frequency tuning of FM stations is desired and its rear portion is used to apply or defeat the AFC circuitry. All of this versatility on FM is made possible by the use of a new varactor-tuned front end (application of a d.c. voltage determines frequency—there is no moving variable capacitor at all!).

Fig. 2—Rear panel of receiver.

The rear connection panel is shown in Fig. 2. Multi-conductor DIN plugs are used to connect phono and tape inputs, and outputs for the speakers. While these specialized plugs are all supplied in the accessory bag, it does mean soldering all your leads of inputs and outputs to these little plugs. The inexperienced solderer would do well to have his serviceman do this job at the outset. Once accomplished, however, this method offers easy disconnects for cleaning, moving, and the like—though we still favor the simple pin-jack for inputs and the simpler barrier terminal strip for speaker connections. Notably absent are any convenience outlets—especially odd since a plastic cover plate implies that they will be found beneath the plate. We found only two blank holes for what appears to be a design change—coming up, we hope.

A voltage selector knob easily selects U.S. or foreign supply-voltage opera-

Fig. 1—Front panel view of the NordMende HiFi 8001/ST Receiver.



HAAAAIH PROOF

THE SHURE UNIDYNE IV is the newest and premier member of the famed Unidyne family of true cardioid dynamic microphones which have pickup symmetrical about microphone axis at all frequencies . . . in all planes. The Unidyne IV is so rugged that it can withstand a Karate chop. Reinforced, cushioned cartridge withstands severe impacts and vibrations . . . the diaphragm can take the full force of a leather-lunged Karate yell! Trouble-free Cannon-type connector. Exceptionally easy to service in the field. The strongest, most durable Unidyne yet! Send for all the facts: Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Ill. 60204.

Available in two models: Model 548 (hand-held), at $100.00 list; Model 548S (with On-Off switch and swivel connector for stand use), at $105.00 list.

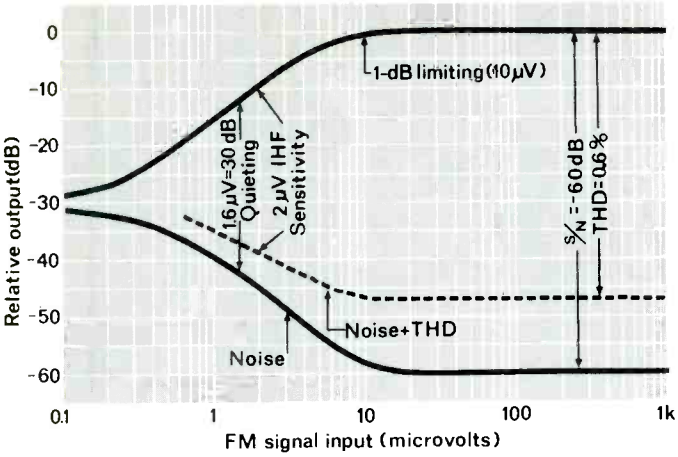


Fig. 3—FM performance characteristics of the NordMende Receiver.

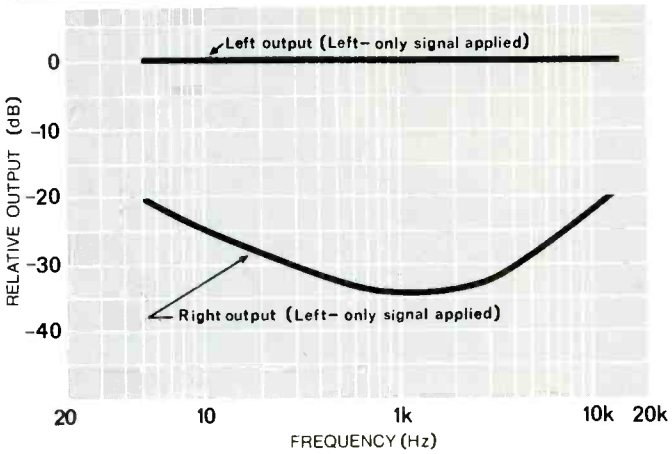


Fig. 4—FM stereo separation characteristics.

Fig. 5—THD and IM distortion characteristics of the NordMende amplifier section.

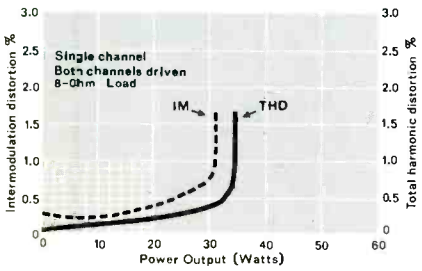


Fig. 6—Power bandwidth curve, single channel.

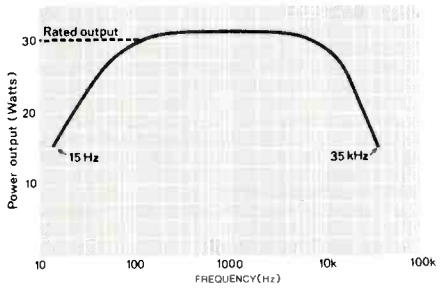
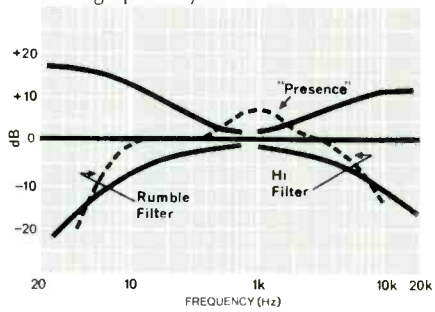


Fig. 7—Tone-control, rumble-filter, hi-filter, and presence-control actions are all shown graphically in these curves.



tion. Perhaps it's a bit too easy, as a less knowledgeable user might "twiddle" this control, with disastrous results. *Here's* where a safety cover might be in order.

As for actual circuitry, there's so much crammed into this package that space does not permit a detailed analysis. The unique front end has no less than four tuned circuits using four back-to-back variable-capacitance diode pairs. These provide more linear frequency calibration and greater trackability from tuned circuit to tuned circuit. FET's are used for the r.f. amplifier and the converter stages. In all, this receiver uses 61 transistors (of which 5 are FET's) and 26 diodes.

Measured Performance

Specifications were generally met or exceeded by this receiver. FM Usable Sensitivity measured 2.0 μV at mid-band, falling to 2.5 μV at the high end. Full details of FM performance can be seen in the curves of Fig. 3. While full audio recovery (1 dB limiting) does not occur until 10 μV of signal has been applied, this is more than compensated for by the nearly 60 dB of signal-to-noise ratio already obtained for that low signal level. Stereo separation at mid-band was a respectable 30 dB and held to better than 20 dB even at the frequency extremes of 50 and 15,000 Hz, as can be seen in Fig. 4. FM mono distortion (THD) was 0.6 per cent, as claimed, while THD in stereo was 0.8 per cent. Automatic FM stereo switching was effective at an input signal strength of about 5 μV and there was no erratic action of this function with marginal signal strengths.

There is no built-in antenna (loopstick) for AM on this unit, since the AM-RF section works for LW and SW as well as for AM. To test reception in these modes, we connected about 25 feet of wire for an antenna and attached a good ground as well. So doing, we picked up more AM stations than is usual for our location. In the evening, in fact, there was literally "no space between stations" on the AM band. We couldn't get too much on the LW band and would have preferred to see another band in the MHz region, say 12 to 20 MHz or so, instead.

Amplifier power checked out at just over 32 watts per channel for rated distortion (0.5 per cent), while rated IM distortion was reached at 30 watts, as claimed. Curves are shown in Fig. 5. Power bandwidth was better than claimed, reaching end frequencies of 15 and 35,000 Hz, as shown in Fig. 6. Tone-control and filter actions are shown in Fig. 7 and conform nicely to published specs. The "presence hump," an off-again, on-again favorite in domestic receivers, peaks out at about 1500 Hz, also shown in Fig. 7.

Listening Tests

We found the gain and power of the HiFi 8001/ST sufficient to drive a pair of low-efficiency, bookshelf speakers to room-filling dynamic levels. Since there are no connection facilities for secondary sets of speakers, power division for feeding multiple sets of speakers is academic.

FM and FM Stereo performance was as good as anyone could require, with 13 FM Stereo stations coming in clearly and with adequate quieting. There was no evidence of SCA interference, though three of the stations are known to be transmitting 67 kHz SCA service (background music private subscriber programs). Total number of listenable FM stations (mono plus stereo) was 38, just about maximum for our location.

Usually, we listen to a receiver under test for at least two weeks—in the belief that a true evaluation can only be made by "living" with a piece of equipment for that length of time. We must confess, however, that part of that time was spent listening to the 31 meter band—with such unusual treats as *Radio Cairo* and *Communist China Radio* keeping us "glued" to the set for hours on end. If we had to guess, we would estimate that no more than about 10 or, at maximum, 15 per cent of the cost of the HiFi 8001/ST is in the short-wave circuitry. Therefore, if you want your high fidelity neatly packaged with an excellent short wave receiver, it would make good sense to consider the merits of the NordMende HiFi 8001/ST.

Marantz announces the end of distortion.

(And the beginning of the new-generation IC amplifier.)

For the first time in audiophonic history, the all-new Marantz Model 16 stereo power amplifier brings to music lovers distortion-free amplification.

Marantz' new-generation integrated-circuit amplifier eliminates intermodulation and harmonic distortion to such an infinitesimal degree it cannot even be measured by conventional test equipment!

The first in a new-generation series of stereophonic equipment from Marantz, the Model 16 RMS eighty-eighty stereo amplifier represents a significant advance in the state of the art. It features exclusive separate power supplies for total isolation of each channel. This means there is absolutely zero cross-modulation distortion. Now for the first time, you hear individual instruments. Distinctly. Without annoying cross-talk from instruments reproduced from the other channels. There is absolutely no sound leakage between channels. When you listen to music through the Marantz Model 16, you will be listening to the purest, cleanest sound ever achieved by any amplifier.

The new Marantz Model 16 stereo amplifier RMS eighty-eighty means just that: 80 watts delivered per channel. (RMS means continuous power—from the lowest to the highest reproduced frequency. Not the "dynamic" or "peak" or "music power" that other manufacturers quote in their specifications. When Marantz quotes 80 watts, Marantz means 80 watts. Period!)

To truly appreciate how infinitely superior the $395.00 Marantz Model 16 stereo amplifier is, we suggest you visit your local franchised Marantz dealer. He will be pleased to furnish you with complete details together with a demonstration. Then let your ears make up your mind.

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THE SOUND OF MUSIC AT ITS VERY BEST.

Tandberg Model 1241X Stereo Tape Recorder

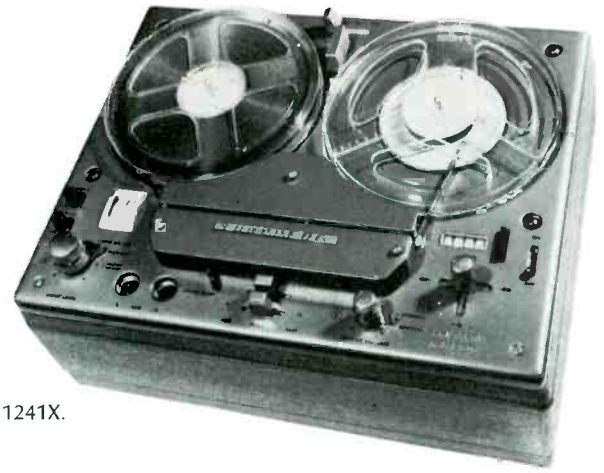


Fig. 1. Tandberg Series 1241X.

MANUFACTURER'S SPECIFICATIONS:

Tape Speeds: 7½, 3¾, & 1⅞. Motors: One. Reel size: 7 in. max. Tape Heads: Three—erase, record/playback, cross-field. Frequency Response: 20-25,000 Hz ±2 dB at 7½; 20-18,000 at 3¾; 30-12,000 at 1⅞. Wow & flutter: <0.1% at 7½; <0.15% at 3¾; <0.35% at 1⅞. Erase & bias signal: 85.5 kHz. S/N: 56 dB. Outputs: preamp output, 5000 ohms, 0.75 V; external 4-ohm speaker, 10 W max. Center channel, 75 ohms, 3 V. Speakers: two 4 x 7 in. speakers. Tone Controls: Bass, continuously variable over a range of 12 dB at 80 Hz; Treble, continuously variable over a range of 12 dB at 8000 Hz. Dimensions: 15⅜" W, 11 13/16" D, 6⅞" H. Weight: 23½ lbs. Price: $485.00.

There is an enormous amount of tape recorder packed in this compact housing — three speeds; cross-field head; input for line, microphone, and magnetic phono pickup; two 10-watt amplifiers and two 4 x 7 in. speakers, and a center-channel output. Among its many desirable features are tone controls, a start-stop lever which remains in either position, even a terminal at which 28 V d.c. is available for use with an external solid-state amplifier, Tandberg FM-multiplex filter, or what not.

Over the years we have seen the Tandberg recorder line grow from one simple model to a much wider variety, and each new model appears to retain all the advantages of the previous ones and to add some new feature or to incorporate a few improvements. In the earlier machines, there was some difficulty in threading because as you turned one reel to secure the tape, the other also turned and tried to pull the tape away from you. In the 1241X—the model we tested—the tape motion lever, which used to move in a T-shaped slot, now moves in a cross-shaped slot, with the upper section releasing the interconnection between the two reel spindles. Now the machine may be loaded as easily as any other. The 1241X model examined was a 4-track stereo machine, though the model is also available with a 2-track format.

Many of us have long preferred the meter type of record level indicator, but the earlier Tandbergs continued to employ magic-eye tubes. The 1241X has a dual meter, which should please users who are accustomed to mixing by meter, as well as those who feel that meters create a "professional" look. The eye indicator shows the instantaneous peaks better than any meter can, of course.

The flexibility of the machine is made possible by the many controls which are located on the panel, as seen in Fig. 1. At the top is a three-position speaker switch—INT, INT+EXT, and EXT—signifying internal speakers only, both internal and external speakers, and external speakers only (or, if no speakers are connected to the output jacks, no sound at all so that monitoring must be done by headphones. Be-

Fig. 2. View of the main printed-circuit board, which is located along the front of the recorded chassis.

Fig. 3. The underside view of the chassis shows a neat and compact construction.

Fig. 4. Top view of the chassis showing the positions of the erase, record/play, and cross-field heads. Note the four-digit counter at the right.

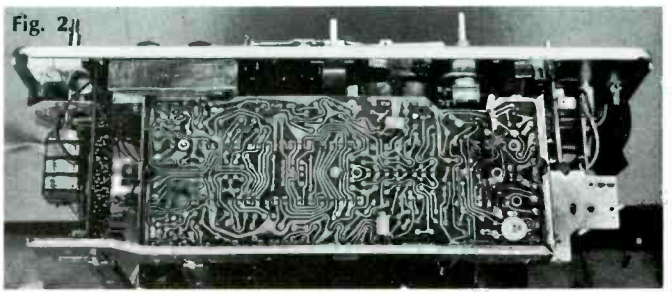


Fig. 2

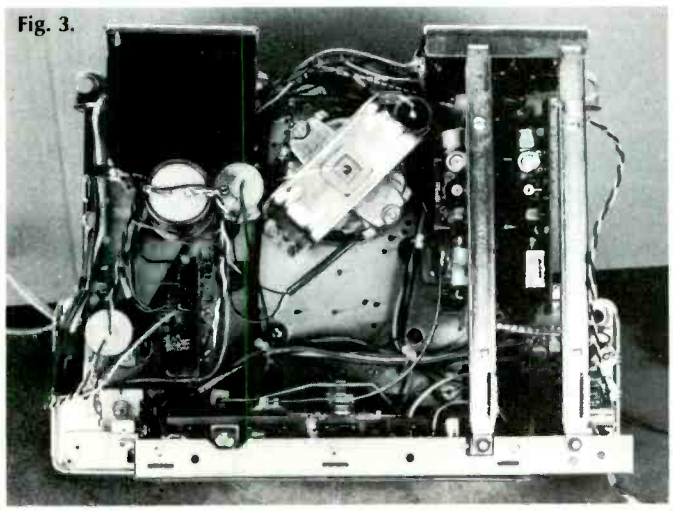


Fig. 3.

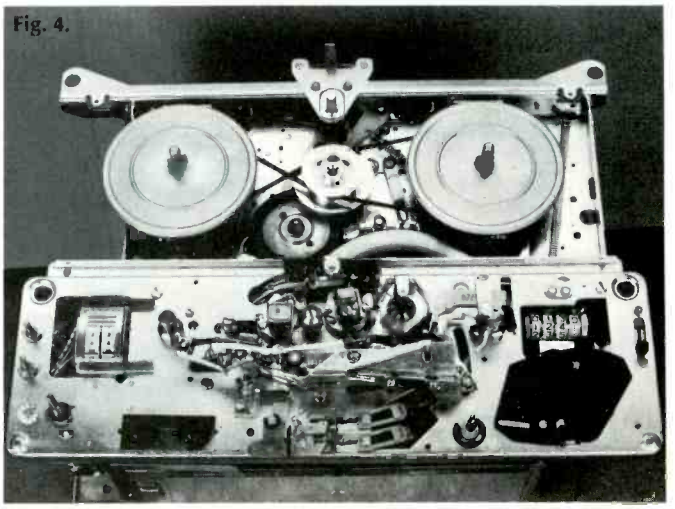


Fig. 4.

What's behind the BOSE 901

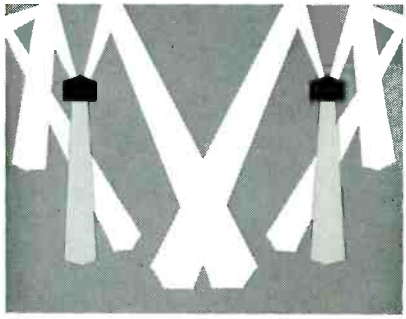
DIRECT/REFLECTING™

Speaker System?

If you have heard the BOSE 901 speaker system, or if you have read the reviews, you already know that the 901 is the longest step forward in speaker design in perhaps two decades. Since the superiority of the 901, covered by patents issued and pending, derives from an ***interrelated group of advances,*** each depending on the others for its full potential, we hope you will be interested in a fuller explanation than is possible in a single issue. This discussion is one of a series on the theoretical and technological basis of the performance of the BOSE 901.

In this issue, we'd like to tell you what our research revealed about the roles of direct and reflected sound in the reproduction of music. The direct sound is what you would hear if the walls and roof of the concert hall were removed. If you have ever listened to an orchestra outside, without a reflecting shell, you know that it is very soft and dull compared to what you experience in the hall. The difference is the reflected sound.

The reflected sound comes to your ears from the walls of the concert hall in almost equal quantities from all directions whereas the direct sound comes to you from the direction of the instruments. The direct sound is responsible for your sense of localization while the reflected sound contributes to the fullness, presence and warmth of the concert hall performance. As the research indicates, "this spatial property of the sound incident upon a listener is a parameter ranking in importance with the frequency spectrum of the incident energy for the subjective apprecation of music."*



HOW THE 901 INCORPORATES THESE FINDINGS

The 901 has eight speakers on the back panels and one on the front. This accomplishes two objectives. First, it provides the desired ratio of about 89% reflected sound to 11% direct sound. Secondly, by proper choice of the angles of the rear panels (see fig.) the 901 projects the image of a musical performance spread across a stage that is located about two feet behind the speaker. This image is established to the extent that it is possible to hear the full stereo spread from a wide range of listening positions including directly in front of one speaker — a feat that is not possible with conventional speakers.

This concept of direct and reflected sound would result in an improved speaker by itself but it would fall far short of providing the realism offered by the 901. There are three other essential advances that must be used in combination with the direct and reflected sound to obtain the full benefits offered by the 901. These will be the subjects of other issues.

In the meantime, ask your franchised BOSE dealer for an A - B comparison of the 901 with the best conventional speakers he carries, regardless of size or price.
You can hear the difference now.

*From 'ON THE DESIGN, MEASUREMENT AND EVALUATION OF LOUDSPEAKERS', Dr. A. G. Bose, a paper presented at the 1968 convention of the Audio Engineering Society. Copies of the complete paper are available from the Bose Corp. for fifty cents.

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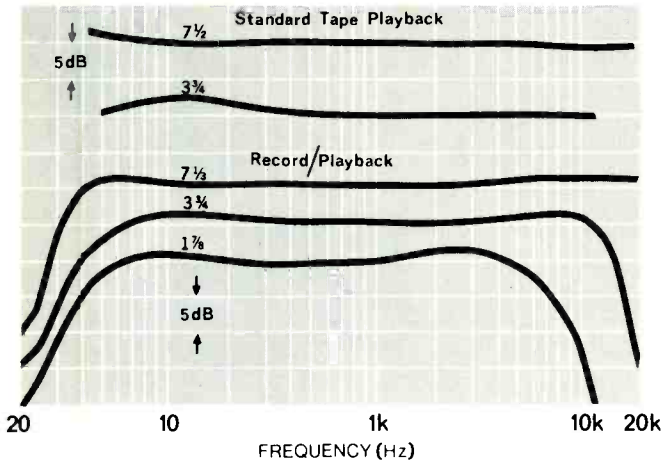


Fig. 5. Response curves under various conditions of operation.

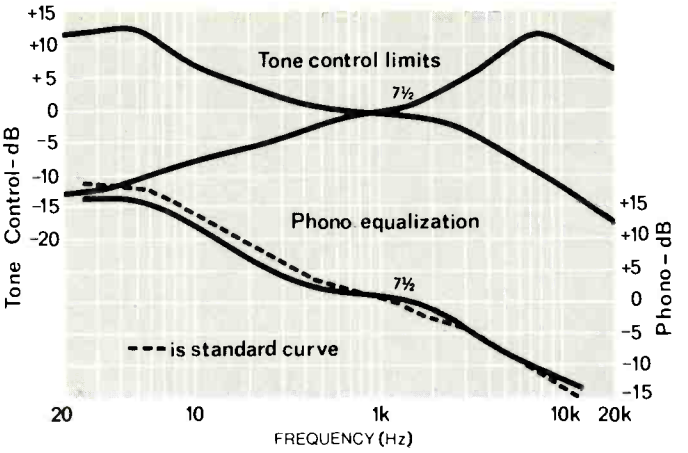


Fig. 6. Curves of tone-control action and the pickup input equalization.

low this control is the speed selector which simultaneously changes the internal equalization circuits. At the left side of the panel are two small black knobs for playback tone control. Below them is the dual-concentric record-level control, and at its base another concentric control actuated by a lever which selects the input—line or microphone, pickup, or "mixer mono." The first two positions permit recording of stereo programs on the two channels, while the third position permits recording of line or microphone on the right channel and a pickup input on the left channel, all in mono, of course. The two edgewise-mounted meters are next, both being illuminated during recording. Toward the front are the two phone jacks for microphone inputs in the U. S. models (they are DIN receptacles in the European models). The START/STOP lever projects from under the front head cover. Next are the two recording levers with REC, PLAY, and AMP designations. To record, the lever for the desired channel(s) is pushed to the REC position and held there while moving the tape motion lever to the play position. When the tape motion lever is returned to the stop position, the record lever(s) return to the PLAY position automatically. For use as an amplifier only, the levers are pushed to the AMP position.

Next to the right are the dual-concentric playback level controls, also with a lever concentrically located at the base of the knobs. This lever has two positions—NORMAL and SPECIAL. In the NORMAL position, the outputs are fed from the respective channels to the two speakers or speaker outputs. In the SPECIAL a mono signal is reproduced through both speakers or speaker outputs. The tape motion lever with its four positions is next, and it controls the movement of the tape, or frees the reel spindles for easier threading. The small lever at the right is the power switch.

At the back of the wood base are three cutouts—the one in the center provides storage space for the line cord, while the other two provide access to the internal circuits. At the left are two phono jacks for line input, a DIN socket for stereo line inputs, another for phono pickup inputs, and two more phono jacks for phono. At the top is the 28-V insulated terminal used to power accessory equipment. A similar panel at the right mounts two phono jacks for the preamp output, three phono jacks for speaker outputs—the center one is for the center channel—and three two-terminal DIN receptacles which parallel the phone jacks.

The recorder employs 36 transistors, one Zener diode, two additional diodes, and a bridge rectifier. These are arranged on a number of separate printed-circuit boards, one of which is shown in Fig. 2. The bottom of the recorder is shown in Fig. 3, while Fig. 4 shows the top with the panel removed. Note the "figure-eight" path of the belt, which accounts for the interlocking movement af the reel spindles. The cross-field head is carried on the same arm as the idler, and during recording is held about .004 in. from the back of the tape.

Operation

The machine is a versatile one since practically any desired operation may be performed with it. Figure 5 shows the response curves in various modes—at the top are the curves for playback from a standard tape, followed by record/playback curves for the three speeds. Figure 6 shows the limits of the tone controls at the top, and the pickup-input response below. Note that this response is within ±2 dB of the standard RIAA curve. Fast forward and rewind times were identical—87 sec. for a 1200 ft. roll of tape.

Judged by the performance table on page 26 of the January 1969 issue, the Tandberg 1241X is excellent in every department. Wow and flutter measured 0.08, 0.11, and 0.15% at the three speeds, and S/N measured 60 dB (using Scotch 202 tape). Channel separation measured better than 50 dB, even between adjacent tracks.

The 3% distortion point was reached at a signal 2 dB above the indicated zero level. Output voltage at the preamp output jacks measured 0.64 V, but the output at the speaker jacks measured 10 W across 4 ohms. It was noted that the meters indicated the level at the recording head, and therefore were influenced by the recording equalization, which may seem to give an erroneous indication to the inexperienced user, although it does actually indicate the maximum level of the actual signal applied to the heads. It does complicate the measurement of the various curves, however, and corrections have to be made to obtain the desired correct values.

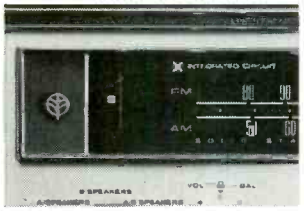
In use, the performance of the machine showed up as a smooth operator, with excellent sound quality. And this includes its performance at slow speeds. Perhaps the only criticism that could be levelled against the unit is its poor fuse location (the machine has to be removed from its base to gain access to it). But this is a very minor point when balanced against the Tandberg 1241X's fine performance—which includes superb high-frequency response, rugged construction, compact design, and notable operating versatility.

Check No. 48 on Reader Service Card

KENWOOD TK-140x

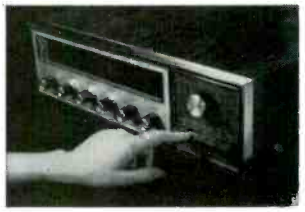
Triple Threat Receiver

● NEW FEATURES...



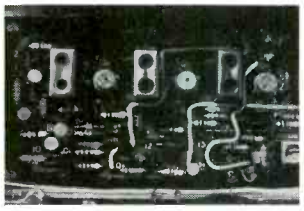
Brilliant "Luminous Dial" that glows blue when set is "on"...disappears to an opaque panel when set is "off". Also, new Tuning Meter with FM Stereo Light Indicator

200 watts (4 ohms) music power plus special circuits and heavy-duty silicon transistors both in driver and main amplifier

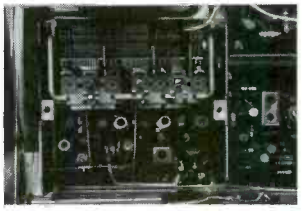


"Feather-Touch Control" to regulate Muting, Loudness (bass, treble boost at low listening levels), Tape Recorder Modes and Low and High Filters

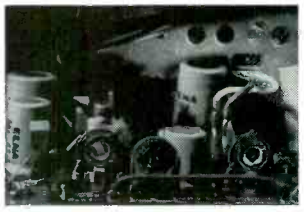
● NEW PERFORMANCE...



High-gain Integrated Circuits (IC) in all four IF Amplifiers to provide a mere 1 dB difference to capture one station and reject another on the same frequency



4-gang Tuning Condenser super-sensitive FM Front End with 3 FETs provides an exceptionally outstanding 1.7 μV sensitivity.



Exclusive Electronic Protection Circuit (U. S. Pat.) guards against blow-up of power transistor. Another example of KENWOOD's quality and dependability.

● NEW VALUES...

Visit your nearest KENWOOD dealer and compare the TK-140x point for point with more expensive receivers. Check the features. Listen critically to the sound. Then compare the price. Hard to believe, but it is true. It's only $349.95 and even includes the cabinet!

the sound approach to quality

KENWOOD

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Exclusive Canadian Distr. — Perfect Mfg. & Supplies Corp. Ltd.

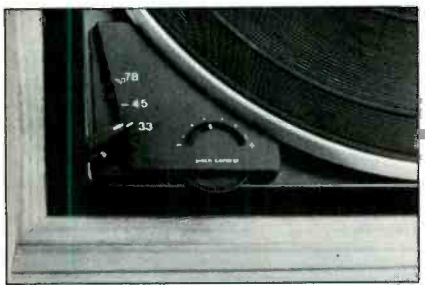
Check No. 51 on Reader Service Card

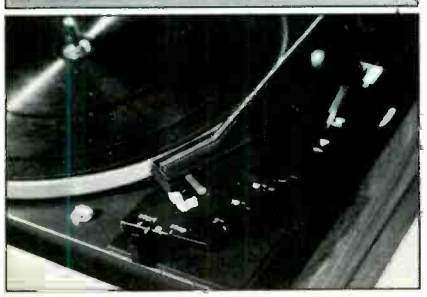
Dual Model 1212 Automatic Turntable

MANUFACTURER'S SPECIFICATIONS:
Speeds: 33⅓, 45, and 78 rpm. Operation: Manual, Auto-single, and Auto-Changer. Pickup Arm: "Dynamically" balanced. Variable speed control: ±3%. Dimensions: (on base) 14½ x 12½ in.; (without base) 13 x 10.8 in. Height above motor board: 4¼ in. Depth below motor board: 2½ in. Price: $74.50. Base: $7.95. Dust Cover: $8.95.

Similar in appearance to the other Duals—the top-of-the-line 1019, the 1009F, and the 1015F, the 1212 is obviously the economy model of the Dual line, but its performance suffers little in comparison with its more costly companions. The counterweight is slightly more difficult to adjust, the anti-skating compensation is fixed in relation to the stylus-force adjustment, and the motor is slightly lighter. However, once the cartridge is mounted, the counterbalance affixed and adjusted, the stylus force set and a record placed on the turntable, the differences do not appear so great at all.

Fig. 2—Top photo shows close-up of pitch control. The cueing lever may be seen to the right of the tone arm in the bottom picture.





At the left front of the motor board is the speed selector, a plastic lever; adjacent to it is a knurled flat knob which is the vernier speed control, protected by a sliding plastic guard so that once set, it is not likely to be moved accidentally.

At the right is the start-stop lever, and along the side of the arm is the lever which selects the record diameter —7, 10, and 12 in. To start the unit, one simply moves the operating lever to the START position. The arm lifts, moves over to the correct set-down position, and lowers gently to the record surface. When the record is completed, the arm is lifted, returned over to the rest, and if no other record is in place on the automatic spindle, the arm drops to the rest and the motor is shut off. If you are playing a stack of records, the next one drops and the cycle completes. If you lift the arm and return it to the rest, the motor stops.

The stylus force adjustment is a knurled wheel that sets the force and the anti-skating adjustment at the same time. It covers the range from 0.5 to 5 grams. The cueing lever raises the stylus from the record surface when desired, and lowers it when the lever is moved to the other position.

Mounting the cartridge in the correct position for minimum tracking error is facilitated by a plastic gauge which indicates the exact height and position for the stylus for optimum performance.

Performance

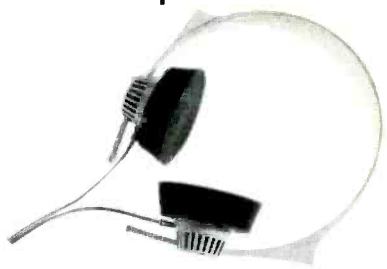
The all-important signal-to-noise ratio is probably the one factor which usually suffers when economies are practiced in the construction of an automatic turntable, but in this model it does not appear to be the case. We measured rumble at 37 dB below a 3.54 cm/sec signal, which is excellent. Wow and flutter measured 0.12 per cent in the 0.5 to 6-Hz range, and only .03 per cent in the range from 6 to 250 Hz, which is also quite acceptable, since it indicates that the wow is in the extremely low range, and not usually audible.

Cycling time at 33⅓ rpm was measured at 13 sec.; it was 10 sec. at 45 rpm, and 7 sec. at 78. Speed variation over a line-voltage range from 90 to 120 was less than the ±3% vernier speed adjustment, so regardless of your line voltage, your records can be played at the proper speed.

The Dual 1212 is judged to be an excellent automatic turntable, and one which would be perfectly acceptable to the user who must, for whatever reason, remember the budget.

Check No. 46 on Reader Service Card

Sennheiser Model HD-414 Stereo Headphones



MANUFACTURER'S SPECIFICATIONS:
Frequency Response: 30 to 20,000 Hz. Impedance: 2500 ohms per phone. Ear Pads: Fine-grained poly foam. Headband: plastic, molded. Cord: 3-conductor plastic, 10 ft. long. Standard 3-way phone plug. Weight: 5 oz., including cord and plug. Price: $29.95.

Imagine a lightweight pair of phones with pads that feel like a pair of powder puffs on your ears, and you get the idea of how the Sennheiser HD-414 phones feel on your head. The pads themselves are of an extremely fine poly foam construction, and measure 2¾ in. in diameter and are ¾ in. thick. The molded plastic housings for the dynamic units are attached to the molded plastic headband by a slip fit, and can be removed easily. The ear pads slip on or off at the slightest touch. Even the cords connect to the phones by a small dual plug which is polarized so that it must be inserted properly. Each cord is covered where it enters the plug by a colored sleeve—yellow for left and red for right.

These are undoubtedly the lightest phones we have ever encountered, yet performance is good. The curves for the two phones are very similar.

In actual use, the HD-414 phones seem so light as to be complete unnoticeable while wearing. The acoustical design is such that large circumaural pads are not necessary, and the poly foam pads provide the smoothing element to make the response relatively flat over the entire hearing range.

The high impedance of these phones has another great advantage to the user who needs high-impedance phones for use with a tape recorder or a preamp output, yet also wants to plug them into the jack on the front of his receiver or amplifier for the usual stereo listening. Because of their high impedance, the headphones are not overloaded when connected directly to the output from a 60-W/channel amplifier, yet they provide listening level when operating from the usual output jack on a tape recorder.

Listening quality is excellent, and for comfort, the HD-414 is just about tops.

Check No. 52 on Reader Service Card

Check No. 53 on Reader Service Card →

The best your money can buy. Period!

Better-than-Studio Specs. Frequency response: 20 Hz to 22 KHz, 40 Hz to 18 KHz ±2 db @ 7½ ips. S-N ratio at peak level to unweighted noise: (Model 770-2) 58 db or better; (Model 770-4) 56 db or better. Wow and flutter: less than 0.09% @ 7½, less than 0.12% @ 3¾, less than 0.2% @ 1⅞. Full 7-inch reel capacity.

Four Heads. The 770-2 has two-track erase, record, and playback heads plus a four-track playback head. The 770-4 has four-track erase, record, and playback heads plus a two-track playback head.

Lightweight. A studio professional tape deck you can pick up and take anywhere. Operates on self-enclosed rechargeable nickel-cadmium battery pack—or plugged into AC.

ServoControl Motor with Vari-Speed Tuning. Automatically maintains exact speed during mechanical load changes and voltage variations. Built-in Vari-Speed tuning for vernier adjustment of playback speeds to match musical pitch.

Exclusive Sony Noise-Reduction System. Sony "SNR" automatically reduces gain of playback amplifier by 6 db during very low passages, when background noise is most predominant. Noise level is greatly reduced, dynamic range expanded 100%. Switch permits bypassing "SNR" when desired! Sony also incorporates automatic built-in limiter to control top-end overload distortion. Built-in defeat switch.

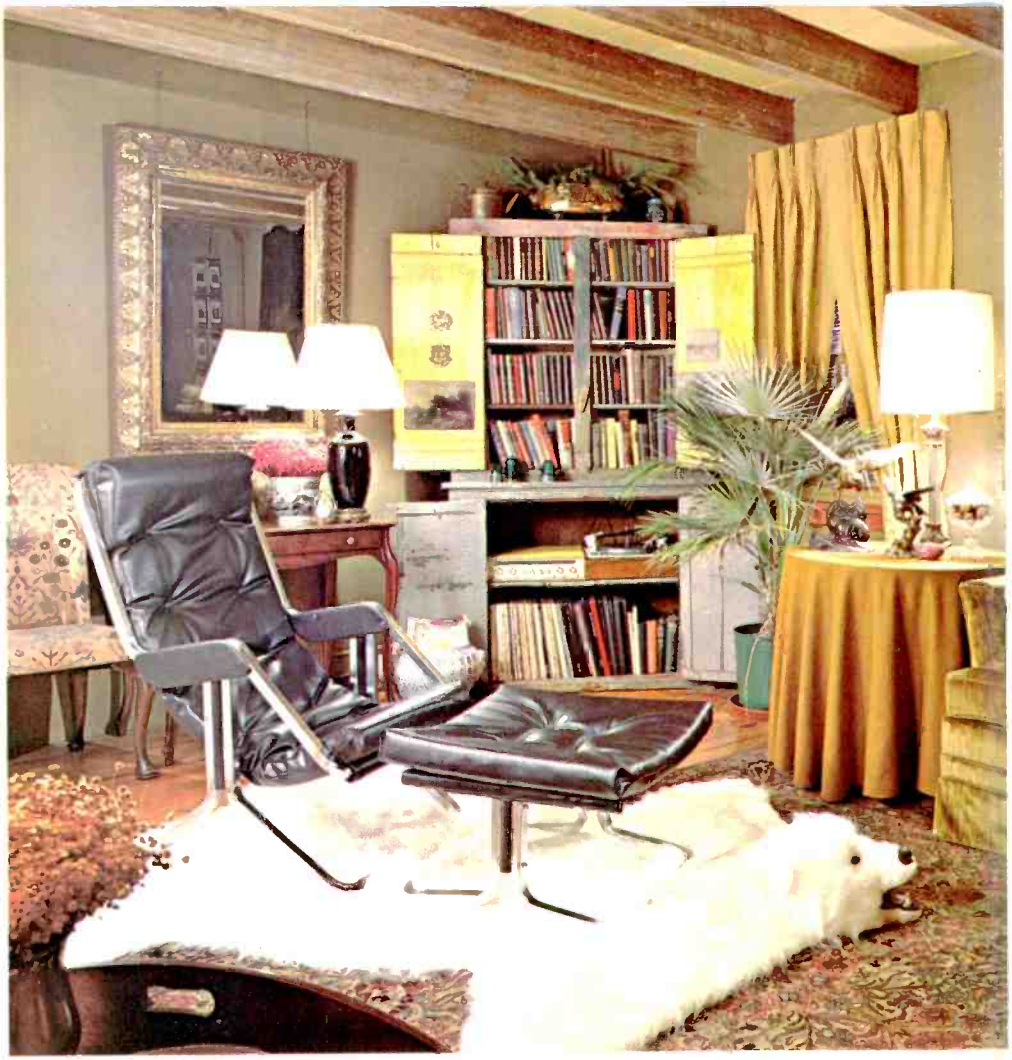
Three Speeds. 7½, 3¾, 1⅞ ips. Other features include two professionally-calibrated VU meters, built-in line-and-mike mixing, push-button operation, scrape flutter filter, low-impedance Cannon plug mike inputs, tape/source monitoring.

Sony Model 770. Priced at $750. For a free copy of our latest tape recorder catalog, write to Mr. Phillips, Sony/Superscope, Inc., 8142 Vineland Avenue, Sun Valley, California 91352.

SONY SUPERSCOPE The Supersonic Stereo

You never heard it so good.

Sound & Decor Styles



Antique- and Modern-Furnished Listening Room

Don Whitney, Bucks County, Pa.—I have a modern stereo hi-fi system integrated into a 200-year-old home that borders on the Delaware river in Pennsylvania. A Sherwood FM stereo receiver and a Garrard automatic turntable are installed in a "Primitive New England" corner cupboard (background), while speaker systems are hidden under skirted tables (only one is shown). The decor setting in this listening room is mixed: "Queen Anne," "Tudor," and "Jacobean," with a touch of modern, exemplified by a 9-ft. x 5-ft. Rojan Polar Bear rug and a Rojan reclining chair, "The Swinger." My record collection consists of approximately 50 operatic LPs and 100 Broadway Cast and other Pop LPs. I plan to purchase a tape recorder in the very near future.

Distaff Hi-Fier

Beverly Hopkins, Springfield, Mo.—I just completed a custom stereo installation which solved the problem of limited space, both horizontally and vertically. To the right, a wall comes in at an angle which allowed a horizontal measurement of 112 inches. A large painting above the cabinet delineated the vertical dimension. In addition, the furniture was tailored to the size of the components, so that the components would fit the various spaces.

AUDIO INVITES YOU TO SEND IN PHOTOS AND DETAILS ON YOUR HI-FI SYSTEM. PAYMENT WILL BE MADE FOR ALL PUBLISHED MATERIAL.

The equipment includes: a pair of AR-3a speakers of varnished walnut; a Marantz Model 15 amplifier; a Marantz Model 7T pre-amplifier; a Viking 88 tape deck; a Dual 1015 changer; and a Shure V-15 II cartridge. The system was assembled by Ross Whitworth, of Reed Stereo & Hi-Fi Center, Springfield, Mo.

The cabinet, three separate pieces, includes (on the left) a three-stage slide for the amplifier, which pulls out to allow access to wiring. Beneath this is an equipment drawer; and beneath that, a pull-out record storage. The middle unit contains the tape deck and the changer, also on pull-out shelves, and underneath them are two drawers divided by partitions into three sections each to hold tape reels. Since my collection of tapes is insufficient to fill both drawers, I keep slides and films in one of them. The unit on the right contains the pre-amplifier, which pulls out, and below that a space as yet undesignated (which may one day hold a tuner). The cabinet is made of walnut with rosewood veneer and molding, and was built by Donald Howard, of Springfield, Mo.

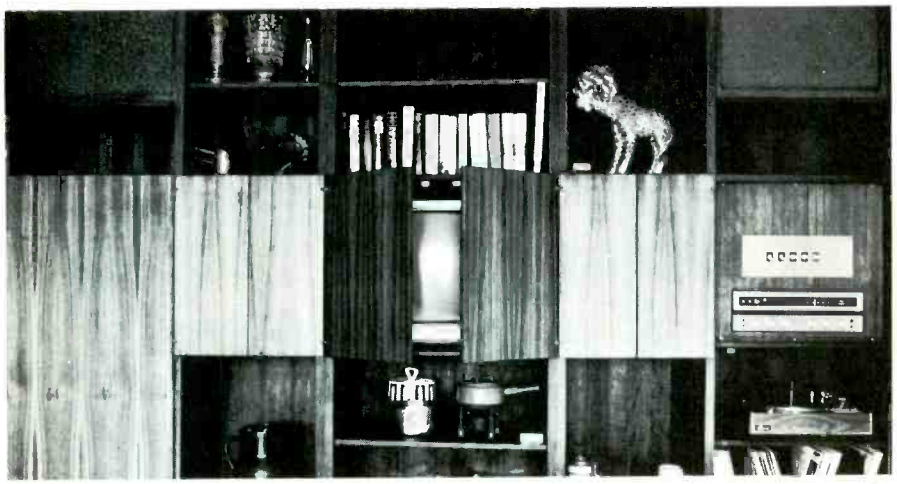
An Oriental Touch

Louis Strauss, Los Angeles, Calif. – The equipment cabinet was designed by myself and built in the Orient. It is made of solid teak and painted cocoa instead of the usual oriental black. Hand-made soapstone figures are inlaid on all sides of the cabinet into a background of hand-painted oriental scenes. Hand-carved dragons encompass the front of the speaker enclosures, in back of which are placed a pair of Sonics AS301 4-way speaker enclosures. The cabinet is made in two parts, an upper and a lower, which are removable from one another but rigidly held in place by means of "locating pins" at the rear of the cabinets. All shelves are adjustable.

In the upper cabinet at the right is housed a Fisher 700T and a Dual 1019 with a Shure V-15 type II cartridge. At the left is a six-head reversible Dokorder tape recorder Series 7000.

The lower cabinet, which houses the speakers at the sides, has storage room in the center for records. Also, since it is a little deeper than the usual cabinet, the space in back of the records is used for tape-reel storage.

(More systems on next page)



Wall-to-Wall Stereo

Rosner Custom Sound, Flushing, N.Y. —The installation shown here is in the home of Mr. David Mankin in Kings Point, L.I., and features five stereo listening locations with switching at a custom panel. A Royce "Audio Robot" remote power on-off control system is installed as part of the system, with remote control and stereo volume built into the wall of every speaker location as well as on the main control panel. The installation and panel were made by Rosner Custom Sound, Inc. of Flushing, New York.

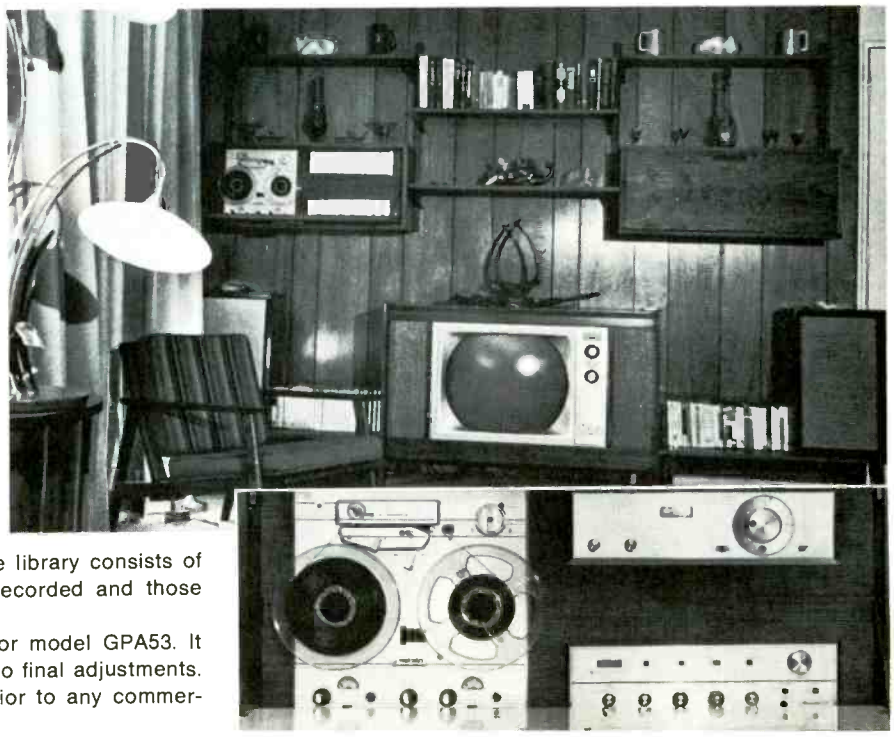
The speaker locations are living room, den, bedroom, basement den and patio. The speakers used in the living room and den, which are adjoined and almost undivided, are four Klipsch Model "H" 3-way systems. Two are built into the living room wall and two are built into a custom wall unit made by F & G Woodworking Co. of Roslyn, L.I. Two Bozak "Bards" are used in the patio area, two Electro-Voice Regency enclosures with Stephens 12-in. speakers are used in the basement, and two Electro-Voice EV-11 compacts are hidden in the bedroom. Each speaker location has a remote power on-off button and stereo volume control built into a switchplate in the wall. All wires are completely concealed.

A panel-mounted Marantz Model "18" receiver drives the system in conjunction with a Miracord 50H automatic turntable with Ortofon S15T cartridge. The system could be summed up as a high quality one with extra conveniences.

Howard Rachlin, Yonkers, N.Y.—The wall unit is of my own design and was assembled from components obtained in kit form. This resulted in a considerable savings over the cost of a comparable factory-built unit. The entire unit was assembled and finished in less than a week, taking only a few hours each evening. The modular wall unit system is particularly suitable to apartment living, since it can easily be changed to fit a different area in a new apartment.

My equipment, which is housed in an open-back cabinet, is cooled by a Rotron fan. The system consists of a Viking 85 stereo recording deck, a Scott LK60 solid-state amplifier (kit form), and a Scott 350 FM stereo tuner. The tuner will soon be replaced with a solid-state unit. It is completed with two Lafayette SK-210 twelve-in. coaxial speakers. My tape library consists of about 58 tapes, evenly split between pre-recorded and those recorded on the Viking.

The television receiver is a Heathkit color model GPA53. It took about 28 hours to assemble from box to final adjustments. The picture and sound quality is far superior to any commercial set I have seen.



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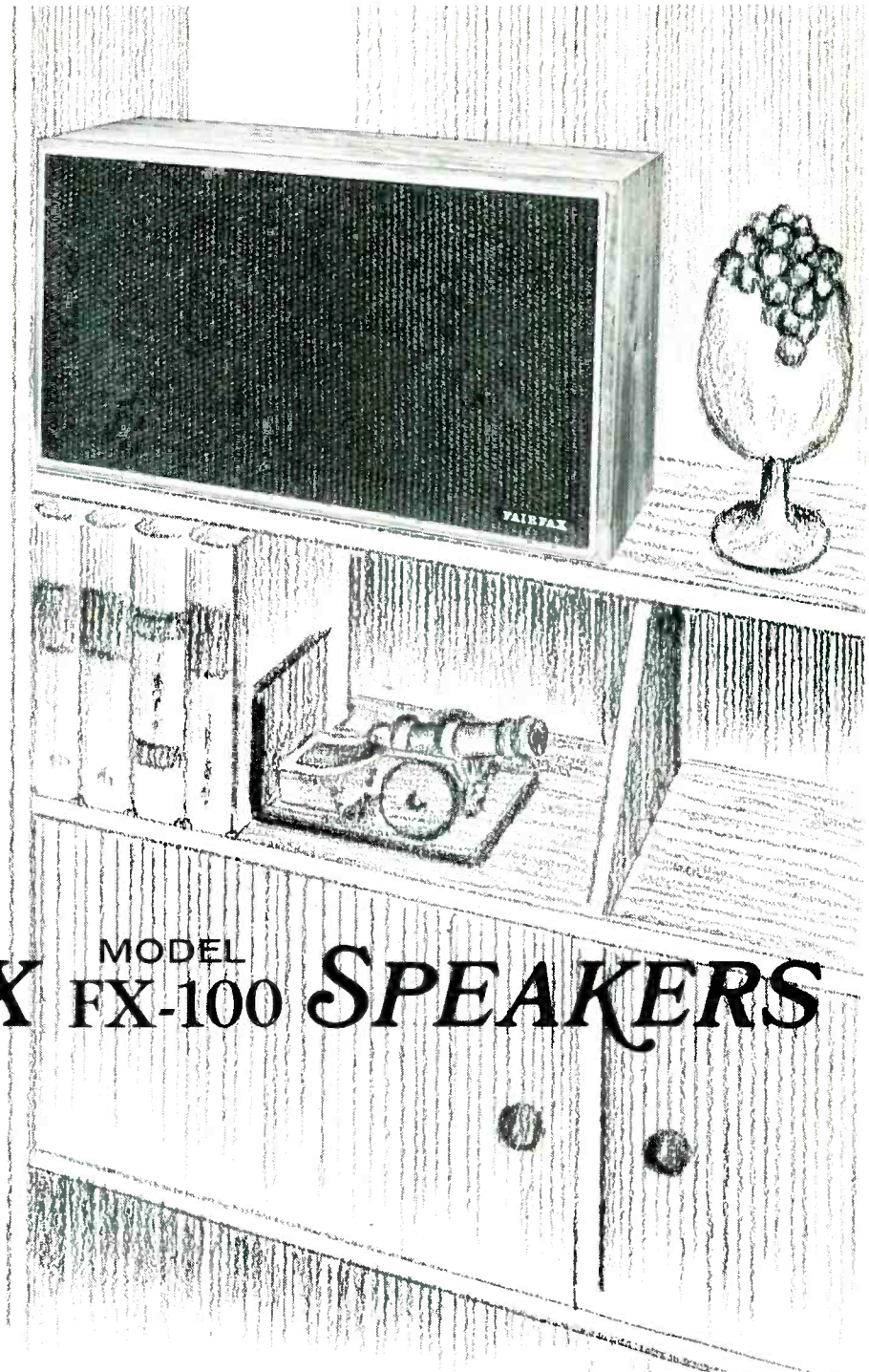

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Classical Record Reviews

(Continued from page 16)

singer voice (suspiciously like that of Oscar Brand) intoning *"O dear, what can the matter be, seven old ladies locked in th lavat'ry. They were there from Sunday to Sat'dy. . . ."* Fade out. End of "Variation IV."

It *is* important in its way, this Cage-inspired chaos. As "a monumental symphony of the visual and aural banalities of our age (it was) highly successful" wrote one critic of the "live" performance. It makes a good party game, too.

Christopher Parkening — In the Spanish Style. (Guitar).
Angel S-36020 stereo ($5.79)
Christopher Parkening — In the Classic Style. (Guitar).
Angel S-36019 stereo ($5.79)

"By reason of his unique talents, he belongs to that special group of my disciples of which I am so proud."

Those words, from the famed classical guitarist Andres Segovia, Spanish Casals of the guitar, perhaps say more than was intended. Parkening, a young Californian just entering his twenties, is not yet out of the great man's long shadow. In fact it is not easy to say, listening to these four LP sides, just who Christopher Parkening is in musical terms; he is all shadow and very little personality. One thing is clear enough. His finger technique is fantastic. Nobody—not even Segovia, nor the fabulous Julian Bream—can beat him on technical grounds.

Parkening is young, of course. But unformed? He began at eleven, was in the public eye a year later, and winning competitions before famous musicians at fourteen. By this time, shouldn't his personality be at least on the road to definition? If so, I can't hear it. Almost ten years of concentrated experience seems merely to have perfected the intricate, polished finger machinery that converts all dificulties into smooth uniformity, surmounts technical hurdles as if they weren't there. The youth seems to play with his eyes half closed, so to speak, off in a dream, his fingers going through the motions with their own automated perfection. Frankly, for the most part I was bored. It all sounds alike. It's all totally bland, innocuous, routinized, pallidly flavored, like process cheese.

Not quite all of it. Once in awhile, Christopher Parkening seems to wake up; a sudden gleam of real interest shows through. One of the short Spanish pieces comes alive in this way, but I'm not telling you which. And, oddly, the long middle section of the famed Bach Chaconne in D Minor, that part which is in the major key, is unexpectedly full of feeling and expression.

As you might expect, an unseemly proportion of the works on both discs are straight out of the familiar Segovia repertory, many of them arranged by, or dedicated to, Segovia himself. You'll find a lot of them on the old master's numerous Decca LPs (and other recordings back into early electrical 78s).

On the "Classic" disc there is Bach, plus a brace of Renaissance pieces and one by a Bach contemporary, Weiss, plus a "modern" work by Tansman, dedicated to Segovia. On the "Spanish" disc you will find those familiar and lilting semi-modern mood pieces from Sor and Albeniz to Villa Lobos (who isn't Spanish) of a sort also very familiar in the Segovia repertory.

Performance: ? *Sound:* B

Mahler: Symphony No. 4. Netania Devrath. Utah Symphony Orch., Abravanel.
Vanguard Cardinal VCS 10042 stereo ($3.50)

The Utah Symphony, which has done countless records for Vanguard, including a good bulk of Mahler, is one of our very best outlying symphonies, a remarkably accurate and alive ensemble of first-rate players. Nothing small-town about this outfit! They are competent to tackle anything that comes along, however difficult or sophisticated, as they have long since proved under their peculiarly Americanized ex-Swiss conductor.

Thus this is a first-rate Mahler "Fourth," stamped, however, with a characteristic Utah sound: forthright, vigorous, rather fast, very alive and healthy, which is something, for Mahler. True, this is his most joyous symphony, among others that run to lengthy ineffability. But Bruno Walter, on Columbia, somehow makes Mahler more poignant, more personal, more European. Utah Mahler sounds like Utah, oddly. Less mystically inclined, more direct and uncomplicated. I like it.

The Dolby system is revolutionizing "classical" recorded sound—more than even those who recognized its importance could ever have imagined. The peculiar silences, the uncanny dynamic range that takes us down, *down,* far beyond the subconsciously familiar limits of *pianissimo,* or alternatively blasts out twice as loud as we expect, is almost unsettling in its impact. We find we no longer know where to set our volume control; we are strangely at sea in a whole new dimension of recorded presence.

Dolby shows up here not only in the dyings-away, the *piano* passages the astonishing *forte* explosions, but indirectly in an unprecedented clarity—as though we were looking through a newly washed plate-glass window, the invisible gray haze dramatically removed. Wonderful.

Performance: A— *Sound:* A—

Sibelius: The Seven Symphonies. New York Philharmonic, Bernstein.
Columbia M5S 784 (5 discs) stereo ($28.95)
(Also available separately)

I have been lamenting at length, lately, over numerous recent Sibelius performances; for I used to love the old Finn's music in the early days when I thought it was the Ultimate in Modern. And now I love it even more, having discovered lately that it *is* modern, though in ways I could never have imagined. Is this big album the apotheosis of current Sibelius performance? It surely ought to be.

Sibelius isn't modern in his tonal language, nor in the style of his orchestral writing, both of which are full-bottomed late Romantic. It is the *organization* that is startlingly modern right now. Symphonies and tone poems set up like enormously skilled Happenings, with the sort of shaping we find in a top-quality electronic work today.

Yes, Bernstein displays his usual good feeling for the big points of Romantic climax and drama in Sibelius, as many a younger conductor (and a few older ones) cannot do. No metronomic computer performances from Lenny! He knows exactly where Sibelius is going, Romantically, in every measure; he doesn't miss a trick.

But there is, alas, the familiar Bernstein sentiment that so often makes his Romantic music more Romantic than real. What he misses cold is the modernity in Sibelius, the tightness, the mercurial brilliance of the internal sonic arrays, the shifting colors and theme fragments, the impassioned developments leading nowhere in particular—they just "happen," they are, they exist for themselves. Modern as all get-out!

But Bernstein muddies it all up, going too slow, dwelling too long. He is strong and passionate, but too mellow,

(Continued on page 60)

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(Continued from page 58)

too sticky. Sibelius is merely nostalgic here.

Performances: B— *Sound:* B

Choir and Instruments

Dave Brubeck: The Light in the Wilderness; an Oratorio for Today. Cincinnati Symphony Orch., Miami Univ. A Cappella Singers, Vocal Soloists, Dave Brubeck, piano. Dir. Erich Kunzel.
Decca DXSA 7202 (2 discs) stereo ($9.58)

One of the most cogent criticisms of modern jazz in this "pop" era of the 1960s has been that it has resolutely set itself against the stream. In a time when "classical" music and its concert tradition are breaking up and reforming, jazz has obstinately tried and tried to go classical—all the way, from Carnegie Hall to black tailcoats and white ties; formality; learnedness; written-out scores (with improvisation mixed in, of course; gotta have that); and, last but not least, monumental, not to say old fashioned, classical forms. If ever the point was to be proved, Dave Brubeck has done it in this enormous, pompous, endless (four LP sides) "modern" oratorio. For my ear it is as modern as, say, the early 1930s, and not half as interesting.

Dave, it seems, has gone classical with a vengeance. For some time he has given up performing in favor of composition, now an all-consuming passion with him. OK—so be it. At least, you will hear the great man in this work now and then, offering a brief, hard-bitten piano interlude to emphasize a Great Biblical Moment. You may be inspired; I found it just embarrassing.

The piece is huge, fat, pretentious and deadly serious. It takes up the most solemn religious matters imaginable: the Temptation of Jesus, the Forty Days in the Wilderness (with jazz improvisation), the Sermon on the Mount, Repentance, Love Your Enemies, and much more out of both Testaments and the Psalms. Serious but, for this pair of ears, both earnest and dull. The style, for all its impressive sonic qualities, is second-hand derivative, out of the big cantatas and oratorios of the Thirties—Honegger, Stravinsky, Copland, Hindemith and many another—depending mainly on a sort of stolid modal tonality with endless pedal-point figures and mild dissonance via melodic lines crossing in opposite directions.

This sort of thing has long since lost its pre-war novelty and at best it was limited in expressive versatility, even in the hands of the older masters —why else did they go on to other techniques? But Dave doesn't agree.

OK, maybe I'm stepping on some sensitive toes here, if not very heavily. But you and I are supposed to buy this huge album and listen to it. Brubeck! A Big Name. So I'm having to tell it the way it is.

I'll have to admit that the performance is both heartfelt and powerful. These people love the stuff, even if I don't. And so, maybe, will you? In any case it's a gorgeous, big sound in stereo, thanks to such a grand mass of performers. And Dave's immense and very classical-sounding grand piano, too.

Performance: A— *Sound:* B+

Varese: Nocturnal (1961); Ecuatorial (1933-34). Henri Lasarof: Structures Sonores (1965-66). Ariel Bybee, sopr., Bass Ensemble of the University-Civic Chorale, Utah Symphony, Abravanel.
Vanguard Cardinal VCS 10047 stereo ($3.50)

Edgard Varese was the most gregarious of Americanized Frenchmen, a man who was friendly to anybody and everybody who could come out with an idea; his snapping eyes and impetuous good humor, so extremely French, made it hard to realize that he was one of the hard radicals of early twentieth-century music. Now he is a musical deity among the young, both professional and amateur. His music seems both violent and fanatically serious—yet I once had the privilege of listening to Varese, much the better for a lot of good wine, describe to me with sputtering guffaws how, as a student at the French Conservatoire, he had played practical jokes on his stuffy olders—he spoke of Saint-Saens as "the old goat"!

Here are two major works for voices and orchestra by Varese, one of them unfinished and his last, completed, like the Mozart "Requiem," by a younger musician — so faithfully that only an extreme expert could tell where Varese lapsed into cryptic sketches and then, into silence. "Nocturnal," begun in three different versions, none completed, pits a sighing, gasping soprano and the gutteral groaning-speaking voices of a bass choir against the typically dynamic, enormously high tension fragmentings of orchestral sound, piercingly strident, that are familiar in other Varese works, both electronic and live-instrumental. Wide pitch jumps, sudden violent rhythmic spasms, extremes of dissonance at screaming volume, slides and fire-siren effects, blats, blops, great organ chords, are all a part of this extremely skillful sound construction.

"Ecuatorial" is a much earlier work of similar impact, the voices in this case singing-chanting a ritual semi-Spanish text, with many added rhetorical syllables *(oh, oh, oh, ho o ha)* translated from the Maya Quiché. The sounds in this work are less piercing, more suggestive of latter-day serial music, than in the later work.

There wasn't enough Varese for two LP sides—what to add on the obverse? The Lazarof "Structures Sonores" are mildly related—the title is French, though the composer was born Bulgarian, studied in Israel, Rome, and the United States, where he has taught French and music in California. Much more important is the sound—for if it can be conceived, Lazarof outdoes Varese himself in sheer dissonant orchestral violence. A very much younger man, of course, and in that sense no pioneer. His music is more sophisticated and, oddly, quite academic in a modern sense; plenty of youngsters toss off orchestral serial dissonance today. But there is an affinity between Varese and Lazarof, nevertheless. Both have an elemental ferocity expressed in virtuoso orchestral terms; both are, beneath the furiousness, urbane and acutely civilized human beings. A good record, this, and congrats to Utah, Abravanel and Vanguard.

Performances: A *Sound:* A—

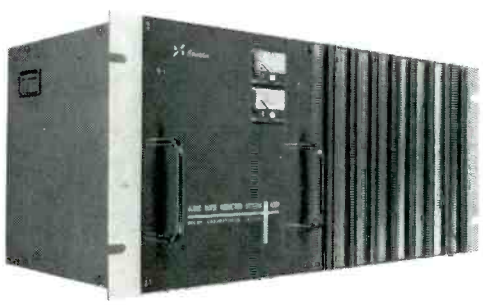
Berlioz: Te Deum. Alexander Young, tenor, Dulwich Boys Choir, London Philharmonic Choir, Denis Vaughan, organ, Royal Philharmonic Orch., Beecham.
Odyssey 32 16 0206 electr. stereo ($2.49)

The magic name Beecham characterizes this excellent restoration of a mammoth British recording from 1953, some years before the stereo era. Sir Thomas is emerging more and more as one of the last definitive conductors of the old school, brought up in the Romantic period and carrying the torch of the nineteenth century halfway through our own century.

Beecham was a stylist, a perfectionist, and yet a flamboyant showman in his own dry way; he made a specialty of French music—he of all people the most utterly British in mein. And he knew how to realize a huge, bombastic work of near-genius such as this "Te

(Continued on page 62)

"The Dolby system gives me a 10 db reduction of hiss, print-through and crosstalk," says Seymour Solomon, recording director of Vanguard Records. "The use of the Dolby Noise Reduction System enables us to record a work with great dynamic contrasts, such as the Mahler 2nd Symphony, with a new dimension of realism. It is now standard procedure to record our Vanguard classical tape masters with the Dolby System."



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The Missing —

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(Continued from page 62)

ing technique produces the same effect, an intimate sound in a spacious acoustic surround.) Nice violin solos throughout — that would have been Mozart himself in the original.

The English orchestra, St. Martin-in-the-Fields, plays with similar effect, a small ensemble performing in a large acoustic surround, a trace too large in this case for the proper intimacy. The Mozart is excellent here too, but not quite as pure nor as well blended in the ensemble as the Viennese product. The three Divertimenti are best; the later Serenata (K. 239) seems rougher, more lunging, in the performance. Taken down on a different occasion?

Performances: A−, B+ *Sound:* B, B

Mozart: Così fan tutte. Price, Troyanos, Raskin, Milnes, Shirley, Flagello; The Ambrosian Opera Chorus, New Philharmonia Orch., Leinsdorf.
RCA Victor LSC-6416 (4 discs) stereo ($23.16)

International opera performance, the principal singers gathered from all over the world, is now rivalling the old national opera where one style, one tradition, tended to dominate each major company. On records, internationalism is even more rampant and in peculiar ways—witness RCA's recent arrangements with the New York Metropolitan Opera, as evidenced in this recording.

The Met hasn't made its own records for many a year. Frankly, between you and me, it isn't good enough. Lots of good singers, good conductors, and so on. But its productions vary from scrappy to musical mish-mash — and sound that way on any factual comparison such as afforded by recordings. So RCA cashes in on the Met's rep, which is huge, but bypasses the New York productions like a batch of hot potatoes.

Send the individual Met artists jetting over to more reliable operatic centers (and cheaper, too). Bring in the major orchestras (or the excellent minor ones, as in Italy). Import the big opera conductors. Do the job over there, and then play up the Met connection for all it's worth, which is a lot. That would seem to be the game.

If I am right, the cast of this "Cosi" is all-American and all-Met. The conductor is Germanic, though just out of Boston; the orchestra and (briefly appearing) chorus are very British, and the recording was done in London. Nicely integrated cast, too.

Result? An oddly styled performance, very American in the singing, more continental in the playing, with little of the Mozartean subtlety of more traditional European performances, out of Vienna or Glyndebourne, yet full of earnestness and vigor. The voices are not so much Mozart voices as all-purpose instruments, not bad at Mozart but not really idiomatic either. Too loud, too brilliant, too high powered. It could as well be Verdi or Puccini.

And yet, considering the extraordinary difficulties and the subtle organization of the complex opera score, these singers do a creditable job within their respective abilities, no doubt helped along by the experienced Erich Leinsdorf, an old hand at German opera. (The text, of course, is Italian but the opera is Mozart Viennese.)

Recommended if you like opera in general rather than Mozart in particular. But if you are a Mozart specialist or afficionado of any sort, better be careful.

Performance: B— *Sound:* B

Music in the Cathedral

Gabrieli Canzonas for Brass, Winds, Strings and Organ. (Recorded in St. Mark's Cathedral, Venice.) Edward Tarr Brass Ens., Gabrieli Consort, E. Power Biggs, Organ, Cond. V. Negri.
Columbia MS 7142 Stereo ($5.79)

The second LP out of Columbia's fantastic expedition into St. Mark's Cathedral, this one is all instrumental, brass choirs against strings, organ and assorted winds. The sound is almost too huge, a bit lost in the Cathedral's golden acoustic haze. The music is accurately played with a lack of rhythmic tension and variety. Even so, the fabled Gabrieli sound gets through and the stereo contrast between groups or "choirs" of instruments is good.

Performance: B— *Sound:* B

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Jazz

BERTRAM STANLEIGH

Charles Mingus: Mingus at Monterey
Mingus Stereo JWS 001/2

A two-record set of the Mingus triumph at Monterey's Seventh Annual Jazz Festival in 1964, this recording was produced on Mingus' own label and is distributed by Fantasy Records. It is clear that bassist Mingus was at the very top of his form for these Festival performances, and much of the soaring passion can be detected on the waxings, but many irksome details militate against unlimited enjoyment of this set. The first section, devoted to an Ellington medley, is so split between sides one and two that "Take the A Train" is divided between the two platters, and the two long compositions by Mingus that make up the balance of the set are each split between two sides in similar fashion. Not only is the length of each work short enough for a single side, but further time could have been saved by eliminating some of the spoken introductions and comments. Instrumental balances are far from ideal, with prominent trumpet solos invariably drowning out all other detail. Background noises are a usual ailment of such live recordings, but they seldom are allowed to protrude to the extent encountered here. The present set is heartily endorsed for musical content, particularly Mingus' "Meditations on Integration," but those persons who want acceptable sound are specifically warned to stay clear of this one.

Performance: A *Sound:* D

Little Brother Montgomery: Farro Street Jive
Folkways Stereo FTS 31014

Little Brother Montgomery has developed a sizable reputation as a "musician's musician," and he demonstrates his clean, open playing, and respectable technique in a collection of piano blues, most of which are Montgomery's own compositions. Sound versions of "Pinetop's Boogie Woogie" and "St. Louis Blues" in a rather elaborate blues setting fill out this worthwhile set. The recording is clean, although the miking of the vocals is a trifle off-axis. The "electronically rechanneled" stereo is not perceptively different from mono sound, but it is quite satisfactory for the material.

Performance: A *Sound:* B+

Herbie Mann String Album. Atlantic Mono 1490 ($5.79)

Herbie Mann is a good jazz musician, but it would be wrong to assume that this set is therefore good jazz. It is, in fact, a sprightly group of pop tunes, including: *To Sir with Love*, *There Is a Mountain, It Was a Very Good Year,* and *I Get Along Without You Very Well,* plus three charming, graceful originals by Mann and a boring bit called *Flight of the Bluebird*, by arranger-conductor Torrie Zito, that might more aptly be titled *Flight of the Sewing Machine*. Particularly in his own tunes, Mann indulges in the cultivated, serpentine meandering that he handles with such elegance. Aside from an unnamed trumpet that offers an occasional solo, all of the music that

Light Listening

STUART TRIFF

Porgy & Bess, Complete

WHAT MUSIC LOVER who has ever heard the soulful Negro wailings of Catfish Row, the ghetto town of George Gershwin's famous "Porgy and Bess," can ever forget them?

Now, thanks to the insight of Columbia Records, we can re-experience the full impact of America's "first original opera." Producer Goddard Lieberson has restored to the public that which is the public's—the uncut, 3-record masterpiece, "Porgy and Bess." Originally issued in 1951, as Columbia OSL-162, the set of three records has never *officially* been out of the catalog; yet, in recent years, it has been increasingly hard to come by in most shops. (Taking into account that there are no less than eight complete waxings each of "Madame Butterfly," "La Boheme" and "La Traviata," seven of "Aida," and six of "Carmen," it is no creditable reflection on record makers that we have not one alternative version of "Porgy and Bess.")

It's difficult to imagine that George Gershwin himself sanctioned such shameful cuts in his score as the magnificent "Buzzard Song" from Act Two, and the delightful Occupational Humoresque ("Good Morning, Brother; Good Morning, Sister") which begins Act Three. These, along with other former excisions, are happily reinstated in this beautifully-performed version, gorgeously sung by Lawrence Winters and Camilla Williams in the title roles. The overall casting could hardly be better, with Warren Coleman, Eddie Matthews, Helen Dowdy and J. Rosamond Johnson (who also trained the fine chorus) lending a note of authenticity, for they all appeared in the original 1935 production.

Conductor Lehman Engel takes full advantage of these two gifts, songs and cast. He lovingly feels his way through the score, resplendent with the actual "gutter" sounds of Catfish Row: fight scenes, a crap game, a rising storm. The choral writing captures Gershwin's American truth as perhaps no other opera to date has done. To my mind, this uncut documentation of "Porgy and Bess" is an unarguable testament to the originality, freshness, melodic invention and overwhelming poignancy of a work that is long overdue in taking its deserved place among the world's great operas.

The reproduction of the 1951 release was somewhat thin, notably in the upper frequencies. This has now been greatly improved, resulting in a fuller and mellower sound, with exceptionally quiet surfaces. The efforts to simulate directionality by phasing the channels in and out, unfortunately, does not come off, and leaves one merely impatient with the awareness of the electronic gimmickry involved. But, this is a relatively minor reservation in an otherwise superb achievement that must rank as one of the recorded milestones of the LP Era!

Gershwin: "Porgy and Bess" (complete). Lawrence Winters, Camilla Williams, Inez Matthews, Warren Coleman, June McMechen, Avon Long, Eddie Matthews, Helen Dowdy and supporting cast; with chorus & orchestra/Lehman Engel. **Odyssey 32 36 0018** (3 discs – rechanneled stereo only) ($7.57) Æ

rises and ebbs behind Mann's flute is pretentiously innocuous. Sound is rather good.

Performance: B *Sound:* A

Peter Seeger Sings Leadbelly
Folkways Stereo FTS 31022

Eleven Huddie Leadbetter tunes recreated by Pete Seeger in a style that is closer to Leadbelly's own performance manner than to Seeger's usual way. For this set, Seeger accompanies himself on 12-string guitar, rather than banjo, and turns in a thoroughly sensitive set of performances. The only question that comes to mind is why one would prefer these tasteful carbon copies to the genuine Leadbelly versions? The original mono recording was made at a live performance 10 years ago and has been "electronically rechanneled to simulate stereo."

Performance: A— *Sound:* B

Woody Herman: Concerto for Herd
Verve Stereo V6-8764

Recorded live at the 1967 Monterey Jazz Festival, the "Concerto for Herd" is a special composition in three movements by Bill Holman, who had written and arranged material for the 1950's Herman band and for the group Herman headed in the early 1960s. The present composition is a somewhat coldly eclectic vehicle, well suited to taking a Herman aggregation through its paces, but lacking in melodic invention and with no real internal rhythmic surge. It does serve to demonstrate that the latest Herman Herd is just as vigorous, precise, and flexible as previous groups.

Performance: A— *Sound:* A—

Don Ellis: Shock Treatment.
Columbia Stereo CS 9668 ($4.79)

Bright, big band sound with a forward beat is enhanced through the use of electronic amplification devices on various brass and woodwind instruments and the use of the Conn "Multivider," which adds an octave below the solo line. Loop delay and overdubbing are additional techniques that contribute to the very special sound of this platter. Used with taste and a sensitive feeling for the effects employed, these devices produce some very attractive big band sound that gets most of its propulsion from a wide assortment of percussion instruments.

Performance: B+ *Sound:* A

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The New Blues

DAVID LYLE SEGAL

British Blues

Bare Wires: A Suite by John Mayall
John Mayall's Blues Breakers, **London, PS 537, stereo** ($4.79)

England, the Mother-country to the socio-political scientists of the Great Experiment, has, in the 60s, presented the American colonies with another "Big Momma"—Blues. Five or so years ago, English Blues, in the person of the Animals, the Rolling Stones, and others came out of its "Liverpudlian" cellar and stoned the world with its unreserved, un-British sound (Howlin' Wolf and John Lee Hooker in Cockney).

Although their approach to Blues was still rather amateurishly executed, it was promising. As it turned out, for years those clever English had been "socking" away American Blues' 78s and albums, studying them, imitating them in sound-proof bomb shelters, and waiting for the day they could claim Blues as their own. Today, with Cream and other groups they have earned at least a respectable position in the Blues tradition.

"Bare Wires" is John Mayall's sixth album (the third released in the U.S.) with the Blues Breakers, and is undoubtedly the best to date. Mayall, at 34, has been a working musician since about the birth of most of the other English musicians, and has been playing and studying Blues for most of his professional life (nontrusters of anyone over 30 take note). In fact, he has been the constant local musician called to back up John Lee Hooker, T-Bone Walker, Freddy King and other visiting Blues artists, and it is this experience that he credits for his authenticity.

Mr. Mayall does not imitate American Blues. Blues, when imitated, is obviously ersatz and that is the vice of most of the other English groups. Mayall plays Blues from its true perspective, from inside. He has a sensitive, small group here, which includes piano, harpsichord, mouth organ, assorted guitars.

It's tough to single out one or two selections as indicative of the album or even for special mention. On side 2 alone, three selections, "I'm a Stranger," "Killing Time," and "Sandy," are surprisingly similar to Percy Mayfield in instrumentation, arrangement and vocal execution (cf. "River's Invitation"), while "No Reply" seems to evoke Jimi Hendrix (a man whose Blues potential is too often overlooked) and "She's Too Young" is reminiscent of Chuck Berry. All are beautiful, authentic, enthusiastic, real, and very personally John Mayall as well as the tradition that preceded him, engulfed him, and which will be undoubtedly reflecting his influence in its ever-changing-ever-different development.

But these comparisons go to the more overall effects of the music—its conception, which is the private preserve of the American Negro, unavailable to most American whites (the exceptions being those such as Mose Allison, who grew up in Negro Gospel-church society, or those who had similar intimate contact with Negroes), much less Englishmen. The fact that Mayall has been able to capture this concept without extraneous distortion is to his credit and his accomplishment is apparent in this album, written by him almost entirely. In particular, pay attention to his voice; its relaxed attitude toward the songs has the same effect as Muddy Waters', a suppression of great power and technical ability, subtly evident only in his genuine riffs and timing and the knowledge that he is singing his own music. Sincerity is too pale a word.

Galt MacDermot's Hair Pieces
Verve Forecast, FTS 3045, stereo ($4.79)

The show, "Hair," has been billed as portraying the soaring, inquisitive spirit of the McLuhan-age future citizens of America, and its music is triumphantly designated as the mode of that generation, rock. (Electric folk-rock, that is, or rather, that isn't.) The promoters may have gone out of their way to class Galt MacDermot's scores as belonging to the "Jefferson Airplane" genre, but, unfortunately, their musical horizons stretch no further than Tin Pan Alley.

Undoubtedly the music is good. Broadway is almost singular in its tasteless tunes and thoughtless arrangements, and "Hair" is probably very avant-garde-dirty-hippie from that perspective. But it wouldn't be considered hirsute in the Village. A little fuzzy perhaps, but not hairy.

The music does include rock in the sense that its lyrics, chords, progressions and rhythms are rock-oriented, but the arrangements are altogether too much the same—the same electric piano lead, the same sexless voices, the same ii-V-I-vi chord framework, the same super-string sterilizer that gelds viable musical compositions. In other words, as rock, the album doesn't make it, except as another phony explanation to mothers and fathers of what their children are listening to. But as Broadway it undoubtedly has started a minor revolution, a careful, but not inaudacious, inroad on the last bastion of Establishment music. For that, at least, it is worth acquiring, especially by show music aficionados.

The Secret Life of J. Eddy Fink
Janis Ian, **Verve Forecast, FTS 3048, stereo** ($4.79)

Eli and the Thirteenth Confession
Laura Nyro, **Columbia, CS 9626, stereo** ($5.79)

These two vocalists should be listened to together and compared. Both women display surprising talent (including Laura Nyro playing her own piano accompaniment) and ease in similar, yet original material. Note especially the artistry evident in Laura's compositions, the use of stereo effects as an integral part of the music, and the fact that the voices cannot be separated from the rest of the instruments without destroying the concepts involved in either album.

In Search of the Lost Chord
The Moody Blues, **Deram, DES 18017, stereo** ($4.79)

Far too commercially oriented for fair comment.

In My Own Dream
Butterfield Blues Band, **Elektra, EKS 74025, stereo** ($4.79)

The title tune is probably the best-cut, both instrumentally and vocally, especially Dave Sanborn's soprano sax counter. For arrangements, see "Last Hope's Gone," a concept reflecting more modern musical theory than would be expected. Æ

Recorded Tape Reviews

BERT WHYTE

Sky Bound Stereo Popular Style: American Airlines Astrostereo.
Ampex W-46, **3¾ ips** ($9.95)

To be perfectly honest, I have avoided this kind of recording. There is a whole slew of them used by the various airlines, covering the gamut of classical, pop, show tunes, etc. I had the notion the sound would be of indifferent quality and the contents a monotonous musical pablum.

Well, at least as far as this tape is concerned, I was wrong. Taken from albums of Mercury, Phillips, Smash and Fontana, the material has been chosen by someone with some idea of programming and the sound for the most part is fairly clean and well-balanced. It is strictly background ma-

terial, of course, but if that's what you're looking for, this will do the trick, as it goes on and on for 3 hours!

"Scheherazade" Revisited

Rimsky-Korsakov: Scheherazade. Herbert von Karajan Conducting the Berlin Philharmonic.
Ampex/D.G.G. DGC9022, **stereo, 7½ ips** ($7.95)

Von Karajan imbues this old warhorse with new life with a performance that is as sensuous as it is exciting. In spite of the ripe lushness of his interpretation, he is very revealing of inner detail and with the superb sound, every note is clearly limned. This has a very big, bright sound, with broad acoustics, high definition, wide dynamics. The Berlin Philharmonic under the von Karajan stewardship gets better and better.

The playing here in every choir is quite outstanding. The important string detail and solo work is just superb and wait until you hear those great horns. Percussion was notable for cleanness and accuracy. Tape hiss was moderately low as was print-through, but the one drawback was an excessive amount of upper mid and high frequency crosstalk. It is possible I got a bad copy. I certainly hope there are clean copies available, since this is such an otherwise exemplary recording.

Aeolian-Skinner in Cathedral

The King of Instruments: Maurice and Marie-Madeleine Durufle.
Ampex/Aeolian-Skinner AEC322, **stereo, 7½ ips** ($7.95)

Here is the tape you fanciers of big pipe organ pedals have been waiting for! The husband and wife team of the Durufles are top-rank organists who perform some of their own music, as well as that of several well-known French composers, for organ. They play the superb Aeolian-Skinner organ in Christ Church Cathedral at St. Louis, Mo., and a mighty instrument like this creates an astonishing output of sound.

The sound is very clean and well balanced and the engineers have managed that difficult feat of great cathedral reverb with good definition. M. Durufle plays his own "Prelude in E flat Minor" and the last third of the work features some of the most gigantic low pedal I've heard in a long time. If you have the proper amplifiers and speakers, there is enough Low C pedal to shake down your walls! The other works on the tape are fairly tame but the "Prelude" is worth the price of admission. Æ

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Advertising Index

ABZs of FM

(Continued from page 42)

ber that audio modulation is, effectively, a rapidly changing level of voltage, both positive and negative, about the "zero center" of the "S" curve of the detector. Therefore, in the presence of program material, the 'scope spot changes into a line whose length, left to right, is determined by the loudness of the program material. Figure 6B shows what happens when "multipath" is encountered. At certain frequencies traversed during the course of audio modulation, partial cancellation takes place, reducing the amplitude of the i.f. voltage, and therefore the vertical position of the trace. Figure 6C illustrates a very severe case of multipath, in which almost complete cancellation takes place at certain frequencies within the desired pass-band. Such a display, incorporated in an FM tuner, serves as an aid in orienting the antenna for strongest, as well as multipath-free, signal. *Æ*

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Hirsch-Houck Laboratories, HiFi/Stereo Review, July, 1968.

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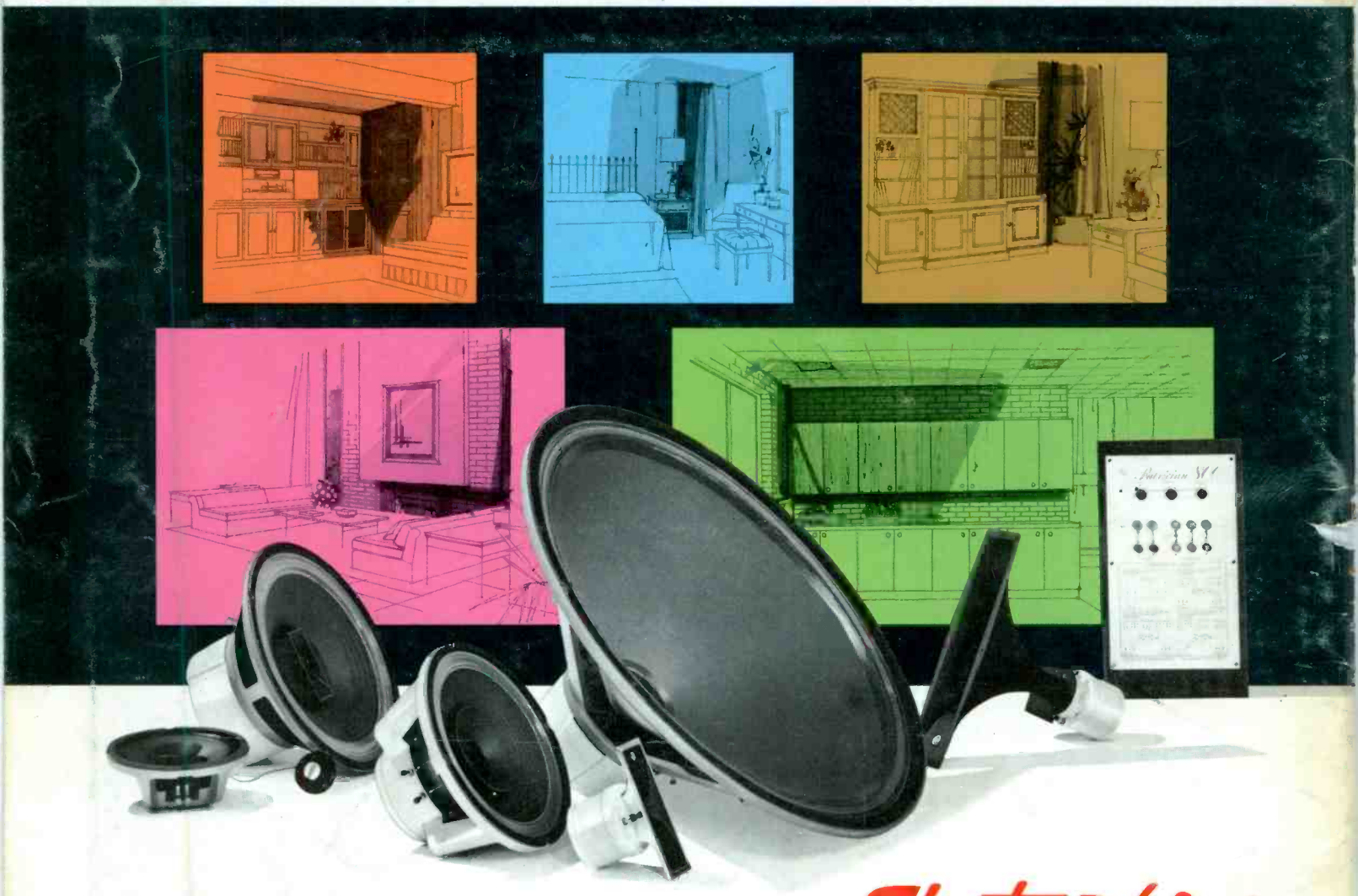

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