...the original magazine about high fidelity!

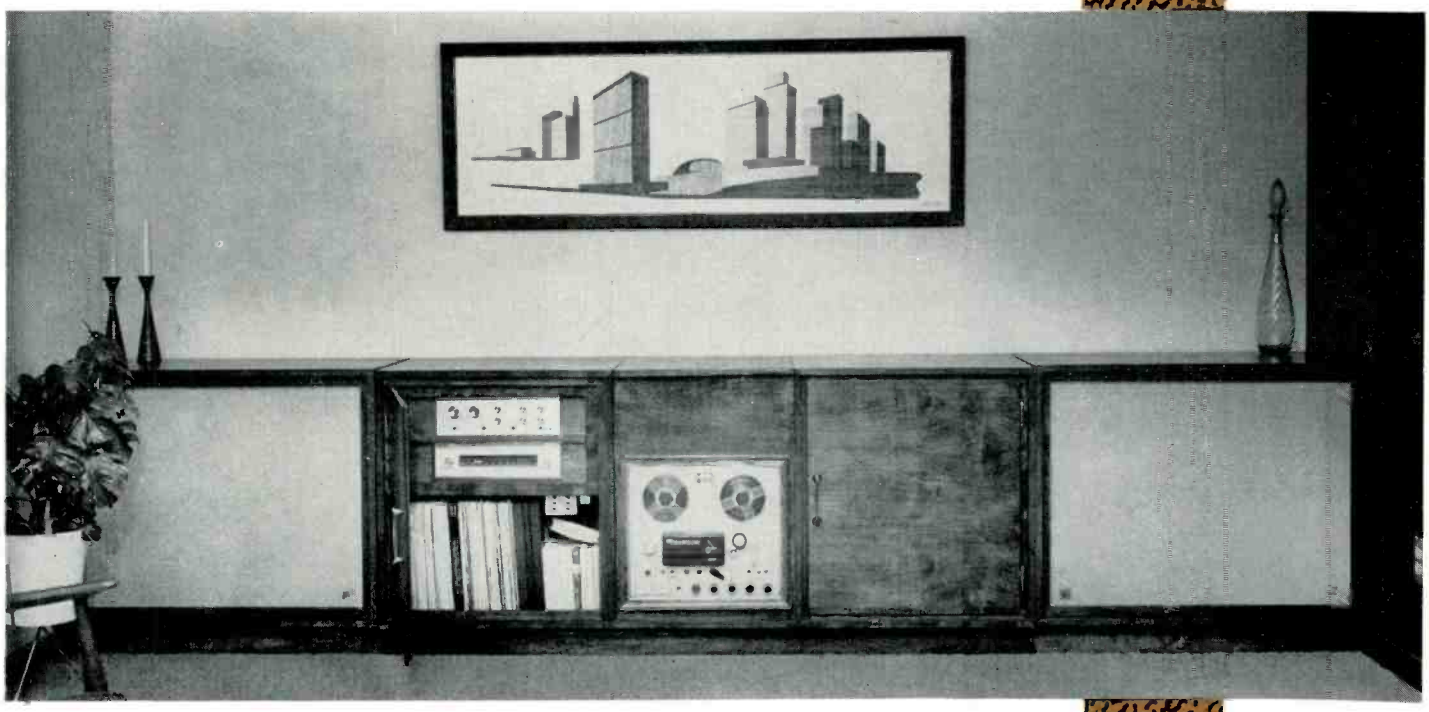
AUDIO

MARCH/1965

60¢

FEATURES

- How To Make An Inexpensive Loudspeaker Sound Expensive
- PI-MODE TRANSISTOR OUTPUT STAGES
- *Equipment Profiles*
  1. Garrard Lab 80
  2. Fisher 600 T
  3. Concord R-2000
  4. Knight-Kit KG-870



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Only Scott has the 10 vital features you need in a solid state amplifier

After an exhaustive analysis of solid state design, Scott engineers have found ten vital design features which determine the performance of solid state amplifiers. Only the new Scott 260 80-watt solid state amplifier successfully incorporates all ten vital features resulting from this research. Now, as before, your choice of Scott assures you of superior performance, long-term value, and unfailing reliability. For completely detailed information on this amazing new solid state amplifier, write: H. H. Scott, Inc., Dept. 260A, 111 Powdermill Road, Maynard, Mass.

Less than $260.

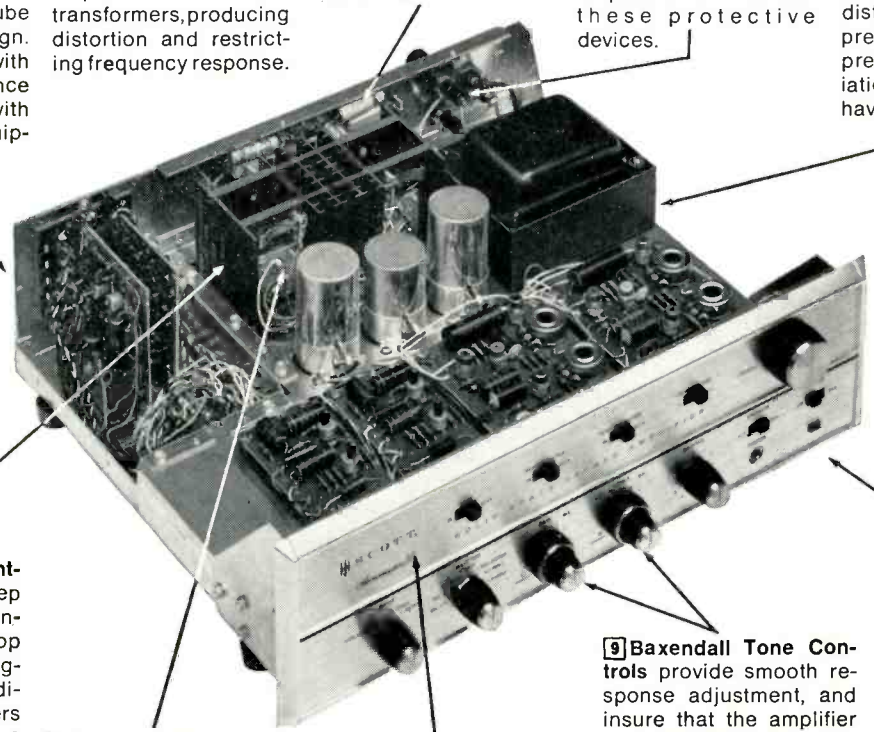
1 High Input Impedance permits use with any tuner or tape recorder, whether of tube or transistor design. Other amplifiers with low input impedance can not be used with subsidiary tube equipment.

2 Direct Coupled Circuitry using no transformers, assures widest possible power bandwidth and lowest possible distortion. Other amplifiers use driver transformers, producing distortion and restricting frequency response.

3 Output Coupling Capacitors prevent direct current from flowing to your speakers. Other amplifiers pass direct current into the output signal, resulting in degraded performance, or even destruction of the voice coils.

4 Fused Output Stage prevents damage to valuable loudspeakers. Special fuses stand guard should there be a chance overload. Other amplifiers do not use these protective devices.

5 Zener-Controlled Power Supply assures top performance and lowest distortion in the critical preamp circuits by suppressing line voltage variations. Other amplifiers have no such provision.



6 Massive instrument-type Heat Sinks keep output transistors running cool, assuring top performance and longer life under all conditions. Other amplifiers use the chassis as a heat sink, making outputs far more vulnerable to breakdown.

7 Rugged Silicon output transistors assure long operating life and far superior high frequency performance. Other amplifiers use low-performance germanium transistors that are far less rugged.

8 Full control complement includes BOTH Scratch and Rumble filters; 3-position pickup sensitivity switch; remote speaker provisions AND outlet for private stereo headphone listening; complete facilities for tape recording and monitoring.

9 Baxendall Tone Controls provide smooth response adjustment, and insure that the amplifier operates "flat" when controls are center-set. Other amplifiers use controls which change the entire frequency response as well as that portion over which control is desired.

10 FM Stereo Tuner matches the amplifier. Scott's famous solid state 312 stereo tuner perfectly matches the amplifier in looks AND performance. (Audio Magazine said of the 312: ". . . one of the finest tuners anywhere.")

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AUDIO

MARCH, 1965 VOL. 49, NO. 3

Successor to RADIO, Est. 1917

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AUDIO (title registered U. S. Pat. Off.) is published monthly by Radio Magazines, Inc., Henry A. Schober, President; C. G. McProud, Secretary. Executive and Editorial Offices, 204 Front St., Mineola, N. Y. Subscription rates—U. S., Possessions, Canada, and Mexico, $5.00 for one year, $9.00 for two years; all other countries $6.00 per year. Single copies 60¢. Printed in U.S.A. at 10 McGovern Ave., Lancaster, Pa.

Second Class postage paid at Lancaster, Pa.

AUDITED PAID CIRCULATION ABC

RADIO MAGAZINES, INC., P. O. Box 629, MINEOLA, N. Y.
Postmaster: Send Form 3579 to AUDIO, P. O. Box 629, Mineola, N. Y.

COMING

Sound At The Fair

The New York World's Fair is scheduled to reopen in April. For those interested in sound, the Fair offers a veritable showcase, a rare opportunity to view sound systems of every make and configuration in almost every conceivable application. AUDIO takes you for a walk around the Fair to view the sound facilities through the eyes of Martin Dickstein, a professional sound man, who describes most of the interesting systems. Then we get specific and give you a closeup of several interesting systems, such as those at the Vatican Pavilion, the Chrysler Pavilion, the DuPont Pavilion, and others. In addition, we have a closeup of the outdoor system which provides sound throughout the Fair.

To cap it all off, we have a roundup of up-to-date commercial sound equipment. The listings will be in convenient tabular form so that it will be easy to pick out the particular type you may be interested in.

All this in addition to the usual Audio articles and Equipment Profiles.

In the April Issue

On the newsstands, at your favorite audio dealer's, or in your own mailbox.

AUDIO CLINIC

Joseph Giovanelli

Send questions to:
Joseph Giovanelli
2819 Newkirk Ave.
Brooklyn 26, N. Y.
Include stamped, self-addressed envelope.

Tracking Down a Thundering Noise

Q. I have been having trouble with a very loud thundering sound, coincident with "blowing" of fuses in my transistor amplifier. When this sound starts I lift up the tonearm from the record but the sound continues until the equipment is turned off.

The local service technician thinks that the trouble is in the transistor power amplifier. I would like to hear your comments on this problem. Basilio del Pilar, Jr., Arecibo, Puerto Rico.

A. I suggest the following method of tracking down the thundering sound in your music system.

If the rumbling occurs only when the selector switch of your preamplifier is in the phono position, you can be sure that the difficulty lies in the phono preamplifier. If the rumbling persists, however, regardless of volume control setting, the trouble is not in the phono. If the tone controls do not affect the rumbling, the trouble is after the tone controls, possibly not in the preamplifier at all.

If all checks up to this point have not established the exact source of the "thundering" noise, turn off the preamplifier with the power amplifier still on. If the noise persists after the preamplifier is turned off, you can be sure that the power amplifier is the source.

As a precaution, keep the speaker leads isolated from the input leads of the preamplifier. Possibly you are getting some oscillation because of capacitive coupling between an input and an output circuit.

Intermittent Amplifier Noise

Q. I am having a problem with my portable stereo phonograph. At times it makes high-pitched, buzzing noises. When the noise starts, it can usually be stopped by banging with my fist on the top of the phonograph. The sound comes only from the main amplifier, therefore I assume it is a defective component in that section. Hum in the main amplifier seems to indicate the trouble can possibly be traced to a bad electrolytic or some other type of capacitor.

I have noticed that changing the main volume control from a high to a low setting reduces the volume of the buzzing noise and introduces noise of a lower frequency.

I think it is possibly a bad capacitor. I am puzzled that I am able to start and stop the noise by merely pounding on the phonograph. Joe H. Apple, Morgantown, West Virginia.

A. The buzzing and humming are probably caused by a bad electrolytic capacitor or by a bad tube. I can see where your puzzlement comes from since you probably assume that if a capacitor is bad it is bad and the condition cannot be reversed by shocking it. This is not true, however, of all defects possible in capacitors. I have seen a number of electrolytics which act in the manner you describe. The capacitor proper is probably good, but the contacts leading to the lugs or pigtails are poor. Thus, vibration influences the degree to which the active elements in the capacitors make contact to the "outside" circuit.

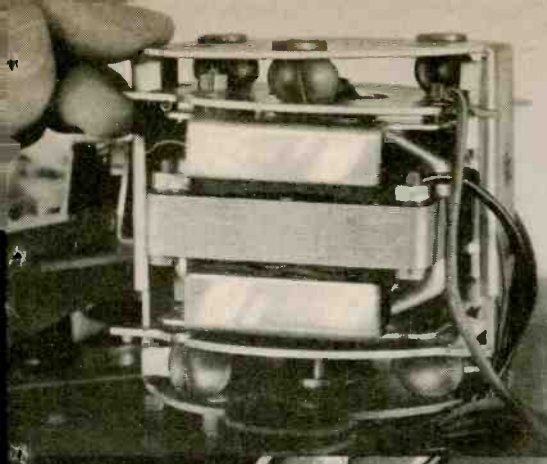
In addition, check the leads from the cartridge to make sure that there are no loose connections.

Further, check the solder connections in the unit as a whole. You may find "cold joints."

FM and TV Antennas

Q. My question concerns the variable of quality-versus-cost. TV and FM antenna costs range from almost nothing for the built-in unit, on up to "super-crossfire's" and "yagi's" with or without boosters, couplers, rotators, and so on . . . and there there is always UHF and AM.

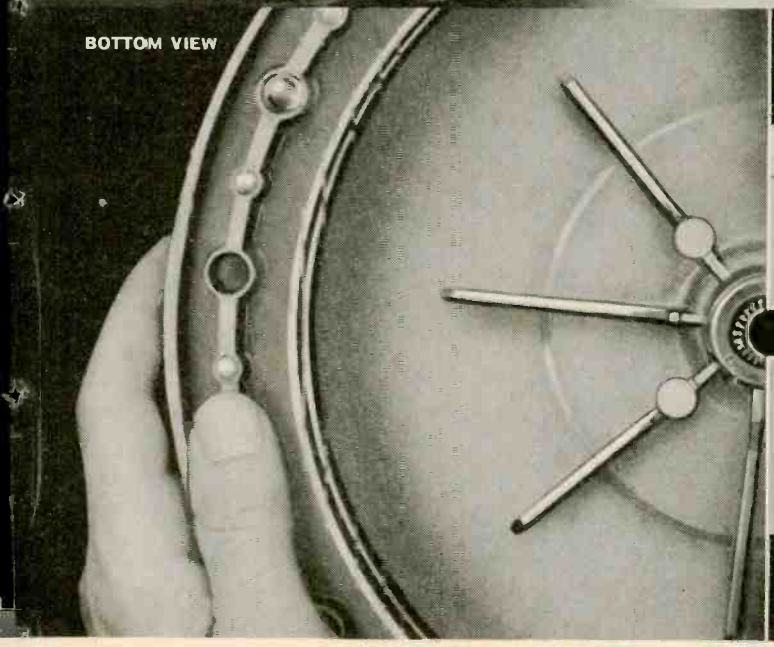
My specific question concerns mounting an FM, TV and UHF antenna on the same or separate masts, and what type of antennas to use. What I have in mind is a 19-element or a 28-element or "super-crossfire" TV yagi, and a parabolic UHF antenna, all mounted on a rotator—with or without a mast-mounted FM booster and UHF preamplifier. Naturally, two masts mean two rotators with these antennas, thus greater cost. Would it be practical, for example, to



Compatibility and the LAB 80...

From its Garrard-designed, Garrard-built Laboratory Series® motor...

to its 12 inch cast and balanced turntable



...every part of this entirely compatible motor/drive/turntable system contributes to the excellent performance of your records

To insure overall superiority, performing with the latest wide range speaker systems and highly refined amplifiers (including solid state transistorized equipment), the Lab 80 Automatic Transcription Turntable is built to an exceptionally high order of precision . . . each segment carefully inter-designed with the other related parts.

Separate though they may be in appearance and function, the Lab 80 motor, turntable, and drive mechanisms are actually a unified system . . . so meticulously engineered, and so silent, that they will not add the slightest noise or distortion at any frequency or volume level.

Constant, reliable speed, of course, is the first essential. Recent tests, now known to the entire industry, have confirmed the traditional Garrard viewpoint that the motor *type* (induction or hysteresis) is *not* the key to fine reproduction. Actually . . . it is *compatibility*—the correctly engineered relationship of the motor to the particular turntable/drive mechanism—plus meticulous manufacturing—which determines outstanding results.

The Lab 80 is powered by the unsurpassed Laboratory Series® shaded 4-pole motor (with dynamically balanced armature) designed and built *entirely* by Garrard. It will keep its speed within rigid NAB standards, even through the unlikely line voltage variation of 95 to 135 volts. The loose assumption or contention that only a hysteresis motor can maintain speed with such reliability is simply untrue. An ingenious suspension system of rubber anti-vibration devices and damping pads isolates the motor from the unit plate, and frees the Lab 80 from any vestige of vibration which might affect record reproduction.

But performance which begins with an excellent motor must be carried through to completion by an equally excellent turntable.

In the Lab 80, the non-magnetic cast turntable is 12 inches in diameter and extremely heavy. In itself, it is an impressive example of precision craftsmanship. Each individual turntable is statically and dynamically balanced to eliminate any possibility of wow (uneven musical pitch) or rumble . . . and to insure precise, constant speed through flywheel action. Every detail has been considered in its relationship to ideal performance.

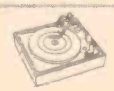
Even the lowly turntable mat is an example. It is formulated from a remarkable new anti-static material which tends to dissipate the electrical charge on records and prevent the accumulation of dust. Dust is one of the persistent causes of record wear as well as unwanted noise, and yet this obvious problem, until now, was not approached in even the finest transcription turntables.

The meticulous attention to precision in design and manufacturing . . . apparent in all the features which distinguish the Lab 80 . . . has established its compatibility with other advanced components, and will add to your satisfaction with the entire music system.

There's a Garrard for every high fidelity system.


LAB 80 $99.50


TYPE A70 $84.50


AT60 $59.50


MODEL 50 $44.50

Prices shown less base and cartridge.

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Canadian inquiries to Chas. W. Pointon, Ltd., 66 Racine Rd., Rexdale, Ontario. Territories other than U.S.A. and Canada to Garrard Engineering Ltd., Swindon, Wilts., England.

CIRCLE NO. 103 ON READER SERVICE CARD

mount the UHF antenna on top, then the TV antenna, and the FM (with booster) on the bottom? Lt. David J. Weisman, Camp Le Jeune, North Carolina.

A. In antenna specifications, it is usually true that the more elements there are on an array, the better the array will work. Therefore, it follows that the price for the better parasitic arrays will be higher than for those having fewer elements. It is not always necessary to use the best available antenna system. Sometimes a simple dipole will work very well indeed, whereas people living in fringe areas may have to resort to the finest possible antennas and boosters. If you can get by with a smaller antenna, there is no need to make a larger investment in time and money. In fact, it is possible to use an antenna which is so good that it results in overloading the front end of the tuner. This overloading will degrade the performance of the system. Furthermore, you can have the finest antenna; yet it will work poorly because of improper installation.

I am not familiar with your reception area for television and FM, therefore I cannot advise you as to the necessary antenna, nor can I advise you of the need for booster preamplifiers.

If you have good masting and if you can guy the mast above the rotator with a proper guy ring, you can place all of your antennas on a single mast. I recommend that you use nylon rope as guy line at least part of the way down from the masting above the rotator so that the guy line will not interfere with the performance of the antennas. The UHF antenna should go on top. The order of the TV and FM antennas is not particularly important.

The antennas should be spaced at least 7-feet apart on the mast, even wider spacing would be better. Therefore, you can see that this spacing makes for a tall structure when a single mast is used. Do not use television masting, and do not use telescoping sections or you may come to grief in strong winds. Use heavy-duty single-piece steel masting.

The rotator motor should also be guyed, and here you can use aluminum or other guy wire. You may also find it necessary to guy the center of the mast supporting the rotator.

When lining up your antenna, remember that the compass points to magnetic north, which differs from the true north by an amount determined by geographic location.

Rotator Contol Boxes at Various Locations

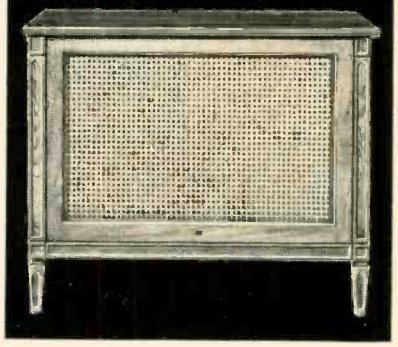
Q. I would like to connect a second control box to my rotator lead-in cable so that I can control antenna position from another location in my house. Is there a method of connecting both control units to one rotator cable so that both control boxes will operate correctly. If the two control units cannot work together, is there a method of transporting the one control unit from place to the other? Ira Lieberman, Brooklyn, New York.

A. If the transformer in the rotator box is the conventional two-winding type, not an auto transformer, you possibly can connect the two boxes as you wish to do. This is conditional, however. The boxes must be so constructed that when the rotator comes to the end of a rotation, there is no continuity between any terminals of the box. Check to be sure that there is no continuity between any of the rear terminals and the line plug. If all terminals are "open" when the rotator is at rest, you can use the two boxes to do what you want without switching. If you have continuity between any two terminals, you must switch between the two rotator boxes by way of a four-pole, double-throw rotary switch. This switch should be wired so that it changes rotator leads to either of the two boxes.

If you do not wish to use the switching arrangement and two control boxes,

(*Continued on page 47*)

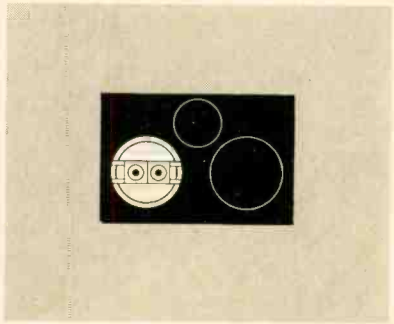
1965–
This is Bill Smith's New Bozak Speaker. It Cost $251*



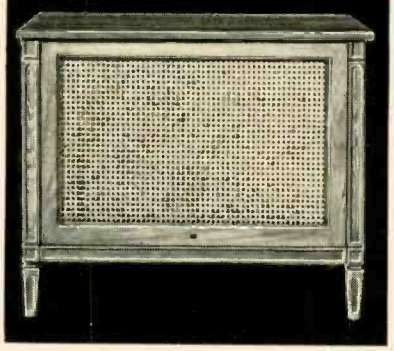
Though young and just getting a start in the business world, Bill has an ear for music. He wants the very best loudspeaker he can afford now, without losing his investment later.

His wife, Mary, wants furniture of which she can be proud.

Wisely, they choose the tasteful Italian Provincial enclosure designed to house a full Bozak B-305 speaker system. In it they have mounted a single two-way Bozak coaxial B-207A speaker.



1967–
This is Bill Smith's New Bozak Speaker. It Cost $94.50*

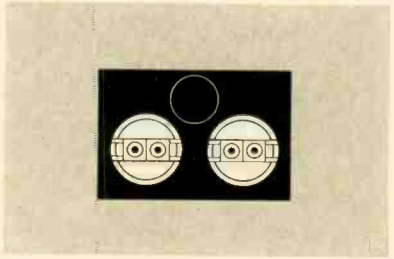


Things are going well. Bill and Mary just moved into a new house. Their living room is big enough to take advantage of a broadened sound source, with its increased realism.

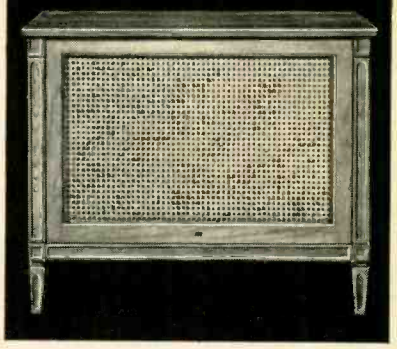
While both secretly believe it to be difficult to improve the sound from their Bozak, they add a second B-207A coaxial speaker.

It's easy — just remove a pre-cut panel and insert the speaker. Total cost $94.50.

To their surprise, they find a new measure of presence, of musical delight, in their Bozak.



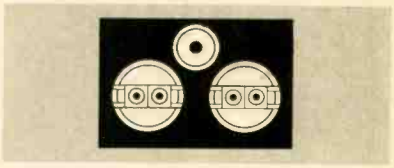
1969–
This is Bill Smith's New Bozak Speaker. It Cost $82.00*



Bill just had another raise. Mary completely refurnishes their home, but finds that the quiet dignity of the Bozak cabinet still adds charm to her living room.

They take the final step toward their dream of listening perfection. They convert their speakers to a three-way system by adding a Bozak B-209B mid-range speaker and a three-way crossover network. Again, they simply remove a panel and insert the speaker. Total cost, $82.00.

Now they have achieved their goal. They have the complete Bozak B-305 speaker system which they couldn't afford when they were first married. Meanwhile, they've enjoyed years of musical pleasure.



CAN LOUDSPEAKERS REALLY GROW?

Yes.

Thanks to Bozak's uncompromising policy of building all speaker components to the same high electrical and acoustical standards, to the same tonal values, you can add speaker elements to a Bozak system without fear of mismatch.

Thus, you can select the Bozak of your dreams today — even though you can't afford it — and build toward it as your needs increase. Meanwhile, your musical pleasure begins with the first Bozak component.

Why not gratify your musical taste — beginning now. Our catalog shows you how. Your dealer will prove it.

*All prices shown are current prices and are subject to change at any time. Prices slightly higher in the South and Far West.

Bozak

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LETTERS

A Small Carp

SIR:

It's very pleasant for a relatively new company to have its efforts noticed. It's especially pleasant when this notice takes the form of the very complimentary review Edward Tatnall Canby gave our stereo LP production, "The Sounds of Steelmaking," in your November issue.

If we may be permitted just one small carp—the review didn't get our name right. It's Hardman Associates.

KARL HARDMAN, PRESIDENT
Hardman Associates, Inc.
213 Smithfield Street
Pittsburgh, Penna. 15222

Hazy Speaker Specs

Sir:

Help, please! I am not a newcomer in the audio field, as I am a charter subscriber to AUDIO, its predecessor AUDIO ENGINEERING, and its predecessor RADIO. I have been building, installing, selling amplifiers and systems for almost thirty years. After all of this time and experience, I am almost ready to throw in the towel.

The problem is, the present-day hazy specifications on loudspeakers, loudspeaker systems, and so on, as to what their power requirements are to do a job, predictable in advance without having a cut and try situation for every different speaker. For example, the only solid information I have been able to find in print, recently, was in an article in your magazine in connection with the RCA Victor "Dynagroove" system, in which appeared the following clear statement, "The RCA LC1A loudspeaker will deliver sound levels of 80, 90, and 100 decibels in a typical living room for electrical inputs of 0.05, 0.5 and 5 watts respectively."

Why cannot manufacturers set down in print corresponding information with regard to their products? With the advent of low and super-low efficiency speakers, containing long throw and extra-long-throw voice coils, the sound technician who does not have access to the most elaborate sound-level measuring equipment and such simply does not know where he is as far as predicting the necessary power for a certain type of application. This is becoming the greatest problem when attempting to use speakers in commercial applications.

NORMAN L. HARPER
Norman Harper Electronics
Charleston, Missouri

Corrections to El Cheapo

Sir:

After AUDIO published my article, I discovered some corrections to the parts layout on page 21 of the November issue.

Diode D_2, as shown, is backwards. Its cathode should be opposite to those of D_1 and D_3. The schematic diagram is correct. The 20-μf capacitor should have its positive end adjacent to Q_3, and the unmarked 200-μf capacitor should have its + end at Q_1.

I have had numerous requests for information about power transformers, and have therefore discovered a supplier. The Signal 56-4 called for in the article may be purchased from Barry Electronics, 512 Broadway, New York, N. Y. 10012. This transformer is used in the 62v supply, and could be used in the 50v supply, as it has a tap at 42v. Barry might supply the MV-2.

RICHARD R. MOORE
3414 N.E. 53rd
Portland, Oregon 97213

Amplifier Power Rating

Sir:

How about using the following method to rate power amplifiers?

Sine-wave power out, before clipping, times reciprocal of I.M. distortion or T.H.D. from 20–20,000 cps, as in these examples:
10 w x 5% = 10 × 20 = 200 Hi-Fi units
20 w x 1% = 20 × 100 = 2000 Hi-Fi units
60 w x 0.5% = 60 × 200 = 12,000 Hi-Fi units

F. BUTTERFIELD
6 Second St.
Brooklawn, N.J.

THIS MONTH'S COVER

This month's cover installation is in the home of Richard L. Kesler of Olney, Illinois. He assembled this system over several years. Here are his own words:

"My present system represents eight years of buying and trading hi-fi components. From a very meager beginning as a high school senior, I have progressed this far. As you can see, I use a Dyna PAS-3, Sherwood S3000V, Concertone 505-4, and AR turntable. Not shown are an Dyna Stereo 70, a pair of AR2a's and an Empire 880P cartridge. Also included are a rotatable log periodic antenna, up 85 feet, headphones, Dust Bug, and two three-way systems in the den. This room also houses a 800-watt single sideband amateur radio station—another hobby! I am known as K9BTU in that world.

The Concertone is both custom mounted and portable. This was desirable for remote live recording, and it takes only a few minutes to pack up and be on location ready to record. This set up also satisfies my whim to have a built-in recorder.

"A word about the speaker enclosures might be in order. I wanted the sound of the AR speakers but I didn't want the small size. Therefore, I built larger boxes. Since I wanted the system to reach from wall to wall (12 feet) I tried to proportion them so they would look right with the equipment cabinet which I made six feet, finally. The large enclosures add much, psychologically at least, to the sound. My friends are usually amazed when I remove the grill fronts and uncover the small speakers!

"In our location, remote to say the least, FM multiplex is just beginning to take hold. (Actually most people here still use AM for listening to the ball games). Very few have ever heard good mono, much less stereo. However, we have managed to log 20 FM multiplex stations at one time or another. Actually, only about half or less are listenable, but I did log each one transmitting stereo. Much of this success is due to the antenna, I'm sure. I put the 76 foot tower up to support my three element ham antenna, and of course, it was a natural for FM, too. Æ

WHEN KOSS & REK-O-KUT PLEDGE THEMSELVES TO QUALITY, HERE'S WHAT THEY MEAN

When John C. Koss purchased control of Rek-O-Kut, he discussed "quality" with Sid Simonson (Rek-O-Kut Manufacturing Vice-President) and Hal Dennis (Rek-O-Kut Sales Vice President). "There's a reason why everyone thinks of Rek-O-Kut as the very finest in single-play turntables. There's a reason why every audio engineer in the business knows and respects Rek-O-Kut equipment," said Koss.

"The reason," Simonson explained, "is that for over 25 years, we paid particular attention to purchase of parts and raw materials. Then we tooled for absolute precision in machining and assembly. If something wasn't perfect, we scrapped it!"

"Good," said Koss, "that's what I do with our headphones and that's what I want continued with our turntables." And that's what is now being done at the Milwaukee plant.

KOSS PRO-4 STEREOPHONES $45.00

Truly a professional instrument. Frequency response: 30-20,000 cps. Impedance: 50 ohms to be used with 4, 8, or 16 ohm outputs. Fluid-filled ear cushions for positive seal and comfort over long listening periods. Highest quality drivers mounted in acoustically designed chambers provide unusually smooth frequency response. Equipped for boom mike attachment.

REK-O-KUT B-12H TURNTABLE $165.00

Three speed. Noise level: -59 db below average recording level. Wow and flutter: 0.085% RMS. Custom-built, heavy duty Hysteresis Synchronous motor for constant speed and "hush" performance. On-off signal indicator.

Write for complete details and specifications on all Koss and Rek-O-Kut products.

KOSS | REK-O-KUT

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ABOUT MUSIC

Harold Lawrence

Inauguration Concert

On Inauguration Eve a curious concert was performed at Washington's Constitution Hall. With the exception of songs from Gershwin's "Porgy and Bess," it was a concert that could have taken place nearly 100 years ago. Howard Mitchell led the National Symphony Orchestra in Beethoven's "Leonore" Overture No. 3; Isaac Stern was soloist in a pair of short works by Mozart and Saint-Saëns; Van Cliburn played the Liszt E-flat Concerto; and Todd Duncan and Theresa Coleman sang excerpts from Gershwin's opera. "When this program was announced," wrote Harold C. Schonberg in *The New York Times*, "there were raised eyebrows. Several journalists took off on the choice, wondering if more native composers might not have been found for so purely American a ceremony as a Presidential Inaugural."

Why did Mr. Mitchell and his advisers put together such a program? They said they wanted it to be 'serious,' but not serious enough to risk displeasing the kind of audience they were expecting. They had considered an all-American concert in keeping with the spirit of the occasion, but they settled for American soloists instead.

Stripped of its extra-musical connotations, the program was perfectly respectable. But, as Mr. Schonberg pointed out, "it is hard to escape the notion that [it] took the easy way out. For so peculiarly American an event, something equally American should have been prepared. Surely the body of American culture contains music that would stimulate an audience without boring or irritating it." The NSO's decision to cling to the tried-and-true parallels those made by most orchestras and conductors across the nation. But during Inaugural Week, who would have criticized the National Symphony for straying from the beaten path?

The "serious" Inaugural Concert was really a "pops" concert without the lemonade. It wouldn't have taken much imagination or daring to assemble a similar program of American music. Keep Van Cliburn, but have him play the MacDowell Piano Concerto No. 2, New World cousin of the Grieg Concerto. Start the program with, say, William Schuman's American Festival Overture, cap it with a Copland cowboy ballet, and throw in the Gershwin excerpts for good measure.

It is easy to cluck one's tongue over this snub to our American musical tradition. But was the audience at Constitution Hall distressed by the absence of native music on the program? Probably not. Some musical observers say that public lethargy is partly responsible for the lack of support of American symphonic music. Others lay the blame squarely on the conductor, especially the foreign conductor.

Ever since Gottlieb Graupner emigrated to the United States from Germany and took over the musical destinies of Boston in the early 19th century, European maestros have traditionally occupied most of the country's key conductorial posts. And they brought their special repertoire with them. As musical director of the New York Philharmonic, Arturo Toscanini, for instance, played more works by Italians than by any other composer or group of composers except Beethoven and Brahms. Nativistic tendencies can be spotted in the programs of many of today's U. S.-based foreign conductors. Why not? It makes good sense to hear Ravel's *Tombeau de Couperin* conducted by a Frenchman, or Nielsen's Third Symphony by a Scandinavian. The trouble is that time spent on unhackneyed foreign repertoire usually is lost to American works of equal interest.

The late conductor of the Boston Symphony Orchestra, Serge Koussevitzky, was an inspiring example of a foreign-born maestro who took an active and profound interest in American music. He launched five symphonies by Roy Harris, helped promote the works of William Schuman and Aaron Copland, and invited many others to compose for the Boston Symphony.

But Koussevitzky was an outstanding exception. A composer-publisher spokesman put it this way: "Conductors pay a great deal of lip service to American music; but when the chips are down, foreign music usually wins. There is a lack of commitment on the part of conductors that frequently keeps the American composer, past and present, waiting indefinitely in the wings. When he does get his chance, it's usually a one-shot affair. Examine the statistics of performances of works by Americans and you'll find that a new composition by even a prominent composer is seldom repeated. The audience may applaud like mad, but the likelihood is that it will not be heard again for many years.

"The phenomenon of the one-time symphony must have its effect on the composer, whose works inevitably take on an academic tone because he knows he is only composing for a 'premiere audience.' "

Practically speaking, what can be done to promote American music generally, and to give our contemporary symphonic composers better incentives than those offered by foundations and premiere-collecting maestros? More performances, of course. "It's about time we waved the flag," urged the composer-publisher representative. "There should be an American work on every symphonic program, wherever possible. If you look over the repertoire, you will find an astonishing range of expression, from such full-blown Romantic symphonists as MacDowell and Chadwick, to the most intricate *avant-garde* compositions. The average music lover would be surprised to learn how much American music is singable, whistleable, fun. It's a pity that conductors often go about programing contemporary music in the wrong way. The recent *avant-garde* series at the New York Philharmonic is a case in point. Abetted by the tongue-in-cheek introductions of Leonard Bernstein, it may have succeeded mainly in alienating the majority of the audience from all 'modern' music." Shock tactics like this lead nowhere. The public deserves more consideration.

Proof that the cause of American music has been poorly served by conductors and orchestras, and that the public at large is largely ignorant of our musical heritage may be found in *Variety* magazine's review of the Inaugural Concert. Reporter Leonard Levinson, after praising the half-hour excerpts from "Porgy and Bess," goes on to note: "It may be that there is nothing else composed by an American that qualifies as a classic worthy of inclusion in an Inaugural Concert today, although this reviewer doubts that." This from a publication that has no vested interest in American symphonic music. Æ

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InZide Audio

LARRY ZIDE

The subject of Audio shows, brought up in our December, 1964, column, certainly seems to be one that generates opinion. Diversified opinion. I have been praised on one hand, and thoroughly raked over the coals on the other. It certainly seems that everyone who goes to an audio show leaves it with at least one thought or idea for change. ("Improvement" they say.)

I believe the airing of different ideas to be a "Good Thing." Widespread discussion could result, at the very least, in *thought*. And action. From the discussion I've had and the mail I've received, it would seem that *some* action is needed. Perhaps.

Most of the *consumer* mail that the December column generated included comments about a single subject: the lack of technical people manning many of the audio rooms at shows. It is most frustrating to find that the only people available in a room are salesmen with limited technical knowledge.

At the same time, in defense of the manufacturer, it is not always possible to have engineering-oriented people on hand all of the time. Engineering departments are supposed to engineer products, not sell them. They cannot hope to continue functioning well if they have to give up two or three key personnel for a show. Therefore, a manufacturer may bring only one engineer to a show, and he simply can't be in the room all of the time, or speak to everybody when he is. This is a very real problem; manufacturers are aware of it. Being aware of a problem and solving it are two different things. Most firms simply cannot afford the obvious—to hire more engineers to attend shows.

Perhaps change is needed. It is quite possible that revisions in the basic concept of audio expositions can solve this, as well as other problems. (And, very possibly create new ones.) We are not suggesting that changing the show format *will* solve this. It may. Following, then, are a few voices on the topic of shows, each with personally valid ideas. Their statements will, I hope, invoke industry-wide contemplation. And that can only breed improvement.

Not Reaching the "Right" People

Empire Scientific Corporation is a well established firm, manufacturers of cartridges, turntables, and speakers. I discussed shows at length with Herb Horowitz, President of the firm and a former board member of the Institute of High Fidelity, and with Leon Kuby, Empire's Vice President, Sales. Both Mr. Horowitz and Mr. Kuby have had a considerable amount of experience with audio shows.

They believe in the basic concept of expositions. Mr. Kuby expressed the following specific points:

"There must be four key areas covered by full-scale audio shows: New York, Los Angeles, San Francisco, and Washington, D.C. The West Coast shows should be tied together, each to be presented for its respective length with a week or so between, to allow time for moving from one to the other. I believe that the New York and West Coast shows should be alternated on a yearly basis; one year New York, the next L.A.-S.F.

"As for the New York Show, it must move out of the Trade Show Building. The rooms there are impossible, the halls too narrow. We should try for a major motel or hotel in the city. Possibly the New York Coliseum would be suitable. The concept of these shows, basically unchanged for many years, needs a fresh approach. We need to devise a way to attract a larger segment of the public than we have done, thus far. Up to now, each year has seen similar types of demonstration directed to the same audience. This results in a narrowing circle where few new faces appear. The same people visit these shows year after year. There is nothing wrong with that if there is also something to attract new consumers. But there is not. The result seems to be a steady fallout of attendance as more and more people realize that we really have nothing new to offer year after year. So, we go around in an annual circle; each year it becomes a little smaller.

"We need a greater association with live music. Personalities of the caliber of a Leonard Bernstein and major singers, pop and classical. There must be linked entertainment of various kinds, possibly we can link these shows with other shows, hobby or home furnishing for example.

"There is also a secondary market area that must be covered, but not by audio shows as presently constituted. Individual manufacturers, or several cooperating firms, can offer consumer sales seminars where the public can meet the man-

(*Continued on page 54*)

A revolutionary tape recorder for the audio perfectionist

– from DYNACO, of course!

Have you ever wanted a recorder which could provide stereo reproduction closely comparable to professional consoles, with the convenience and flexibility of studio facilities in a functional, portable package? The Dynaco Beocord 2000, designed expressly for the U. S., and backed by Dynaco's full one year guarantee, is basically the same machine which Bang and Olufsen of Denmark has marketed in Europe for almost 2 years, drawing unparalleled critical acclaim. For the serious enthusiast, this recorder provides convenience and versatility beyond compare.

The basic purpose of a tape recorder—the ability to make a personal library of excellent source material—seems to have been overlooked recently. A tape machine is far more than a playback gadget. Serious recording of local instrumental groups or family activities is almost unknown today, because high quality facilities—recorder, microphones and mixer—have been beyond the economic reach of most recording enthusiasts. Now—with the Dynaco recorder—the situation has changed. The simplest live pickups can provide the finest quality program material which is the most stringent test of your music system.

Other recorders necessitate lugging microphone input stepup transformers, an equalizing control preamplifier, a mixer, and monitoring playback amplifiers to the recording session, as well as the tape transport. All of these, of comparably high quality, are built into the Dynaco recorder.

The outstanding performance of the Dynaco 2000 is available in the popular tape-saving 4 track version. Those of you who can afford the luxury of a 2 track record-playback system will be glad to know that this alternative, with concomitant advantages and even better signal-to-noise ratio, is available without extra cost—but there will be a slight wait.

TECHNICAL SPECIFICATIONS

Frequency Response:
±2 db, 40 to 16,000 cps at 7½ ips
±2 db, 40 to 12,000 cps at 3¾ ips
±2 db, 50 to 6,000 cps at 1⅞ ips

Wow and Flutter:	Peak to Peak	RMS
7½ ips	0.2%	0.075%
3¾ ips	0.3%	0.11%
1⅞ ips	0.5%	0.18%

Channel Separation: better than 45 db

Signal-to-Noise Ratio: better than 50 db.; ½ track better than 55 db.

Dimensions:
Console: 18" wide, 14½" deep, 9" high
Portable: 18" wide, 14" deep, 10" high

REVOLUTIONARY CONVENIENCE! No more reliance on high impedance mikes—enough sensitivity for the finest of the low impedance microphones. But perhaps you've guessed . . . B & O Dynamikes have earned a unique reputation for value among the professionals who owned recorders which could utilize these characteristically low impedance ribbon designs. However, it was a rare home recorder which could capitalize on their inherently superior sound. When used, though, they dramatically improved the taped sound of any quality recorder.

$498

The Model 200 stereo Dynamike achieves full separation with the inconspicuous installation and convenience of a single mike, and assures more natural sounding pickups with its smooth, wide frequency response, an ideal figure 8 pattern, and extraordinary polar response at all frequencies. And from a technical point of view, the superiority of single point pickups over spaced-mike techniques in creating a natural "curtain" of sound, as well as affording compatibility with FM stereo broadcasts, is clearly evident.

Three stereo mixing inputs (6 channels) with interchangeable plug-in preamplifiers enable easy conversion for multiple mikes, or other specialized uses, and utilize professional type slide potentiometers for smooth fading action, precise tracking, and lowest noise.

A built-in RIAA magnetic cartridge input enables easy mixing of commentary and musical selections when making your personal taped productions. Integral 8 watt per channel amplifiers can drive even low efficiency speakers to normal room levels, and a front panel jack accepts standard low impedance headphones.

REVOLUTIONARY FEATURES! All of the electronics are contained on 9 plug-in etched circuit modules, and the amplifier is easily separated from the transport mechanism for faster, easier maintenance. Both European and U. S. input and output connectors are provided for the utmost plug-in convenience. A push-pull 100KC bias oscillator for low waveform distortion, and integral multiplex filters assure the best FM stereo recording. There is provision for both high and low speed cueing, and an "instant stop" pause brake. There is never a possibility for a "click" when going in and out of the record mode, for the tape is completely clear of the heads when the record lock is actuated. An automatic solenoid stop is actuated on tape runout, or in the middle of the reel when foil tape is used. A built-in tape cleaner keeps the heads clean. A unique shield prevents "capstan wrap" of thin tapes. Dual auto-tension arms assure smooth winding, and maintain uniformly low tape handling tension throughout the reel. Naturally, there are no pressure pads on the record and playback heads—it uses lifters. And we've even included a die-cast splicing aid in the head cover.

REVOLUTIONARY PERFORMANCE! Smooth, extended response in both playback only (from alignment tape) and record-playback cycles. At 3¾ ips its reproduction accuracy will surprise you. Wow and flutter specs are exceptional on an RMS basis, but more significant are the really low peak-to-peak figures, rarely mentioned in recorder specifications.

The outstanding performance characteristic is its phenomenally low modulation noise, which is a full 10 db below other similar machines. This achievement, the result of exceptional tape control as it passes the heads and capstan, results in markedly improved delineation of instruments, and a clarity of reproduction which sounds to the ear as important as lower wow and flutter.

Tape handling is smooth and effortless—even with the thinnest tapes—proof of the superiority of single motor drive in 7-inch-reel machines. The carefully balanced drive system is best demonstrated by the capacity to shift instantaneously from fast forward to rewind, and back, without loops or excessive tension. An exclusive permanent capstan treatment permits locked-in tape control with relatively light capstan idler pressures. The capstan-flywheel assembly is dynamically balanced and machined on its own shaft to a tolerance of 1.5 microns.

REVOLUTIONARY FLEXIBILITY! Of course, the usual sound-on-sound and echo facilities are pushbutton actuated (and close head spacing keeps the echo effect from sounding ridiculous). The exclusive synchro monitor enables a soloist to make a self-accompanied stereo recording by making it possible to synchronize the second track precisely with a previously-recorded first track (it monitors the record head!), and facilitates slide-synchronization, which is simple with the accessory B & O Synchrobox. Full controls are provided to enable the recorder's use as the nucleus of a complete music system.

Oh, yes! It's solidly solid-state! Exclusive electronic transistor protection circuits prevent problems due to shorted speaker terminals. But transistorized or not, this is no lightweight. A rugged chassis and quality parts add pounds, and this tips the scales at 38. We didn't cut corners to impress you with portability.

If you would like a detailed analysis of this revolutionary recorder, just request it on a postcard, and it will be sent along with the literature. See this machine now at your tape recorder specialist's showroom before you consider any purchase.

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AUDIO ETC.

Edward Tatnall Canby

A "Permanente" for U. S. Hi Fi?

An odd little train of thought was set off in me this morning by a boiled egg. It was a big boiled egg, the sort that only the good old U.S. seems to find desirable these days, as witness my egg cup. (I should explain I eat boiled eggs in the shell, no other way.) Also a kind of egg cosy. This involves the strangest sequence of ideas, ranging from an exhibition in Denmark to the principle of the V-Groove.

As for the V-groove, its simple. I have a set of nice little egg cups, rather fancy china, which are shaped to fit the egg, more or less. Very pretty and they once must have been quite practical. No more. The eggs we buy now simply won't fit in them. It happens, though, that in the 1930's my brother bought himself a rakish modern set of 1930-style cordial glasses, banded with red metallic stripes and shaped in a streamlined V. Somehow, I got hold of two or three of them (probably when he was off in the army) and they are still around. They make absolutely ideal egg cups. Ideal? Exactly! Because no matter what the size of my boiled egg, it always fits. Like the stylus in the V-groove.

But this wasn't the primary idea that came out of my boiled egg. When I was in Denmark in 1956 I visited a fabulous exposition in Copenhagen called the *Permanente*—"The Permanent"—at which, among other things, I acquired for myself a little set of tricky egg cosies. (You know what a tea cosy is: an insulating potholder thing that fits over a teapot to keep it hot.) What a nice idea, I thought. Now, if the phone rings just as my egg comes out of its boiling water, I can drop an egg cosy on it and the egg will still be warm when I finish my phone biz the usual half hour later.

Nice idea but it didn't work out. The egg cosies were too small. Like my old egg cups, they were shaped to fit. To fit little eggs. Wouldn't even cover the end of one of our giants. The cosies were rounded, too, not V-shaped. So that was that.

A Place to Order

The *Permanente,* though, is something else again and (here I come to the point) here is an idea that we should seriously consider ourselves. Specifically, an idea for people in the component industry.

The *Permanente* is a permanent exposition of Danish consumer products of all from many manufacturers, housed in a splendidly ornamental modern building, the displays tricked out with the most seductively up-to-date decor and arrangement. A superb place to visit and browse—a museum-exposition all in one. AND a marvelous place to *order*. Aha! That's the big deal.

The *Permanente,* if I'm right, is government-operated. It is not unlike the national exhibits we find at the various World's Fairs, except that this is a home-products exhibit, in its own country. The many exhibits are, if I'm right again, not managed by their own makers in so many "booths," as is the inveterate American way of doing things; instead, the Permanente is like a modern department store crossed with an exposition. It has its own employees, sets up its own displays.

But what is best about this permanent show is that *everything is for sale,* and on the spot. Not to carry out, but strictly via order. You can *order* anything—the prices are all right there—and the *Permanente* will ship it to you direct, wherever you are. My egg cosies and some folded-paper lampshades arrived in the U. S. quite handily just after my return home. Very pleasant.

You see, we in our exhibitions tend to straddle the fence and fall down flat on both sides. On the one hand, we make an awful sales ballyhoo, every producer setting up his own display and stridently trying to outblast his neighbor, with precious few ground rules to keep away utter chaos. It's tiring and people do resent it. And yet—On the other hand, if somebody actually pulls out a pocketbook and says, right out loud, *I want THAT, right now,* pointing hard, we suddenly go all prudish. Oh no-no-no. Never, *never*. Our goods aren't for *sale,* or anything like that. Just to look at and listen to. What a frustrating sort of double-talk!

Now at the *Permanente* in Copenhagen if you take a fancy to a piece of goods you just call the nearest attendant and say *I want THAT, right now,* pointing hard. And she says certainly sir! Or certainly, madam! (In English, too.) May I take your order? We will ship immediately. We will manage all the complications. The goods will go directly to your home. Thank you, sir. Thank *you,* madam.

Now keep in mind that this "saleslady" belongs to the Permanente management. She doesn't represent the product maker. She is as impartial as a department store sales gal. (But much better informed, I'd say.) Keep in mind, too, that this exhibit is as "permanent" as a department store, too. It's not a temporary show. It keeps going. And finally, keep in mind that it is run *entirely*—including sales and demonstrations and exhibits, by its own management. No "exhibitors" allowed. Just their products.

Ah yes, I know. It's against our principles to do things in any such quietly restrained fashion. What would we do without the big ballyhoo, the strident sales talk? (And how about the dealers—we can't by-pass them?) And yet—

And yet, I think, we would do well to try for an American equivalent, modified to suit our needs. If for instance the IHF would just get up its dander and enterprise, it could do a marvelous prestige job for hi-fi componentry in this fashion. A *permanent* hi-fi exhibit, put on in style to match the best, with every sort of elegance of decor, with sound, too, if you want. Why not? BUT managed *entirely* by a central management to bet set up by the Institute itself, not by individual exhibitors. Attendants—yes. All you want. But they would be management attendants, not manufacturers' representatives, not dealers. *And every single item would be for sale, on the spot*—via ordering. Impulse buying! It would thrive.

By-pass the dealers? No problem. There's plenty of precedent for a desirable procedure. The orders would be taken down, paid for in cash (or maybe charged in standard fashion, perhaps via American Express, Diners Club, and such) and credited to the local dealer. Technically it would be his sale. Even if, for convenience, the goods were to be shipped direct from the various factories or warehouses.

Knitting Needles

Oh yes, I know. A million reasons, too, why it couldn't possibly work. There always are. Who would decide which items to show, and in which desirable position? (Well—somebody does something about *that* in Denmark, you may be sure.) Which dealer gets the credit? Etcetc. Yes, I know. Petty bickering would break out in minutes. Intra-industry jealousies right and left. Makers would be sore because speaker A got placed 2 in. forward of speaker B, and amplifier C was turned up 1 db louder than amplifier D. UNFAIR! ! Dealers would squawk because

(*Continued on page 62*)

GOTHAM ANNOUNCES

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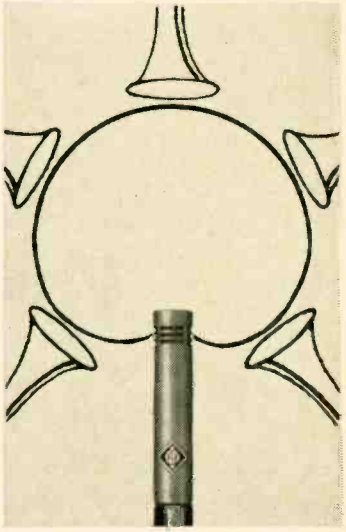
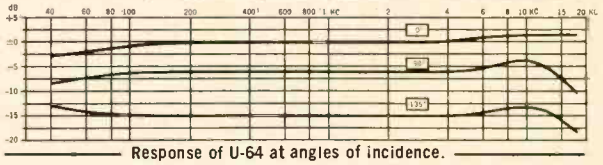
You may ask "Why does that flexible studio 'work horse,' the U-67, even need a partner?" Let us explain in detail.

THE INDUSTRY RESPECTED **U-67**: This microphone, first introduced in 1961, is NEUMANN's answer to a number of demands growing out of today's operating methods and recording vogues. The need here is for a microphone capable of linear response for a sound source even inches away from the microphone element, leading to: A sharp 40 cps cut-off to suppress "popping" at this distance; a further low end switchable attenuation; overload protection to extend its 100 dB dynamic range; all three patterns to cover many unpredictable eventualities in the studio; and a standard tube type (the EF-86) for simple local replacement. The unprecedented sales record of the U-67 testifies to NEUMANN's accurate interpretation of what our Industry had desperately needed. The ridiculously low repair rate attests to its reliability and ruggedness in 'round-the-clock use.

MEET THE NEW PARTNER—THE LINEAR ADMITTANCE **U-64**! Again demonstrating its foresight, the NEUMANN Engineering Department has applied itself since 1960 to the solution of another long standing studio problem—designing a condenser microphone element that would come closer to the ideal cardioid pattern *at all frequencies* in the spectrum—not just in the midrange. Such a microphone would permit a greater working distance from instrumentalists resulting in a better sound perspective. Bear in mind that there are two ways of evaluating a directional microphone. 1) How dead is it to sounds other than from its front? and 2) How flat is its response to sounds emanating from directions other than directly in front? At very close range (Say less than 2 feet) point 1 is more important, for you are then concerned entirely with a pick up directly at the microphone's axis of maximum sensitivity where it has flat response. What happens, though, when you get farther away from your sound source and try to cover an entire string section, saxophone group, or get a better perspective on a piano pick up? The answer is that you must consider what the frequency response (i.e., sound quality) will be for a performer at 45, 90 or even 135 degrees from dead ahead of the microphone. NEUMANN has solved this problem with the U-64 linear admittance cardioid condenser microphone! Now the off axis sax player will be heard with the same linear response as the one directly in front, and string players in the back row sound the same as those with the direct shot at the mike. With the new U-64 you can henceforth enjoy the benefits which come only from a diversity of distances between performers and microphones.



TECHNICAL DATA	U-64	U-67
Frequency Response:	40-18,000 cps	40-16,000 cps
Capsule Construction:	Vacuum gold steamed Mylar® diaphragm with acoustical delay network	Same but two diaphragms
Directional Characteristic:	Cardioid	Cardioid-Omni-Figure 8
Overload Protection:	Built-in 14dB, switchable	Same
Distortion, Harmonic:	<0.5% to 120 dB SPL (to 134 dB with overload protection)	Same
Effective Output Level:	−43 dBm re 10 dyne/cm²	−48 dBm re 10 dyne/cm² (with built in pad)
Self Noise Level (DIN 45405):	<29 phon	<26 phon
Amplifier Complement:	RCA Nuvistor type 7586	EF-86 / 6CF8
Connectors:	Cannon XLR series throughout	XLR output connector
Power Supply:	a) N6u single unit supply (portable) b) N62u dual unit supply (portable) c) N66 19" rack mounted to power six U-64 units in permanently wired installations	NU-67 single unit supply (portable) NUK single unit plug-in type for rack frame
Finish:	Standard matte satin chrome or non-reflecting dark gray	Standard matte satin chrome
Microphone Size:	7/8" diam. x 4"	2¼" diam. x 7⅞"
Power Supply Size:	a) 8¾" x 4" x 4" b) 8¾" x 4" x 4" c) Standard 19" rack x 3½" high	8¾" x 4" x 4"



Response of U-64 at angles of incidence.

	U-64	U-67
Accessories Available:	Z-118 Wind Screen Z-38 Elastic Suspension Z-68 Auditorium Hanger UC-11 Extension Cables in 25, 50, and 100 ft. lengths UC type bulk cable for permanent installation wiring.	Z-67 Wind Screen Z-48 Elastic Suspension UC-5 Extension Cables in 25, 50 and 100 ft. lengths

If your microphone problems are outside the studio or if you need information on the applicability of NEUMANN's other condenser microphone types, our Engineering Department is always available for consultation. No obligation, of course.

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Valle del Locomotora de Vapor
Mobile Fidelity MF 14

The Valley of Steam Locomotives mentioned in the title of this latest Mobile Fidelity album is to be found in Mexico. Steam enthusiasts are well aware of the fact that steam locomotives are darn near impossible to find in this country still doing the work for which they were designed. The past decade has seen Mobile Fidelity and other labels specializing in steam take their recording equipment into areas increasingly remote from "civilization" in order to capture the last sounds of these full-throated beasts of burden. The search has brought into prominence small regional rail lines scarcely known to the residents of the areas they happened to serve. The expensive and back-breaking job of recording the last engines of the steam era has been a race against time. As stereo recording techniques improved, producers such as MF bent upon turning out the best possible technical job found themselves with less and less to record. It will gratify sound fans to learn that this two-record album, sonically the best to date from Mobile Fidelity, has a large and willing cast of locomotives belonging to the Queretaro Division of National Railways of Mexico. Although much of our southern neighbor has been dieselized by now, MF found in the late summer and fall of 1964 a sizeable group of large, American-built steam locomotives working out of the 32-stall roundhouse of the Valle de Mexico yard a few miles north of Mexico City. This yard and Tula, a division point to the north, provide the setting for a truly outstanding recording. For some of the extra frills, whistle artists south of the border can hold their own with any U.S. cabman. Where this recording really shines is in the reproduction of the transients of escaping steam and the really low bass created only when a large moving locomotive snuggles down to the rails. The use of Polymax in the pressings permits a dynamic range rivaling that of the master tape. When the trains recede in the distance, surface noise is still inaudible on this record even at points where the sound source was too distant to kick the recording engineer's VU meter. There are three episodes in this album I particularly enjoyed. The amazing collection of the subtle hisses of an engine in closeup is the best I've heard on disc or tape. The stereo-surround perspective when the mikes are placed in the locomotive cab is an uncanny effect. Finally, for indoor stereo atmosphere on a grand scale, the closing scene of the locomotives coming to rest in their roundhouse is a sonic jewel of its kind. Don't miss this one.

Allan Sherman: For Swingin' Livers Only
Warner Bros. Tape WSTC 1569

Certain albums to be used whenever the gang drops in for a party are sure to have a longer life if you get them in the more durable tape form. Allan Sherman is still riding high in popularity with his cleverly paraphrased comedy songs so there is sure to be someone in the crowd who will want to hear this album for the umpteenth time. There's no better way to keep Sherman's routines sounding fresh than with this crisply-processed Ampex tape taken from a bright Warner Bros. master. Possibly because he doesn't push as hard as some comics, Sherman is sure fire here in quite a high percentage of these songs. I found him at his best in *Beautiful Teamsters,* based on Stephen Foster's *Beautiful Dreamer,* and the highly topical *Shine On, Harvey Bloom*—said Mr. Bloom being an astronaut already upon the moon.

Breedlove 500+
Capitol KAO 2175

This record promises more in exotic sound than it delivers. It's a documentary report on Craig Breedlove's jet car as it smashed the land speed record last fall. Of the major labels, Capitol Records has jockeyed itself into a leading position in the coverage of car races of every sort. When Breedlove was ready to undertake trial runs in his jet-powered Spirit of America on the Utah salt flats, Capitol producer Jim Economides was assigned to cover the events. Talk, both before and after the actual runs, takes up most of this record, a lot of it devoted to the wild chatter that followed the watery crash of the car after the 500 mile per hour record had been broken. The car itself has few surprises in sound since it is no more than a jet plane cruising on land.

The Coon-Sanders Nighthawks
RCA Victor LPV 511

The latest tidbit from RCA's Vintage Series is a bit of a letdown after the recent Isham Jones recording from the early dance band era. Any accredited radio fan of the late Twenties and early Thirties was certainly familiar with both of these great bands. The Coon-Sanders orchestra occupies a special niche in the history of broadcasting for its pioneering work as an air dance band. Having enjoyed their broadcasts when radio was a comparative novelty, perhaps I was expecting too much of the Coon-Sanders organization upon hearing it now. The Nighthawks led by Carleton Coon and Joe Sanders just don't sound as exciting as they once used to over the air. Could it be that network transmissions in those days, despite the limited range of the phone lines, provided a more convincing replica of a dance band than recordings made at the same time? My guess would be that the acoustics of the ballrooms heard in the broadcasts made the difference, being so much livelier in nature than the "padded cells" used for recording studios. Four cities figure as recording locales in this disc—Chicago, Kansas City, Camden and New York. In all of them, RCA Victor obviously maintained studios of identical deadness. Quite apart from any difference in acoustics, I'm sure I recall more nonchalance and joie de vivre in the broadcasts than the Nighthawks exhibited when recording *Wabash Blues, Here Comes My Ball and Chain or Keepin' out of Mischief Now.* The album is a good reminder, none the less, of an era when the midwest had far greater influence on American entertainment than it does now.

Luau at Waikiki
RCA Victor LSP 2885

Don't look for the simple Hawaii of former years in this on-the-spot recording from RCA Victor. If the dual cover of this album is an indication, commercialism has really come into flower on the major islands. Prominent on the front jacket of the disc is the emblem of the Hilton Hawaiian Village, "the fun resort," where RCA's crew taped a performance of a floor show. The bottom of the album cover has a plug for United Airlines. Once the customer gets past the reef of commercials in this project, the entertainment itself is innocent enough as native singers and dancers take over the spotlight. The singing master of ceremonies is the valiantly effervescent Ray Kinney, long a fixture on the Hawaiian tourist entertainment scene.

Eddie Cantor Sings
RCA Camden CAS 870

This new Camden release should easily go to the head of the list as a definitive recording of the old master lighting up his famous songs. The disc doesn't have the reminiscences of his fabulous career found in his New York concert appearance taped a few years ago by Audio Fidelity (AF 702). On the other hand, the voice here is still vintage Cantor, untouched by time as it was on the AF disc. The collection includes just about every tune Eddie made his own in vaudeville, Broadway musicals, films, radio and television. Unlike other equally irreplaceable performers, Cantor has left behind a comprehensive recorded collection of his best work.

Three Penny Opera (Original Soundtrack Recording)
RCA Victor LSO 1086

American theatre audiences first became aware of Kurt Weill's "Three Penny Opera" in 1954, shortly after the "off-Broadway" theatrical movement got underway in New York City. Marc Blitzstein's English translation of the original text by Bertolt Brecht had been produced for the first time in concert form at Brandeis University under the direction of Leonard Bernstein on June 14, 1952 but it was the long-running Theatre de Lys production off-Broadway that established the show and its hit tune, *Mack the Knife.* First produced in Berlin in 1928, this German view of the crime-infested London slums at the time of Queen Victoria's coronation has never lacked for interesting recordings of its acidly cynical score—many of them now deleted from the catalog. For years the M-G-M album by the Theatre de Lys cast (E 3121) was the leading recording of the show until Columbia Records issued a complete German version in 1958 with Lotte Lenya, the composer's wife, playing the role she had created in 1928 and at the Theatre de Lys. Anyone familiar with the easily raffish style of the earlier recordings will be disappointed in this soundtrack release. Only Sammy Davis as The Streetsinger approaches the spirit of the original in his blithe treatment of *Mack the Knife.* Martha Schlamme's voice is heard in a rather bland rendition of Jenny's songs. Despite the fact that musical direction in the film is handled by the same Samuel Matlovsky who served as conductor in the 1954 New York production and the M-G-M original cast recording, this sound track simply doesn't catch fire.

Al Hirt and the Boston Pops
RCA Victor LSC 2729

This recording would have been an interesting sonic experience back in the days when RCA was producing a stereo disc with a relatively full range of frequencies and dynamics. Someone had a bright idea in combining the pop trumpet of Al Hirt with the orchestral drive of the 93-piece Boston Pops in an ambitious program ranging from a Haydn Trumpet Concerto to the hit tune, *Java.* Exotic touches were added with *Eili, Eili* and *La Virgen de la Macarena* from "The Brave Bulls." Richard Hayman's arrangement of "Carnival of Venice" vies with several well known Leroy Anderson favorites for trumpet and orchestra. Yet the results do not come up to the promise of the program on paper. On this weak-in-bass disc the orchestra only faintly suggests the bite and impact of the big numbers as they were heard in Boston's Symphony Hall. Hirt, more than a bit awed by the surroundings, almost rises to the occasion in his spotlight work. The best trumpet sound is displayed (a result of more distant miking?) when the soloist is joined by trumpeters Robert Mogilnicki and Andre Come of the Pops' brass section in a bristling version of *Bugler's Holiday.* In sound and the playing of the soloist, this is a blockbuster that failed to explode. AE

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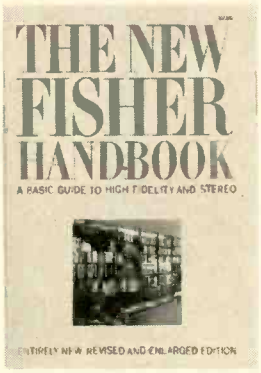

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EDITOR'S REVIEW

A Skeptical Friend

The theme of the Los Angeles High Fidelity Music Show is "Bring a Skeptical Friend." That's him you see at right. Mr. Skeptical Friend in the square. This year the L.A. Show occupies the same elegant stand it has for many years, The Ambassador Hotel on Wilshire Boulevard. Show dates are Wednesday, March 10 through Sunday, March 14. Show hours are 3:00 to 10:30 p.m. Wednesday through Friday, 12:00 noon to 10:30 p.m. on Saturday, and 11:00 a.m. to 6:00 p.m. on Sunday.

The theme of this show is exceptionally appropriate this year, pinpointing clearly the attitude of so many "friends" about high fidelity.

"Hi Fi," they say "sure I heard about it. Its expensive and the Zilch Consolette sounds almost as good at lots less. I heard you gotta be a nut to go for that stuff."

That's the guy we mean. Old Charlie Skeptical.

Bring him to the Show and let him hear why the Zilch will never give him what good components can give him. Stack the cards a little. Try to take him when the exhibits aren't too crowded and ask the people manning the room to crank up the gain. Make sure its the type of music he likes and is familiar with. If that doesn't convince him, forget him; he wasn't much of a friend anyhow.

But suppose he likes it and his "better ⅔" doesn't? Simple. If, after looking at the many handsome designs and custom potential of components, she still prefers the French Doric of the Zilch, just forget it. After all, your problem is your friend, but your friend's wife is *his* problem. Wish him luck with his French Doric.

For those interested and able to bring a skeptical friend to the L.A. Show, we have presented a list of exhibitors on page 48 of this issue. Read it and steer your friend to the right places.

By the way, for those unable to attend the Show, why don't you drag a skeptical friend to your local Hi Fi Emporium and deal from the same deck? What better way is there to tell who your real friends are?

THE CASE OF THE MISSING ARTICLE

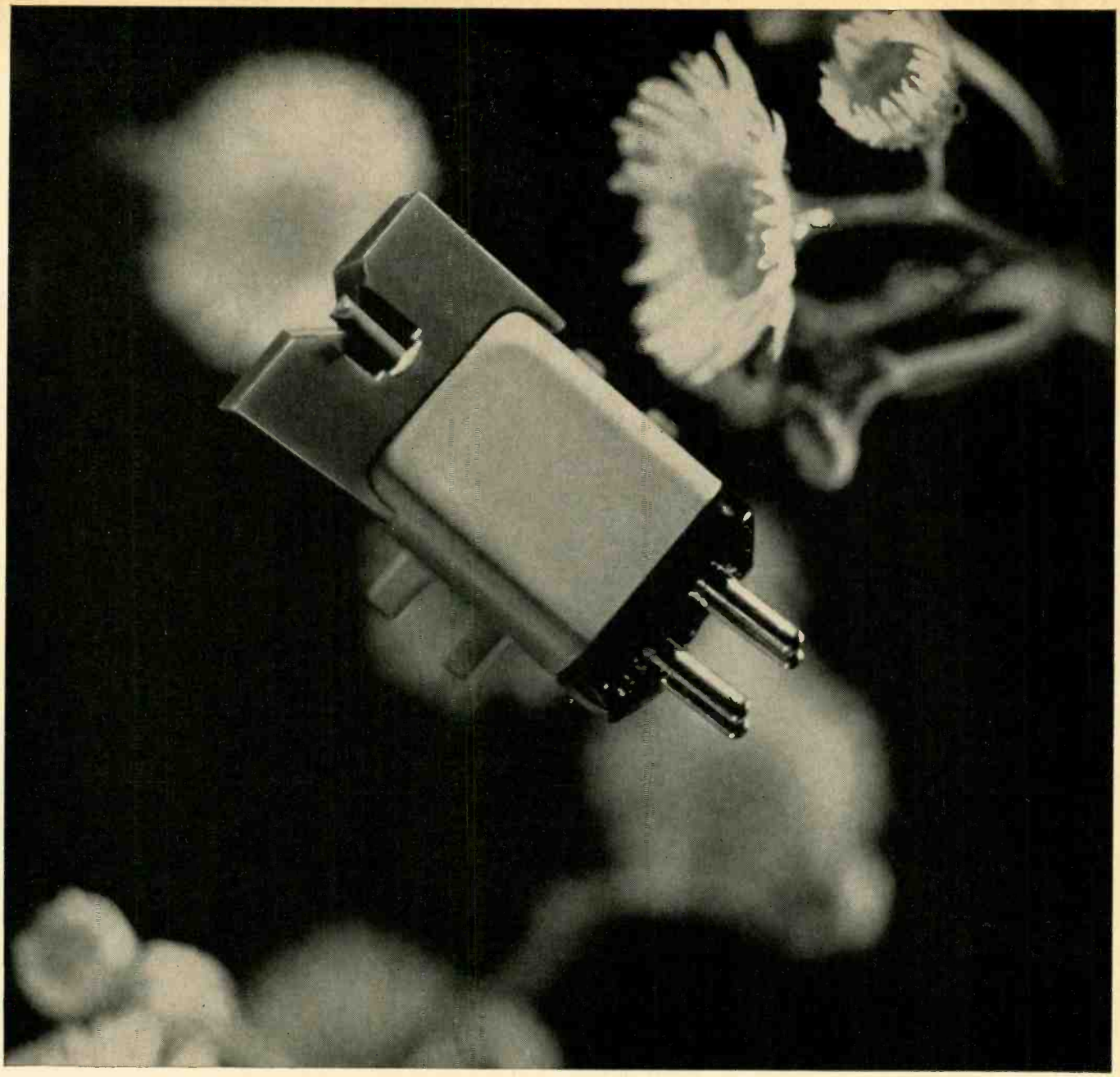
Last month we announced that we would present an article concerning a calibrated stereo control unit. The implication was that it would appear in this issue. It doesn't.

Why?

Well, that article turned out to be quite long. Much longer than we had room for. In March, that is.

We will present it in April. Even if we have to print it in 3-point type. It is a good article, well worth waiting for. (But 3-point type?)

While we're on this topic, we would like to explain why we occasionally miss a cue on Equipment Profiles. Some of you have noticed that several Profiles, which were announced, appeared late. One *never* appeared. In the later case, the product ceased to be manufactured. Of course it would have been silly to profile a product which was no longer available. In the cases where a profile turned up late, we ran into technical difficulties. Either we received a defective product (in one case it was damaged in shipping, in another the wrong product arrived), or something went wrong at the last minute. Be assured of one thing, if we announce that a product will be profiled, it will be (as long as it is still available).



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A La Pi-Mode

And I Tiresias have foresuffered all.

GEORGE FLETCHER COOPER

PENTODES OR TRIODES, tubes or transistors, silicon or germanium: the debate goes on, but away from the public discussion the men in smoke-filled back rooms are making their plans for the next few years ahead. We shall not get too far out of line with them, because what they decide will fix the price and availability of the devices. We shall say again, as we said when we gave up horns, or triodes:

Well now that's done: and I'm glad it's over.

I have no doubt that there are some readers who will have to be dragged, screaming, into the transistor age, and I don't doubt that their screams will be reproduced as Letters to the Editor. In case anyone is interested in my view, most of these arguments seem to me to be nonsense: each device, each design, will provide a bumper bundle of difficulties and I cannot see any way in which we can reach general agreement on the relative difficulty of getting 5 db more feedback or 5-deg C higher permitted ambient temperature. We must, I feel, rely on what in some political circles is called "obtaining the consensus of opinion," which means that everyone stabs everyone else in the back and the last man still standing is the popular choice. Right now the trend, as the psephologists say, is to transistors. Which circuit is to be the leader?

At moderate power levels the quasi-complementary half-bridge circuit described quite a long time ago (*Electronics*, Sept. 1956) by H. C. Lin is, with all the variations the years have brought, the general favorite. Some time ago, however, I attended a listening test which compared an amplifier of this kind with an amplifier of the same rating, using the same transistors, but operating in a rather different way. We also listened to a couple of tube amplifiers. The voting showed that the new circuit did show up as a better amplifier.

The π-mode class AB output stage amplifier was designed by Tharma and Osborne of Mullards Ltd., and it is, of course, the output stage which is of chief interest in the design of audio amplifiers. The output of this particular design is 10 w, and this means 10 w of sine wave. By American standards this is rather low, although the Mullard theatre holds more people than I can afford to buy drinks for, and we were all happy with the level of the 10 + 10 w stereo.

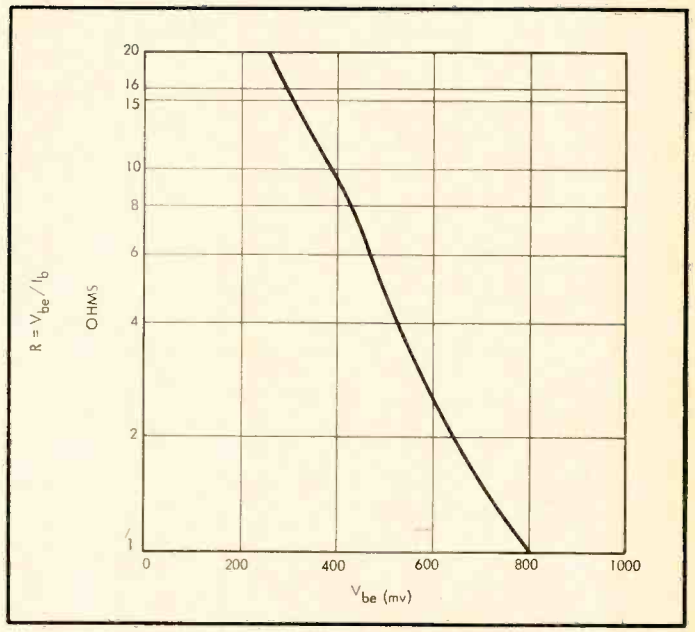

Fig. 1. Base resistance for a power transistor.

Anyway, what is π-mode class AB? It is a transistor circuit mode of operation in which the total d.c. current is independent of the drive. The transistors operate in class A push-pull for power levels up to about 40 per cent of full output. Even if you are aiming to get 10 w out at full modulation it is only when the composer calls for fortissimmo that the amplifier will move out of the class-A condition and the neighbours will move out of their apartments. However, as the drive is increased the operating point is shifted and the transistors float down through the class-AB region until at full output they are operating in class B.

The advantages claimed for this mode of operation by Tharma and Osborne are:

1. Absence of crossover distortion associated with class-B operation;
2. Very low distortion at normal levels because of the class-A operation;
3. Very simple power supply arrangements because of the constant current drain; and
4. The transistors are not damaged if the output is short-circuited. The circuit is much safer than a class-B circuit.

When we assess the meaning of these four claims we first notice that as the drive increases we shift towards class-B, and then on to class-C operation. The first claim amounts to saying that the class-B condition is the absolute limit which we approach but do not reach. There is always some overlap between the two transistors.

The simplicity of the power supply can easily be over-rated. Many transistor amplifiers use a power transistor in the supply system to provide regulation, and if the elimination of this transistor leads to undue complication elsewhere we are not necessarily any better off. What we have in this circuit is a strong element of local negative feedback which eliminates the class-B "rectification into the supply" effect.

Do you have the sort of installation which we see, month after month, on the cover of AUDIO? If you have, instead, the bare amplifier, the trailing wires, which I see in some homes you will appreciate the advantages of the fourth claim. On the other hand, the *value* of this feature is really rather small. We can see this by guessing some numbers. Suppose that one amplifier in every 100 is subjected, during its working life, to a short-circuit across the output when fairly full drive is applied. What fairly full drive amounts to depends on the detail of the feedback path: it can, in fact, be what we should normally call a small drive. Suppose that this causes $10 of damage to a conventional class-B stage. The cost per amplifier is then only 10 cents and if

you spend more than this on preventing the trouble you are not an engineer. A fairer analysis puts in a money value for the annoyance of having the amplifier out of commission and a few more factors you can dream up for yourself. Although calculations of this kind involve a good deal of guess-work, they do help you to keep some sense of proportion.

The real heart of the matter is the "soft" characteristic which class-A operation, at most levels, ensures. We know that there is no risk of the distortion rising at low levels, as there is when we use class-B. I suspect that this is a very important factor in judging the subjective effect of distortion on program material. Let us, however, turn to the circuit itself.

The transfer characteristic of a simplified transistor, the collector current—base voltage curve, is exponential in shape. We can attribute this to a combination of constant current gain and an exponential voltage-current relationship in the emitter diode. In any practical circuit using a practical transistor we cannot apply the drive voltage, as such, to this exponential diode. Inside the transistor there is some additional base resistance, which is assumed to be constant: outside the transistor there is the source resistance of the driver stage. If we actually wanted an exponential characteristic we could use a mixture of negative and positive feedback to make the driver have a source impedance of $-r_{bb}^{1}$, but that would be a rather odd thing to want, anyway. The practical source impedance will linearize the characteristic for values of the emitter diode current above the point where the exponential resistance can be, roughly speaking, neglected in comparison with the total source resistance. There is a short transition region between the linear region and cut-off.

It is not too difficult to find where this transition will lie. In *Fig.* 1, I have obtained, by working from a power transistor input curve, the exponential (a straight line on a log scale) resistance characteristic. With a 4-ohm source the take-over should lie in the region of 500 mv (V_{be}). Just for completeness' sake we may note that this corresponds to 1 amp of collector current through a 6-amp transistor.

We must go back a step. A smooth exponential characteristic looks quite like a parabolic characteristic and Tharma and Osborne hint that if we had zero source impedance we should be happy fitting the two exponentials of our push-pull stage together. They suggest that it is a small amount of linearization that is undesirable. As it stands this does not seem to be a reasonable conclusion, but I think that

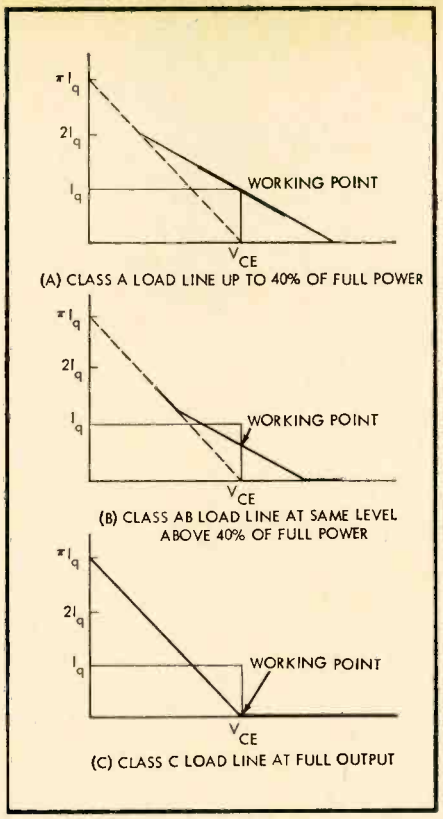

Fig. 2. The load line for a π-mode stage moves as the drive is increased.

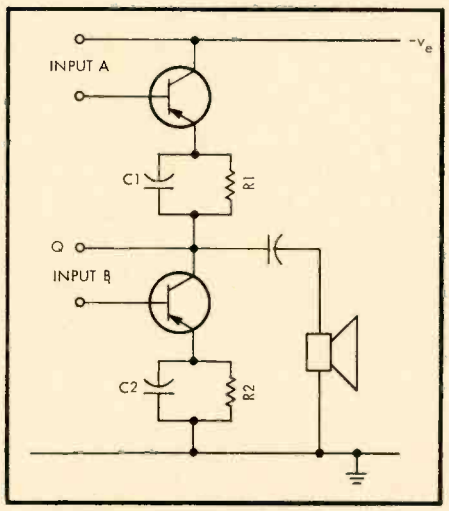

Fig. 3. In this circuit each transistor has its own constant-current network.

the clue lies in this matter of characteristic "softness." A linear characteristic with a short transition region will call for a more accurate matching of the working points and will give a "harder" change of slope.

One of these days I propose to discuss the detail of this problem of driving power transistors. Here we must follow Tharma and Osborne, who have chosen to go all the way towards linearity by putting local feedback round the output stage. They use the emitter-follower configuration. If the load resistance for one transistor is R_L, this is roughly equivalent to making the driver impedance equal to $(R_S + h_{fe} \cdot R_L)$. The second term is the dominant one and may be several hundred ohms. We need not go into details about the theory of the emitter follower, although it is worth while noting that the feedback action does a good deal to cancel out the effect of variations in h_{fe}, variations which act both to vary the input impedance and the current gain.

The two transistors of a class-AB push-pull stage are biased fairly well down, so that we can consider two regions of operation. Small signals will remain in the class-A region, with both transistors conducting, and, in the a.c. equivalent circuit, each contributing one-half of the load current. At the extremes of a larger signal drive, one transistor will be cut off and the other transistor will be called on to provide the full load current. This, so far as the source is concerned, implies a sharp change in the factor $h_{fe}R_L$, but the change need not be significant if $h_{fe}R_L$ is sufficiently large compared with R_S.

The average current through a transistor operated in class A is constant because the upswing of current on one half cycle just balances the downswing on the other half cycle. If the transistor is driven down to cutoff we have a non-linearity intervening just when we are really calling for a negative current. Because we cannot get this negative current contribution the average current increases: the transistors are driven up. Suppose, however, that the emitter circuit contains a large resistance which is decoupled by means of a sufficiently large capacitance. This gives us, in fact, the circuit known as the infinite input-impedance detector (Terman, "Radio Engineer's Handbook," p. 563 in 1st edition). In our case the "detected signal" at the emitter will be the upper part of the syllabic envelope. The effective drive to the transistor will contain an added term, an emitter drive voltage, which will just counter-balance the drive-up effect. This aspect of the circuit is introduced because we must never forget that any circuit working out of the Class-A region must involve some production of other frequencies. In ordinary class B the syllabic frequencies are driven back in push-push into the supply. More conventionally we say that the emitter resistance provides substantial negative feedback to d.c. and thus holds the direct current constant. This implies a movement of the working point, which is driven down by the change in the emitter steady potential.

Obviously this process cannot be continued beyond the point at which the circuit is operating in class B. This leads us to *Fig.* 2, which shows the load lines

for three different levels of drive. The conditions which must be satisfied by the quiescent current, I_q, the peak current, I_p, the steady current, I_d, the load resistance, R_L, seen by each transistor and the collector voltage V_c, are:

$$I_q = I_d = \frac{V_c}{I_p \pi R_L}$$

In general the stage is treated for design purposes as a class-B stage, but is operated at quiescent current of I_p/π. There will be no crossover distortion so long as the load remains above $V_c/\pi I_q$ at all frequencies.

You may wonder just how this term πI_q has come into the picture: I did, for it is not in the original report. Suppose the peak current is I_p and that we consider a sine wave of the form $I_p sin\ \omega t$, in the class-B case, *Fig.* 2(C).

For a single cycle, lasting a time $2\pi/\omega$, the current will average

$$\int_o^{\pi/\omega} I_p \sin \omega t\, dt = \frac{I_p}{\omega} \Big| - \cos \omega t \Big|_o^{\pi/\omega} = \frac{2}{\omega} I_p,$$

and so the value of the d.c. will be

$$\frac{2}{\omega} I_p \Big| \frac{2\pi}{\omega} = \frac{I_p}{\pi}.$$

Thus we have the relationship $\pi I_q = I_p$. The class-A load line is drawn to have a slope corresponding to $2R_L$, where $R_L = V_c/R_p$, since each transistor only supplies one-half of the load current. The load line shown in *Fig.* 2(B) would take rather more involved calculation, but we do not really want to know the working point so this can be left as an exercise for the mathematically minded.

The collector power falls as the drive is increased. It is, at zero drive, just $(V_c \cdot I_{pk}/\pi)$ and is thus about two-thirds of the maximum (class-B) output power. For 10 watts output the collector dissipation will be 6–7 watts, compared with the 10 watts which would be dissipated by a class-A stage, and the 2.5–3 watts of an ideal class-B stage. It is, of course, well-known that the class-B figure is deceptive, since better cooling is needed in order to ensure thermal stability. Sometimes, too, designers overlook the need, in class-B stages, to provide extra cooling in order to prevent the working point drifting into a region where crossover distortion can begin.

We have not yet mentioned any particular circuit configuration. Nowadays we may assume that the output stage of a transistor power amplifier will be a half-bridge or full-bridge output-transformerless circuit. The basic circuit is then the circuit shown in *Fig.* 3: R_1C_1 and R_2C_2 are the circuits which hold the two transistor currents constant, and the inputs A and B include the biasing circuits which set each transistor to the wanted quiescent current. Notice that

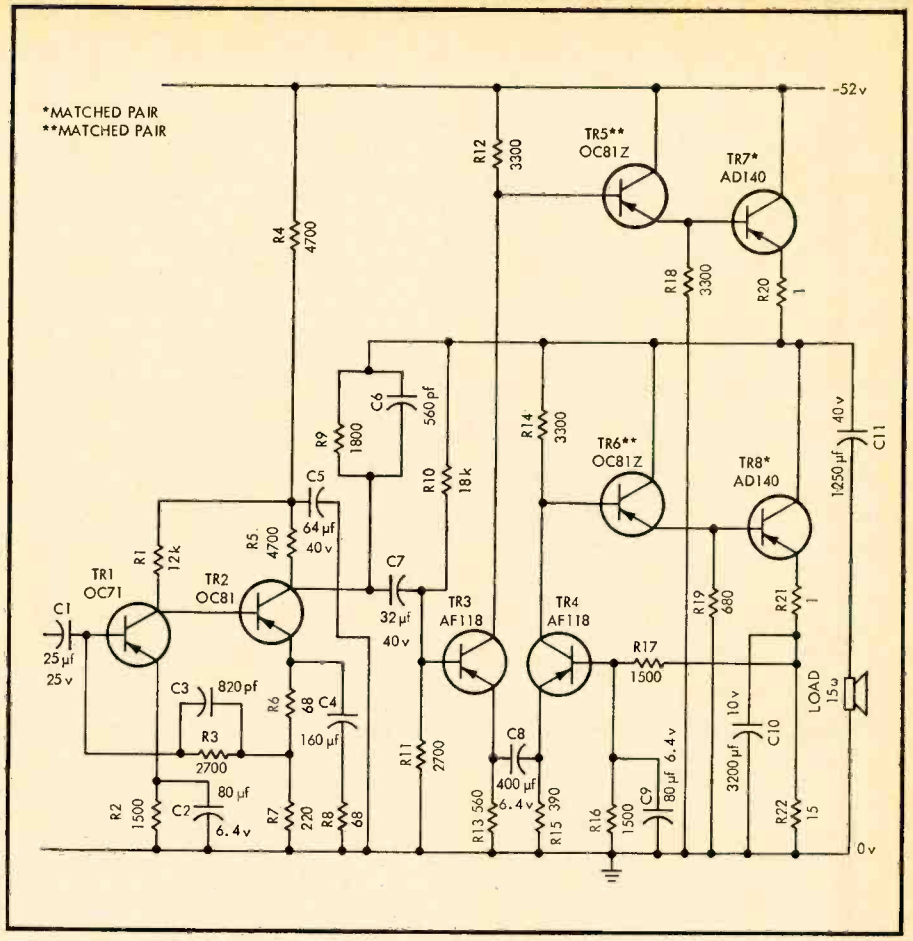

Fig. 4. The final result.

the input to each transistor is applied between its base and its collector.

In their description of their practical circuit Tharma and Osborne say that they need a low-impedance drive for each transistor and that therefore they use emitter-follower drivers. Exactly the same result is obtained if we just say that we need the output stage to operate from a low-power phase splitter, and that the transistors shown in *Fig.* 3 are therefore, in practice, compound pairs. In this amplifier, though not in their class-B amplifier, they do not use the quasi-complementary structure: the circuit is pnp transistors all the way.

Unless there is some substantial current flowing away at Q, the center-line, constant current through one transistor means constant current through the other. This leads to some simplification of the over-all circuit. The components R_1C_1 are eliminated and control is left to R_2C_2.

The phase-splitter selected by the designers is the long-tailed pair. The advantage of this circuit is that it is, inherently, a symmetrical circuit. We see here the implications of a true engineering approach. High-frequency power transistors are available, and in AUDIO, Oct. 1963, Messrs Myers (Junior) and Kahn say we must use them. The only thing against this view is the price which we must pay for them. Shall we get enough extra quality per dollar? By using low-impedance drive we can push up the effective cut-off frequency of the power transistors, although there are some limitations which are too complicated to discuss at the tail end of an article about something else. The response is, however, dependent on the drive impedance, so that the phase-splitter must offer the same impedance to each half of the push-pull stage. This is the justification for using the long-tailed pair.

The thing to do now is to examine *Fig.* 4, the complete circuit diagram. Starting with the output stage we see R_{22} and C_{10}, the constant current control elements. R_{18} and R_{19} improve the working conditions of the driver transistors and allow for the reversed base current needed by the power transistors. In consequence, the power response has its −3 db point at 20 kc although the common-emitter cutoff frequency of the power transistors is 4 kc. The resistors R_{20} and R_{21} provide reverse bias when their transistors cut off, and reduce the softening (increase of I_{co} at high collector voltages).

In the original version of the ampli-

(*Continued on page 63*)

Acoustic Resistance Damping for Loudspeakers

JOHN L. GRAUER

Achieving better damping of moving-coil or dynamic loudspeakers by acoustically loading the mechanical vibrating systems, provides proper control and directly improves the quality of sound reproduction

FROM THE STANDPOINT OF DAMPING, the dynamic loudspeaker is often in need of further help. Economically, it is not usually feasible to provide proper damping in medium or low-priced units. Better damping can be achieved by means of a more powerful magnet system (electrical damping), free suspensions having some inherent viscous friction, such as air holes in a plastic foam suspension (mechanical damping), and/or acoustical damping, usually in one of two forms: that of a horn, providing an essentially resistive and heavy air load on the driving cone, increasing conversion efficiency along with giving better damping and control of radiator motion; or that of a purely dissipative acoustical resistance, consisting of holes, slits, or slots in an otherwise solid member, positioned into the acoustic circuit so that the sound waves are forced to pass through the holes. When powerful magnets are used, the cost of the speaker will rise drastically, as the magnetic assembly may account for some 60 per cent of the total speaker cost. If a viscous suspension is used, it may prove difficult to achieve an optimum amount of damping, consistent with the correct suspension freedom and linearity. A horn system can provide good damping and efficiency, though for lower frequencies the horn structure must be folded, due to space considerations, and the size will still be large, with complex configuration, which makes for an expensive system. In the case of a purely dissipative acoustical resistance, where unlike the horn no attempt is made to augment efficiency, a medium-quality speaker can be used, along with a small and mechanically simple housing. Using an optimum configuration, acoustically resistive damping can control cone excursion to any desired degree.

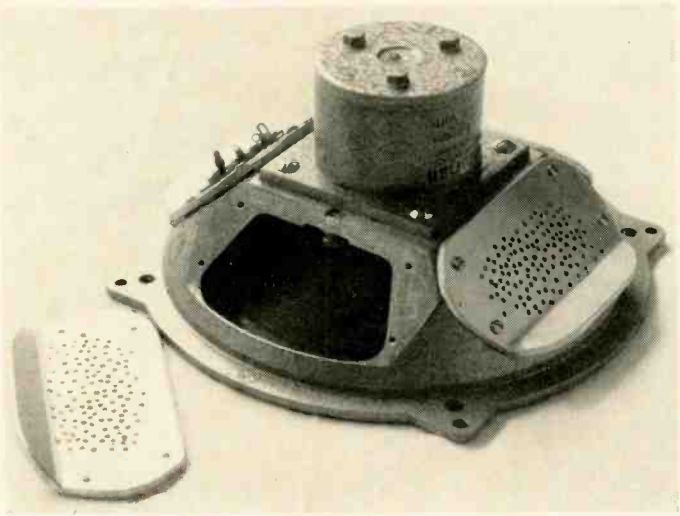

Fig. 2. Working model, built around a Stentorian HF-812U 8-in. speaker.

The problem with many direct-radiator systems is to determine what is the optimum configuration for resistive damping. Attempts have been made to place damping on inside walls, in the port of a bass-reflex cabinet, as a single resistance screen partition inside the box, or as a set of multiple partitions. Each of these methods has some effect on damping, though often the results are not as expected, because of system differences. In one case the designer is trying to damp the box air resonance, in another the speaker mechanical system, and in another perhaps both.

A way, which appears optimum, has been found to damp a direct radiating system by introducing an acoustical resistance directly behind the cone. In this way one can use a medium-quality speaker, having a free, linear suspension but often a weak magnetic circuit, and achieve proper damping acoustically. The approach is flexible, adaptable to many different speakers of varying quality, in different housings, and at

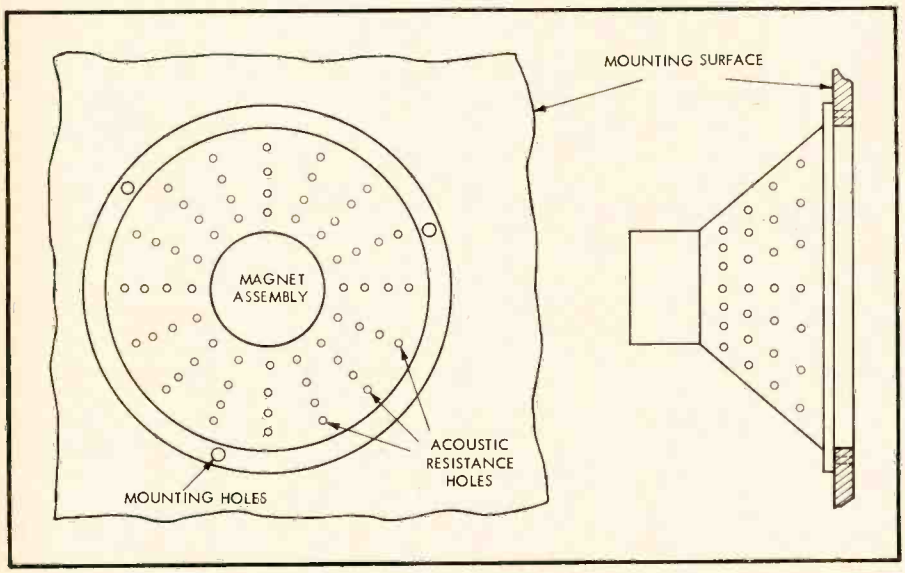

Fig. 1. Speaker with integral damping.

best results in greatly improved performance. The bass transient response is improved, the power handling capacity goes up, and the bass response is smoothed considerably. The over-all performance can approach that of a much more expensive system.

The resistive damping can be applied to a direct radiator speaker in a box by enclosing the rear of the speaker with one or more layers of suitable cloth, securely tied about the rear of the speaker. The cloth should be as tight as possible, so that it cannot vibrate in unison with the cone, and materially degrade damping. Acoustically resistive damping is achieved by forcing air (the rear sound waves) through the many small holes in the cloth, turning part of the sound energy into heat, and damping both the rear wave and cone motion. The result can be considered acoustical attenuation which directly affects the amplitude of cone vibration. The barrier behind the cone prevents it from vibrating too violently. It can be seen intuitively that moving the barrier away from the cone is bound to substantially reduce the control that can be achieved, because of the increase in magnitude of the intervening air cavity between cone and acoustical resistance. A close position insures greatest possible control. Using the optimal configuration, with damping directly behind the cone, the amount of damping introduced can be controlled by the cloth structure or porosity, and the number of layers used. These can be varied over wide limits, to compensate any given speaker as required.

If the system performance is investigated, it will be found that damping of this type directly affects the height of any bass impedance peaks, and in the case of a reflex, where two are present, the heights can be substantially equalized by even a small amount of damping. The acoustical response will usually show a reduction in peaks with increased damping, though it should be noted that too much damping will reduce response, as well as the undesired peaks.

This method of damping, which was developed by Voigt in 1959,[1] provided outstanding results with speakers having medium-strength magnetic circuits, and linear suspensions. It was not, however, completely free from faults. First, it required the user to do the work in adjusting, with or without the necessary laboratory equipment. Second, it was clumsy in that multiple layers of suitable cloth were required, which meant that the user would have to determine what was a suitable cloth, and apply it in the correct number of layers. Third, there was the possibility that the layers of cloth could work loose when subjected to the large acoustic pressures developed by the close-working loudspeaker, and thus degrade damping. There was also likely to be some initial difficulty in fixing the cloth layers behind the speaker, so that they would be —and remain—sufficiently tight to prevent sympathetic vibration.

Voigt apparently did not see how readily the acoustic damping he described could be built integrally into the loudspeaker, by making the required resistance a part of the chassis assembly. It was with this idea in mind that the author undertook to fashion such a novel loudspeaker. If the damping could be realized in this way, it would be possible for the manufacturer to damp his speakers properly, acoustically. This would be especially valuable in the case of medium-quality units, where the damping is limited by the cost of a good magnetic circuit. Excellent damping, that is, could be achieved acoustically, rather than magnetically. The manufacturer could adjust damping as required, for each different design.

Preliminary experiments showed that such a speaker could be realized, at a nominal cost. A working model gave good reproduction in a simple small reflex.

Designs with Resistive Damping

The possibilities are manifold. The damping can be applied.

1. By putting the acoustical resistance directly behind the vibrating cone, as an integral part of the chassis;
2. by putting the resistance directly behind the vibrating cone, as a non-integral part of the chassis; and
3. by building the resistance into a separate cover or can, to be placed around the back of the speaker.

The first two methods would be useful for speakers under design, while the third would be useful for improving older speakers.

Let us examine these designs.

Figure 1 shows an integral design using a chassis which completely encloses the rear of the speaker. It is relieved by holes symmetrically distributed across the chassis back, behind the cone, which introduce the required resistance.

In order for the cone to vibrate at the lower frequencies, where maximum excursion always occurs, the acoustical resistance of the holes must first be overcome. As the cone moves backwards, it "sees" and is impeded by the small openings, through which it must first force air in order to move. The desired damping of excessive cone motion, at resonance and elsewhere, is thus obtained. As the cone moves forward, a different condition exists, the front air offering relatively little resistance to motion. However, the cone cannot move forward as rapidly as it would without the rear damping, for in order to move forward, air must first be "sucked" through the resistive openings, which again introduces dissipative damping. The damping is thus fully effective on both forward and rearward cone excursions.

In some cases, it may be found that the loudspeaker "sees" one value of acoustic resistance when moving in one direction, and another value when moving in the opposite direction. Here the acoustical resistance could cause nonlinear speaker operation, the cone being subjected to unequal forces. The remedy consists in designing the resistive holes in the chassis basket to have a tapered configuration, in which the hole diameter

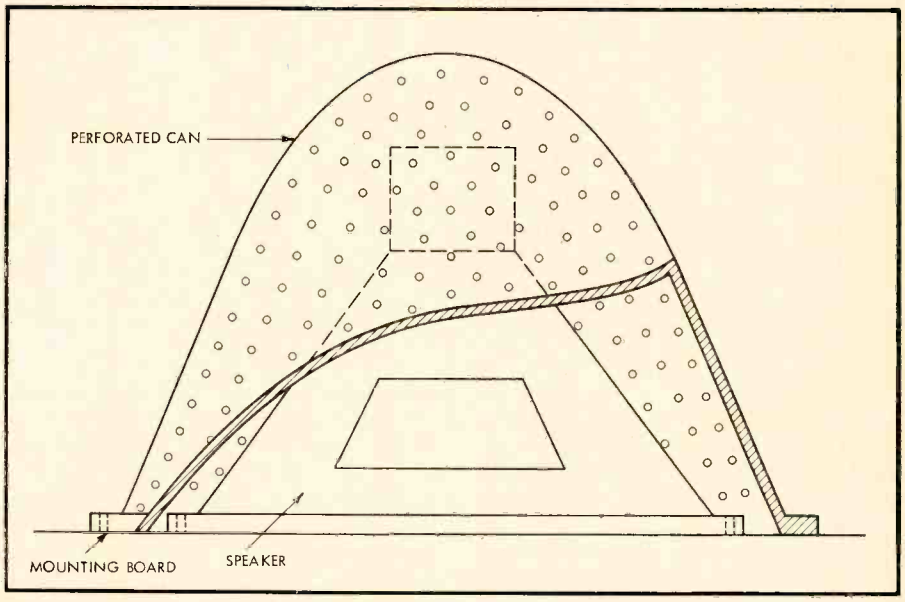

Fig. 3. Subsidiary enclosure with resistance.

[1] P. G. A. H. Voigt, "All About The Reflex Enclosure," *Radio-Electronics*, August 1959, pgs. 39–41.

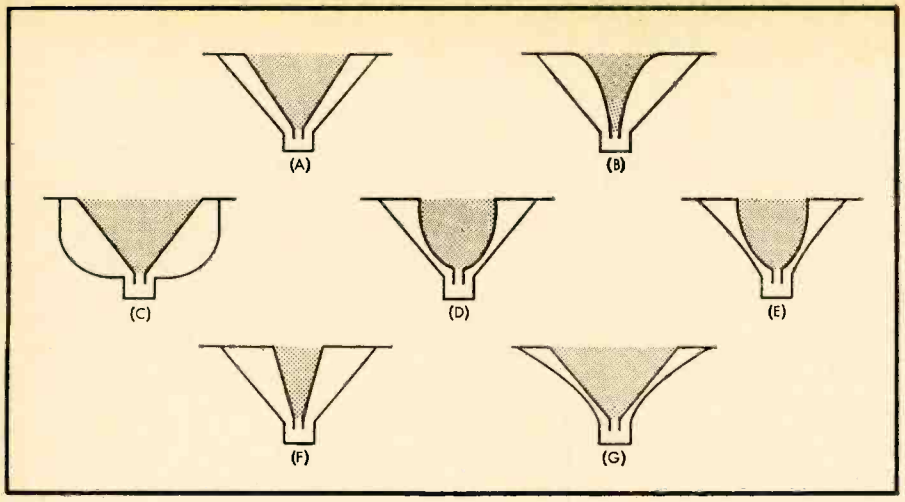

Fig. 4. Speaker geometry.

is larger on one side than the other, with a smooth transition in between. A tapered hole of this type presents one value of resistance to a cone moving in a forward direction, and another value in a rearward direction. (The effect is similar to that of talking through a megaphone correctly, and then reversing the megaphone, talking through the wrong end.) The relative gains or losses depend on the taper, length, and size of the hole(s). In practice, however, such a complication is hardly likely to be necessary in a speaker having linear compliances.

Figure 2 shows a working model used to test out the idea. The speaker is a standard Stentorian HF-812U, which was chosen for experiment because: (a) it was inexpensive; (b) the magnet was of moderate power; and (c) the chassis has four essentially flat surfaces onto which could be fastened removable plates. The plates were opened up by holes, in steps, and curves run after each step, to ascertain the effect on the electrical impedance characteristic. Mounting the plates in a non-integral manner, as illustrated, would facilitate centering the coil and gluing the spider, and probably would be best for mass production. The plates were made of ⅛" sheet aluminum with a bend in them, to fit the chassis.

An even simpler method would be to use a chasis having three or four completely flat surfaces, onto which could be fixed the flat perforated plates. No bend would then be needed. For connection to the voice coil, two feed-through terminals could be put either through the chassis proper, or through one of the plates, as was done in the model.

If an airtight seal between chassis and plates is desired, and cannot be easily obtained, because of surface irregularities of the chassis or plates, a felt or other washer can be used. This washer will tend to minimize irregular surfaces, and also rattles and buzzes should one of the plates loosen during use. There would, however, be little chance of encountering this difficulty, under normal use, if suitable lockwashers are used under the mounting screws.

The resistive openings in the plates can be holes, slits, or slots. Choice of shape can be made on the basis of secondary considerations, or the designer's preference, because it is possible for any shape to introduce the correct amount of damping. The matter of holes and slits as acoustically resistive elements has been treated mathematically in Olson's "Acoustical Engineering."

Figure 3 shows a method of introducing damping by a separate can with perforations, which encloses the back of the speaker and is attached to the mounting board by holes through a circular flange. This is suitable for updating older speakers of moderate magnetic power. The speaker does not require a specially designed chassis, because the damping is introduced by holes in the separate and removable can.

This method suffers from the disadvantage that an additional acoustic cavity is introduced between the cone and the acoustically resistant can. The results obtained are, however, nearly the same as the previous designs, but in some cases the additional cavity of air may introduce unwanted resonances. In these cases further damping consisting of absorptive "stuffing" in the cavity will reduce the resonances. It is also possible to reduce them slightly by means of a thin layer of suitable fabric or sound absorbent material attached inside the perforated can. Here, however, it is important to avoid any blocking of the acoustically resistant openings, for if they are partly blocked by fabric, the value of acoustic resistance will be increased.

A further design, not shown in a figure, would consist of more than one acoustically resistive can, fitted concentrically behind the speaker, which would effectively function as an additional resistance in series with the first can. If the resistance of the first can were the same of the second, the two would approximately double the value of acoustic resistance introduced. Three similar cans would triple the resistance. In general, however, there is probably no particular value in using more than one can, for any desired resistance can be realized in a single unit, where the number, size, depth, shape, and relative spacing of the holes can all be varied to attain the desired result.

Needless to say, the can can be shaped in many ways. These include a pressed-steel or aluminum can of circular section, a tapered tube, a tapered tube which is open-ended (with damping in the open end), a cone shape, a shape to conform to the contours of the speaker, or even a pot or a box shape.

Figure 4 shows schematic sections of integrally damped speakers, similar to *Fig.* 1. These seven designs are intended to illustrate that when acoustically resistive damping is built into the speaker chassis, resonances can occur in the cavity between cone and chassis proper. These will tend to be relieved through the resistive openings in the chassis, but

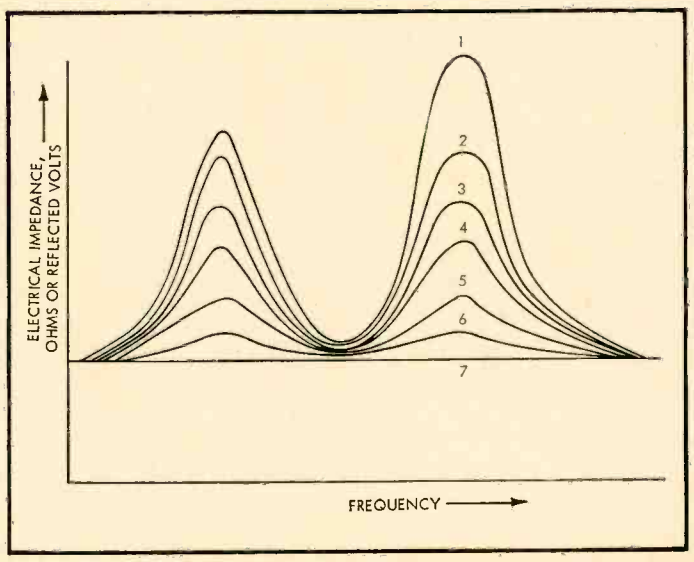

Fig. 5. Effect of resistive damping on reflexed speaker.

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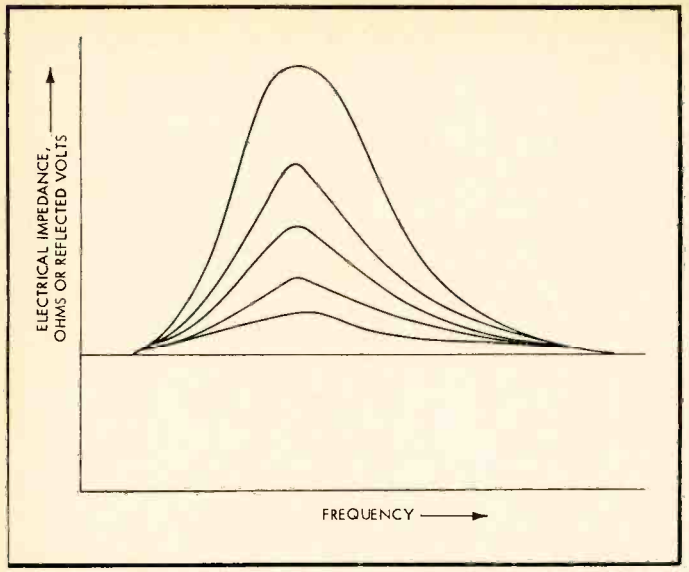

Fig. 6. Effect of resistive damping on infinite-baffled speaker.

in some cases, as when a speaker handling very high frequencies is resistively damped, the standing wave formations may cause irregular response. In such a case designs such as 4(A), (B), and (C) should not be used, as these configurations will tend to aggravate standing waves and other spurious air resonances in the cavity between chassis and cone. The designs of 4(D), (E), (F), and (G) are to be preferred to minimize these resonances. A layer of absorptive material can also be employed, affixed to the inside surface of the chassis, facing the cone, provided that the acoustically resistive holes in the chassis are not seriously blocked thereby. Rough or irregular surfaces may also be valuable here.

Performance of Resistive Damping

Figures 5, 6 and 7 show the performance of some basic loudspeaker systems using this damping. The results shown are smoothed curves, normalized from experimental data. *Figure* 5 shows a typical electrical impedance curve of a resistive speaker in a correctly-tuned (both resonances coinciding) bass-reflex cabinet. Curve 5-1 is the speaker impedance without any applied damping. Curve 5-2 shows the speaker impedance with some resistance. Curves 5-3, 5-4, 5-5, 5-6, and 5-7 show the effect of increasing resistance gradually in steps, with curve 5-7 showing the speaker impedance in a "closed-back" condition, having no resistive openings through which to propagate the rear wave. The reflex peaks are completely damped, and it can also be seen that cone motion is practically nil. The fundamental resonance is pushed up drastically, for the rear of the cone is "feeding" into a small cavity, having no outlet or pressure release for the air trapped therein, and having a considerable acoustic stiffness. The amplitude of vibration is, however, so impeded at resonance that the new resonance of the speaker, in this virtually blocked condition, could not be located on the curves. The intermediate curves, figures 5-3 and 5-4, gave best performance on an 8-in. speaker having a resonance near 60 cps, and 12,000 oersteds flux density.

It should also be noted that the height of the peaks, with behind-the-cone acoustical damping in effect, is not only reduced, but also equalized, in that the two peaks tend to have about the same height, using a given amount of resistance. When damping is introduced in this manner, the bass-reflex enclosure begins to behave in the manner expected from classical theory, having two peaks of equal amplitude. Before damping was applied, the peaks were invariably of widely different amplitudes, in some cases the ratio being nearly 4 to 1. It was difficult if not impossible to substantially equalize the peaks by means of damping material in other positions, on cabinet walls, in the port, hanging in the cabinet, and so on. The peaks were most effectively reduced and equalized by using resistive damping positioned directly behind the cone.

The reasons why two peaks of different amplitudes tend to be equalized when using resistive damping can be understood from the way in which the speaker and resistance interact. At lower frequencies the impedance peaks are an accurate indication of relative cone motion, showing the frequency of frequencies of greatest excursion. The resistance, however, has a constant value independent of frequency, so that at the frequencies of most violent vibration (which is at the peaks), the damping introduced is greatest. A more fortunate situation is hard to imagine!

At other frequencies the cone vibrates less, so that it encounters less damping. The net effect, then, is to level off the motional impedance curve, because the effective damping realized is a function of the excursion.

It is thus possible to load the cone acoustically in the extreme bass range, where motion is greatest, without materially affecting the higher frequencies. It can also be shown that the full effect of this loading extends undiminished down to zero frequency, or d.c. A given speaker cannot be so easily overdriven below the fundamental resonance, even if the enclosure is "letting go" below a certain frequency.

Figure 6 shows the effect of increased resistive damping on a speaker mounted in an infinite baffle cabinet. The single impedance peak, typical of an infinite baffle, shows the expected reduction in amplitude as damping increases.

Figure 7 shows the effect of an increase in resistive damping in terms of the acoustical response versus frequency, under ideal conditions, using a speaker in need of increased damping. The same general trend of curves would hold for either a bass-reflex or a basic infinite baffle type, because the speaker mechanism is being damped, not the cabinet. It is seen that the response at lower frequencies decreases as more damping is used. Curve 7-1 shows the response with no applied damping, with curves 7-2,

(*Continued on page 53*)

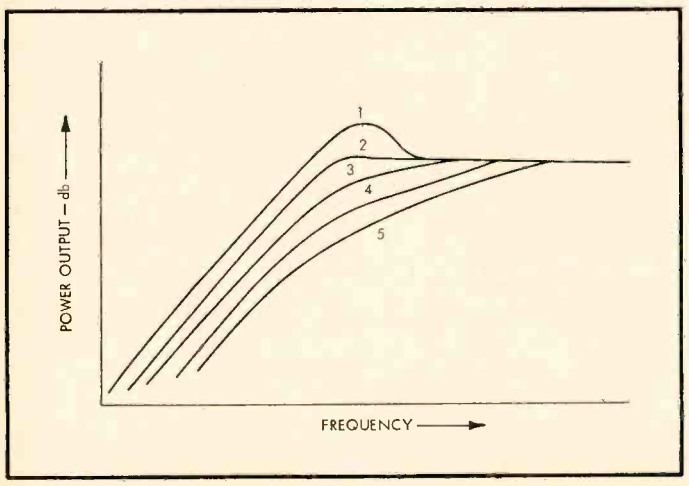

Fig. 7. Response curve of system using resistive damping.

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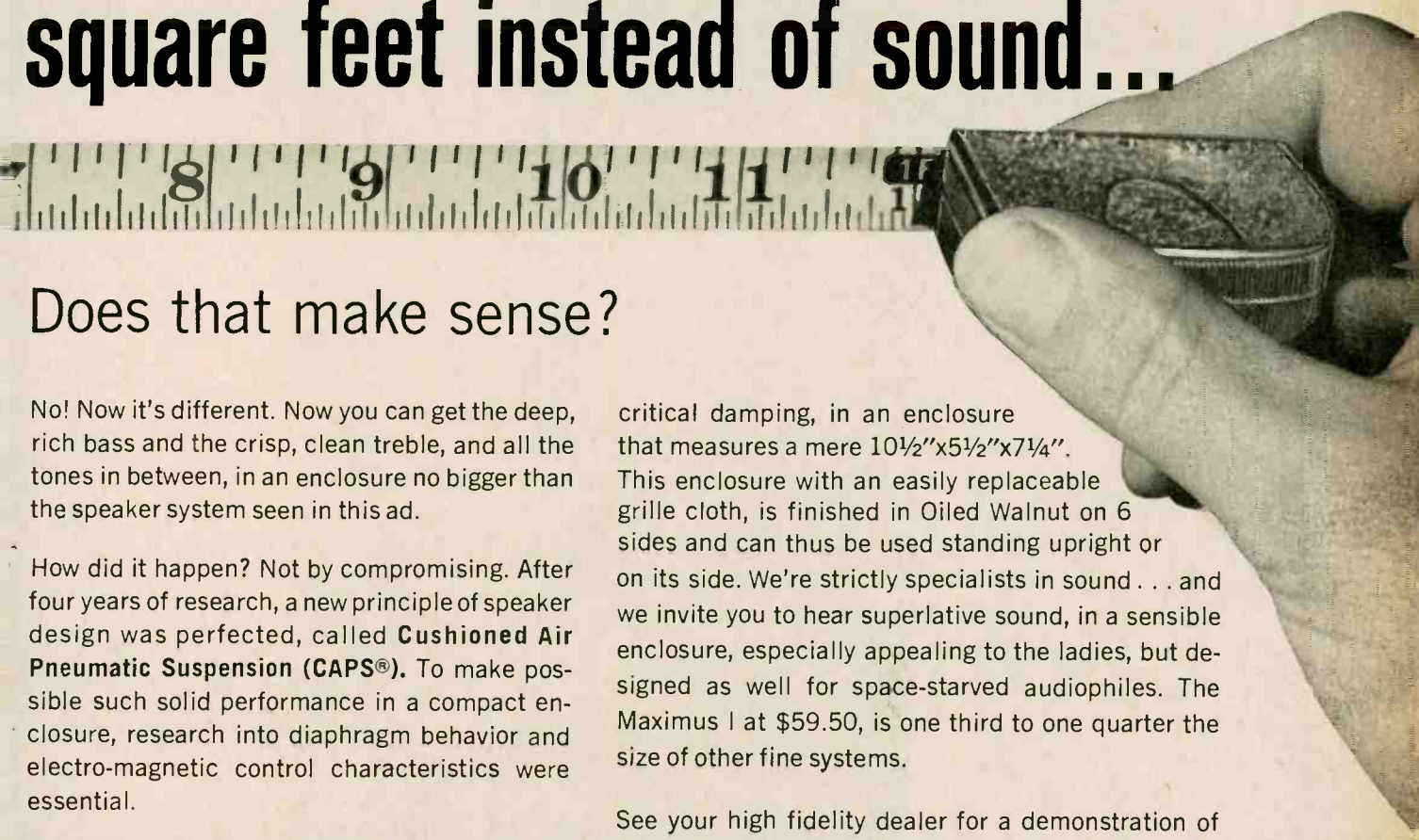

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Sound Reproducers for Electronic Organs

D. WOLKOV

Some electronic organs require speaker systems which modulate the tones supplied them, some can use hi-fi speakers, all require good sound dispersion.

THE ORGAN TONE cabinet designer tries to emulate air-organ sounds in spite of uncertainty of pitch and location. In addition to vibrato, tremolo, and percussion, or reverb which we discussed earlier, he may incorporate chiff or other superimposed noises.[1]

Some organ designs include electronic tone modification (Baldwin, Schober, Conn, and Artisan are examples) so that the tone signal is completely modulated when it leaves the power amplifier and it is expected that the speaker will respond in a linear fashion.

There are other designers who feel that every effort should be made to modulate the acoustic signal to achieve special sound effects. Leslie, Allen, and Wurlitzer are examples of such design philosophy.

Theoretically when electric currents are fed into a speaker, one should be able to reproduce any musical effect. But in reality the spatial effect of an air organ is difficult to reproduce.

In an air organ every note of a given stop emanates from its own individual source. Let us compare a single note in a pipe organ with that of an electronic organ each with a stop combination of diapason, octave, and flute. In the air organ at least three pipes would be speaking and furthermore these pipes would be separated from each other by several feet. In the electronic organ all three of these tones would be coming from one or more speakers with the sounds superimposed.

Of course it might be possible to use a separate loudspeaker for each note of each stop. However the cost would be prohibitive.

Careful analysis of the note in a pipe organ indicates the presence of a nervousness or indefiniteness of pitch. This is caused by the combination of variations in air pressure and the peculiarity with which each pipe speaks.

The musician who wants his electronic organ to achieve some of these air organ effects, can choose from among many interesting systems and schemes for modifying the normal electronic organ sound.

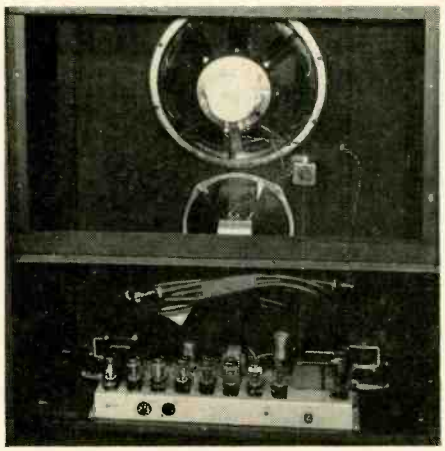

Fig. 1. Conn tone cabinet.

We will divide our discussion into two parts. First we will deal with speaker systems which modulate the speaker cones or the transverse audio wave train that the speakers generate. Such speaker systems usually cannot be used for hi fi.

Then we will deal with speaker systems which are more or less conventional hi fi systems.

The electronic organ voiced for high quality hi fi speakers must, as a consequence, have electronic vibrato, tremolo, and even reverb as discussed in the many earlier articles.

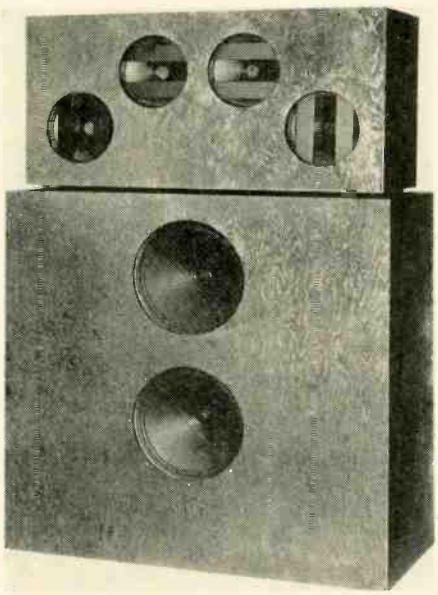

Fig. 2. Large Conn tone cabinet.

The Conn Classic Organ is normally wired for two-speaker operation, that is the manuals play through one amplifier and speakers and the pedal plays through another amplifier and speakers. It is possible to make a simple change in the console to separate the manuals from each other so that the Swell and Great manuals will have their own amplification and speaker systems.

When should three-channel operation be used? When the console is centered between the two tone chambers so that the organist receives the same volume from each of the chambers. Under this condition it is effective to place all of the Great and one-half of the Pedal speakers in one chamber and all of the Swell and the other half of the Pedal in the other chamber.

In an earlier article we described the Conn system of modulation of the speaker fields. *Figures* 1 and 2 show Conn speaker cabinets, and in *Fig.* 1 we see an amplifier installed in conjunction with the speakers.

Hammond Tone Cabinets

Hammond Organ supplies a large family of tone cabinets over a wide range of amplifier power and speakers complements. *Figure* 3 shows an internal view of a typical Hammond tone cabinet. Note the reverberation unit delay lines in the lower right hand corner of the photograph.

Reverberation control is an important feature of any Hammond Organ installation. The Hammond reverberation control is an electro-mechanical device which introduces multiple echoes by means of reflections within a network of coil springs and thereby provides reverberation in locations where natural reverberation is insufficient.

Earlier, Hammond had supplied a fluid unit in which the delay springs were immersed in a viscous medium to provide the necessary damping. A later device which uses springs in air has become the standard in the electronic organ industry.

A signal from the amplifier is applied to the driver unit in the reverb device

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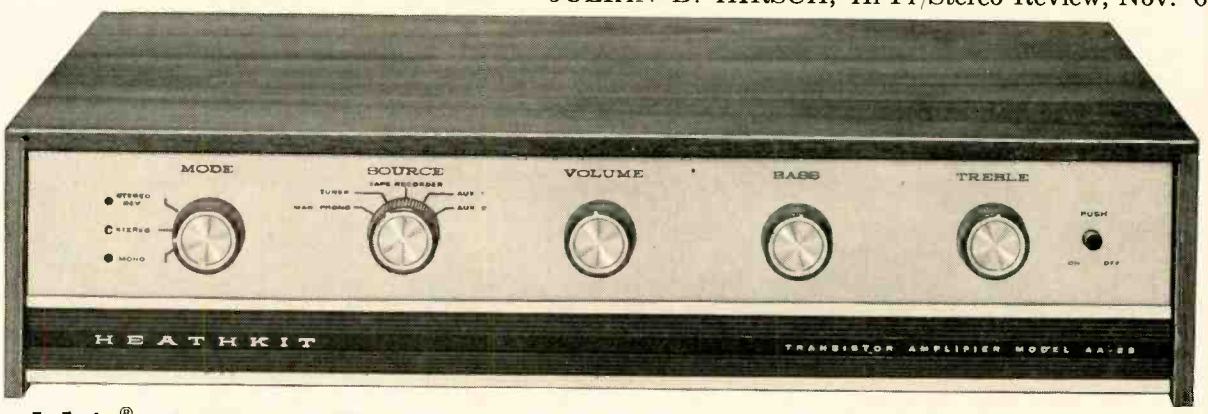

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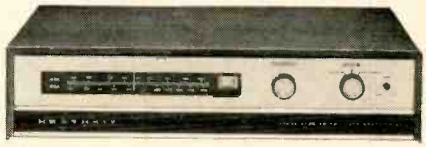

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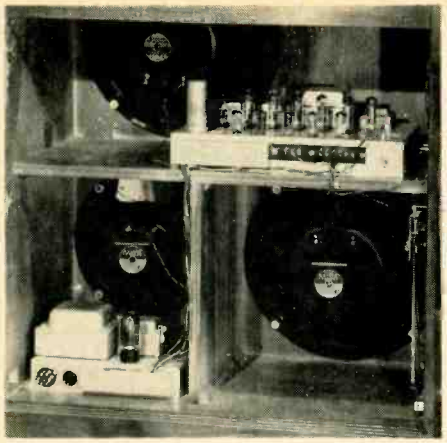

Fig. 3. Interior of Hammond tone cabinet.

which then converts the electrical signal into mechanical energy. This energy is fed to three different springs.

The signal takes 1/22 second to traverse the shortest spring to the pickup. The pickup converts part of the mechanical energy to an electrical signal and also reflects most of the energy back along the spring to the driver. Here again most of the signal is reflected back along the spring to the pickup.

This transaction continues until the signal energy at the pickup is reduced to one millionth of its original value. This takes about 2 seconds. The other two springs operate in a similar fashion, but their reflections occur at longer time intervals, 1/17 and 1/15 second respectively. The damping for each of the three springs is so proportioned that they decay at a uniform rate.

In the amplifier, part of the console signal is applied to the reverberation driver. The resultant reverberated signal at the pickup is separated into frequency bands, one from 32 to 200 cps, and the other from 200 to 6000 cps.

For reproduction, the low-frequency direct and reverberated signals are electronically mixed and the high-frequency direct and reverberated signals are acoustically mixed.

The two selector switches which are mounted on the side of the Hammond tone cabinets provide a variation in the amount of reverberation produced. The bass reverberation switch provides increased direct output as the amount of reverberated signal is reduced. This is accomplished by varying the amount of direct signal fed into the bass channel.

The treble reverberation switch controls the gain of the treble reverberation amplifier channel, but if the switch is turned to "Reverberation Off," the direct console treble signal is fed into this channel to provide full treble output for the tone cabinets.

Except for damping technique, both the wet and dry units operate on the same basic principles.

The principles of operation of the Allen Gyrophonic Speaker[2] (see *Fig.* 4) and the Leslie speaker may seem ludicrous unless one understands what the designers are trying to accomplish.

Electronic musical instruments, such as electronic organs, are generally provided with stationary loudspeakers. A noticeable difference is evident when a musical selection is played on an ordinary electric organ as contrasted to the playing of the same selection on a pipe organ. The difference in tonal effect is due to several things, among them the spaced relationship of the individual pipes, or sound sources, of the pipe organ.

This difference in tonal quality is also due partly to the directional difference in which the respective sound sources of the two instruments are pointed.

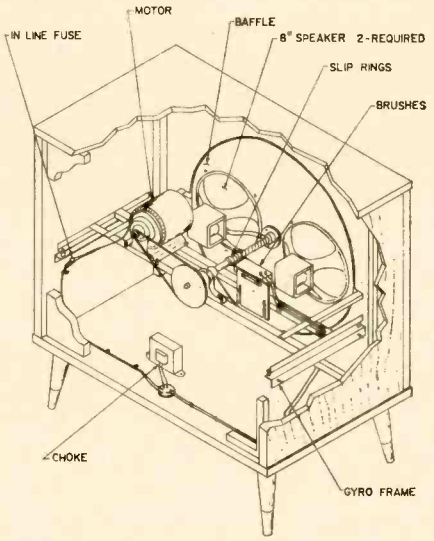

Fig. 4. Details of Allen Gyrophonic tone cabinet.

Openings for the pipe organ are located in different vertical and horizontal planes, whereas in a conventional electric organ, the location of the multiple sounds is not dispersed.

The object of the Allen Gyrophonic unit is to provide a loudspeaker which can produce musical tones equivalent to a plurality of loudspeakers simultaneously fed from one amplifier. Allen thus mounts the speakers on a vertically positioned rotatable support in such a manner that the longitudinal axis of each speaker is substantially parallel with the rotational axis of the support. The speakers are spaced in diametrically opposite points from the center of support. This design also provides the effect of a slight pitch uncertainty.

The Gyrophonic speaker unit includes a casing, the front wall of which is a baffle board and the rotating segment. As the disc rotates the sounds produced will be emitted from the loudspeakers at constantly varying points in the circle of rotation simulating that which might be produced when musical tones are successively emitted from spaced sources.

The Leslie

A very popular organ tone cabinet system is the Leslie. There are very good reasons for the Leslie system being recommended by so many organ manufacturers as the adjunct speaker for their organs.

The Leslie Isomonic Sound System[3] uses a large fan, instead of the rotating speakers of the Allen design. The arithmetic which describes the generation of the varying Doppler frequencies is quite involved, so it is best to understand its philosophy in an empirical manner.

The moving blades can be considered as constantly changing horns. Thus the speaker acoustic loading varies as the blades move, which causes the undulation or vibrato effect.

The Leslie Isomonic is an acoustic integrating system. The Isomonic system divides the keyboard chromatically into two channels, so that the notes adjacent to each other are not in the same audio channel. The net effect of this separation is to prevent the fourth and fifth from mixing in the amplifier or in the speaker; permitting them to mix only acoustically.

One of the unique aspects of the Leslie speaker design is the method of producing tremolo or tremulant. Two rotary elements within the Leslie cabinet project the sound a full 360 degrees in a manner which results in an acoustic tremolo. This patented system[3] adds musical values to the tone of the organ.

Some intriguing musical possibilities result from having the Leslie tremolo under partial on/off control. In this

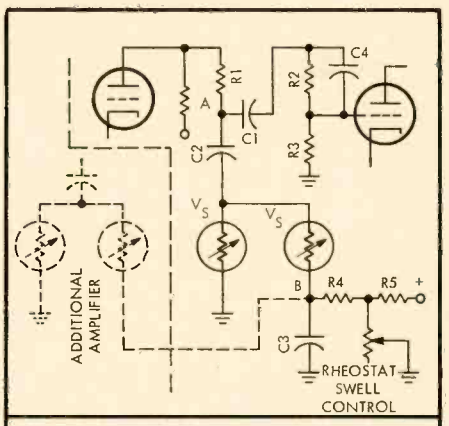

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Fig. 5. Leslie Varistor volume control.

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The Dyna Stereodyne III cartridge is an improved model at a new low price. It is one of the truly musical pickups.

The Dyna SCA-35 integrated amplifier was described simply and accurately in the 1964 *Hi-Fi Tape Systems* as "the finest low-powered amplifier on the market." We have nothing to add except to note that the all-in-one* SCA-35 has more than adequate power to drive AR-4 speakers.

*Also available at a slightly higher price with preamp and power amplifier separate.

Modern Hi-Fi wrote of the new AR-4 speaker: "The results were startling... the AR-4 produces extended low-distortion bass. The power response and dispersion of the AR-4's tweeter are as good as those of units that cost many times as much. All in all, it is difficult to see how AR has achieved this performance at the price."

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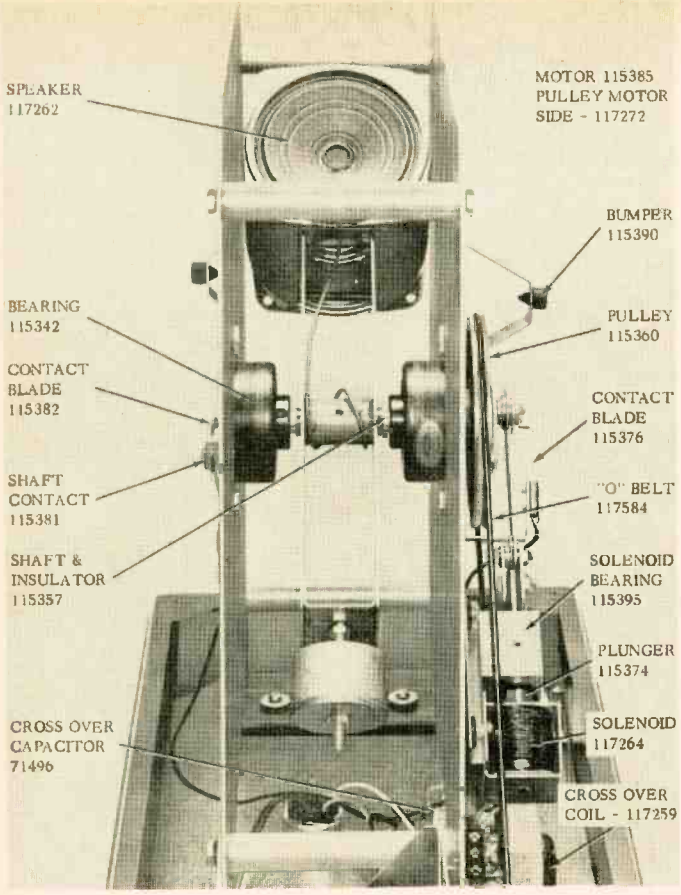

Fig. 6. Wurlitzer Audio Radiance tone cabinet details (counterbalance is at bottom center).

arrangement the lower bass rotor is kept constantly in motion, while the upper (treble) rotor is controlled independently by the on/off switch. For example, notes played in the top two octaves of the keyboard, using a brilliant registration such as strings, will be channeled mainly through the treble rotors. With the tremolo off, this rotor will not be in motion, hence these notes will have practically no tremolo. If at the same time (still with the tremolo off) notes are played in the lowest three octaves of the other manual, and using a bland registration such as Tibia, the sound will be heard mainly through the bass rotor which is revolving and will thus produce a full tremulant.

The solo part may be played on either keyboard, with the accompaniment of the other. Due to the contrasting tremolo treatment, the tonal difference between the solo and accompaniment parts is quite substantial.

Utilization of these special tremolo possibilities can be further influenced by the vibrato system of the particular organ that drives the Leslie. If the vibrato is controlled separately for the two manuals, many combinations of acoustical tremulant and electronic vibrato become possible. A reasonable amount of experimentation will reveal many interesting musical possibilities.

When the tremolo control switch is in the off position, braking of the tremulant motors is necessary if the unpleasant tremulant decay due to motor coasting is to be avoided. In the Leslie, d.c. braking is used.

The use of multiple Leslie speakers in an installation not only results in greater sound volume, but makes possible improved sound distribution. To this end, several speakers in an installation are usually separated from each other.

Since it is desirable that the organist be able to control the speakers selectively, an "Echo Control" is used. The Echo Control is a switching device that permits the organist to select the speaker or speakers that will be heard.

The speaker or speakers located nearest to the console are designated as the main speakers. The speaker or speakers which are far from the console are referred to as the "Echo" speakers.

The Leslie uses a two-way speaker system. Pedal and midrange tones are reproduced by a heavy duty 15-in. unit. Upper middle and highest tones are generated by a compression sound chamber driving unit.

The 15-in. unit is mounted in a bass reflex enclosure. The high-frequency driver is loaded by means of the rotary horn.

The preamplifier has separate channels for Flute and String signals. This provides the necessary signal isolation. The separation of channels is carried on through the power amplifier and even the speakers.

The electrical and mechanical problem of synchronized volume control for both channels is solved in an interesting manner through the use of a Varistor circuit. Varistors are made from specially prepared silicon carbide, with the property of varying resistance with applied voltage. One variable d.c. control can simultaneously control any number of amplifiers which are front-ended with Varistors. The following describes a basic circuit, as shown in *Fig.* 5.

The amplifier gain is controlled by varying the resistance of one section of a series divider circuit. With the input to the following stage connected to point A, a reduction of resistance on the Varistors results in a reduction of signal voltage fed to the amplifier.

C_2 is chosen so as to provide bass compensation. At medium and high frequencies, the impedance across C_2 is very low; however at pedal frequencies the impedance rises and the gain goes up, resulting in bass compensation with swell-control action.

The two Varistors are effectively in parallel for signal voltages due to the shunting of C_3. For the d.c., the path is traced as a series circuit, with each Varistor receiving one-half of the voltage applied to point B.

The d.c. voltage to control the amplifier is obtained from the divider consisting of the variable swell rheostat and R_5. R_4 acts as a filter resistor. The combination of C_3 and R_4 act as filter for any a.c. voltages that might reach the signal paths of the amplifier.

The advantages of the Varistor circuitry is that the leads to the control need no shielding and being non-critical

(*Continued on page 59*)

Fig. 7. Schober LSS-10 organ tone cabinet.

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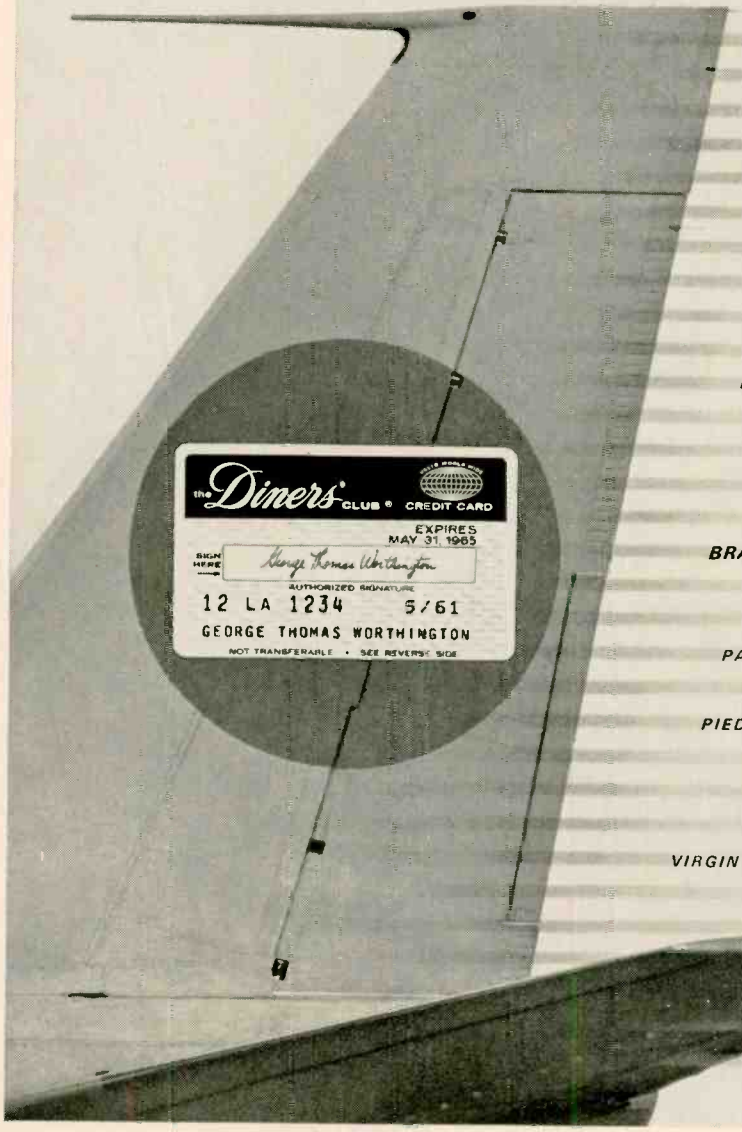

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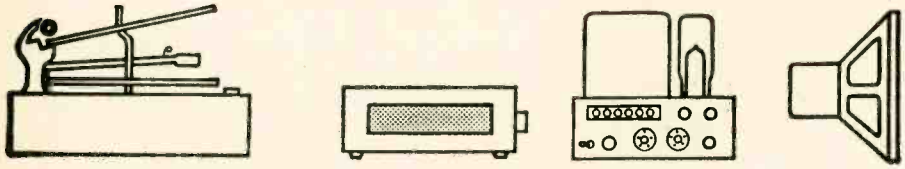


GARRARD LAB 80 AUTOMATIC TURNTABLE

In many ways the new Lab 80 Automatic Turntable represents a radical departure for Garrard. Not that quality in a changer has eluded them; rather this is an attack from a new direction.

The Lab 80 is designed to bridge the gap between the ordinary changer and the super manual player. The fact that it comes as close as it does is testimony to British ingenuity. This Garrard does a lot, and it does it amazingly well.

The first thing that you see when you unpack the unit and set it up is that it *looks* professional. The Lab 80 boasts a 12-in. platter. Underside examination shows it to be quite massive and carefully balanced. The platter is set upon a ball-race bearing that surrounds the center spindle.

This spindle system is a departure for Garrard. Unlike earlier units which used outside pusher platforms or balance supports, the Lab 80 changes records entirely from the main spindle. Three wide-spread teeth support the stack. At the critical change moment, the teeth are retracted. At the same time a plastic wedge is expanded into the center holes of the discs. The wedge contacts all but the bottom record. That record falls. Can't help itself.

This automatic spindle can be exchanged at any time for a short manual spindle should it be desired to use the Lab 80 purely as a manual.

Four control levers operate the system. From left to right they are the speed selector, manual start-stop, automatic start-stop, and record size selector. The levers are carefully linked and we found it easy to effect a mode change while a record was playing without any jarring.

The powers that be at Garrard decreed that the Lab 80 would be only two speed. And, so it is. 33 and 45 rpm are provided. The wisdom of that decision can only be decided by the needs of the individual prospective user. Obviously the decision was prompted by the relative disuse of 78 rpm discs.

We have left description of the tone arm for last simply because of its unique appearance (for an automated player). It is apparently made of wood. Actually it combines the rigidity of a metal shaft and the damping of wood. The arm is walnut wood on top of a U-shaped metal channel. On the underside of the arm, toward the rear, is the stylus-force adjustment. To select the stylus force one moves a knob, which moves a pointer, which in turn applies or removes tension to a spring. Starting from zero, the pointer moves forward in click stops, each stop represents a quarter gram of stylus force to a maximum of about five grams.

To set up the arm, it is first zero balanced. The rear counterweight is screw mounted and click stop retained to make this operation easy and precise. Between the arm and this counterweight there is a thin layer of rubber. This serves to isolate the counter-weight from the resonant mass of the arm.

On the front of the arm is mounted a lightweight metal shell. Cartridge mounting was easy and conventional. There is more than enough room to hold any cartridge. The shell is held in place by a large retaining screw. This makes for firm contact, both mechanically and electrically, between arm body and shell.

Two special features set this arm apart from the other automatics (and quite a few manuals). The first is an adjustable skating-bias control. This can be set for the proper stylus force used. It works effectively, without binding on the arm. It has the added virtue of being completely defeatable. If you don't want anti-skating, you don't have to have it.

The Lab 80 is equipped with a pneumatic-type arm-cuing lift. This is used in the manual mode of operation. It is not needed, nor is it normally activated, when the Lab 80 is used as a changer. When the manual lever is activated, a hook from the rear of the arm bearing engages a bar on the underside of the arm, pulling down (so the front of the arm goes up). The arm is then positioned by hand over the portion of the record to be played. Finally, a lever in the arm rest is depressed. This releases the hold mechanism and the arm floats gently down. The release is complete. When properly adjusted, there is no contact between arm and lift mechanism once it is released.

Fig. 1. Garrard Lab 80 Automatic Turntable.

Test Results

The Lab 80 aquitted itself admirably on the test bench. Flutter was 0.05 per cent; wow rose to 0.24 per cent. Rumble was essentially inaudible.

Speed accuracy and constancy in the face of changing voltage was outstanding. We found no more than a 0.5 per cent variation from 125 volts to 90 volts. This was measured with a one-gram load on a record. Free run, without load, provided the same speeds, indicating more than adequate motor torque. Measured speed at 110 volts was exactly correct.

Tone-arm measurements were also gratifying. Bearing friction is very low both in vertical and lateral motion. The

McProud test, which requires playing an eccentric 45 rpm donut disc, played at 45 rpm, allowed for a two-gram tracking force. This is comparable to most manual tone arms.

Tone-arm tracking error was always less than 1 degree. There was no provision made for cartridge overhang adjustment, so this figure could vary from brand to brand.

Tone arm resonance was somewhat broad and centered at 20 cps. Since resonance was well damped, limited to a 1 db rise, there were no tracking problems introduced. In any case, the resonant frequency measured here is low enough to be out of the trouble range.

One of the prime problems of the past when it came to using automatics was the fact that the tone arms simply would not track at the lowest stylus forces. So cartridge compromises had to be made. The Lab 80 arm does very well indeed. The limiting factor on the arm is the automatic trip mechanism. On our sample, a minimum force of 0.4 gram was required for reliable tripping. This is far lower than any of the present cartridges. It is safe to say that the Lab 80 will perform well with *any* cartridge currently available (or on the horizon).

Changers are made to play stacks of records. If a high compliance cartridge is to be used, it is important that there be no large variation in tracking force from the bottom to the top of a stack of discs. In the case of the Lab 80 we started at one gram on a single disc. On the eighth disc, stylus force was only up to 1.5 grams. Further proof of the Lab 80's ability with any cartridge.

Over-all operation of the Lab 80 was a pleasure. It is smooth, easy and positive in its characetristics. We did wish for a way to play the unit *automatically* with the short spindle in. It cannot be done. However, the arm will lift automatically at the end of a disc and return to rest. What more could one want?

The Garrard Lab 80 is a fine piece of equipment. It performs well and it looks well. With such a combination, it may well be *the automatic* turntable which can satisfy both the decorator and the music lover. You judge for yourself.

Circle 215

FISHER 600-T STEREO FM RECEIVER

The 600-T FM-stereo receiver is the very latest from Fisher. It incorporates a sensitive tuner, a 110-watt amplifier, and a complete audio control center. And it uses only four tubes. Plus 48 transistors, 15 diodes, and a couple of bridges.

The 600-T is the first solid-state amplifier and tuner we have reported from Fisher. As such it requires the closest scrutiny to uncover what one of the top manufacturers thinks about the use of transistors. A lot of reputation is riding on this product.

This is not a suspense story so we will declare now that the Fisher reputation seems secure. Apparently, having decided to take the plunge into transistors, they went about the complicated business of getting reliable circuits with performance capabilities equal to, or better than, tube circuits. They seem to have succeeded everywhere except for the "front end" of the tuner where tubes are still retained. Obviously they think that transistors are still not as good as tubes in that critical r.f. circuit.

Technical matters aside, we must admit that the 600-T presents the handsomest visage we have experienced from Fisher. Especially the use of contrasting polished and brushed brass. And the use of soft lighting on the green-hued dial lettering, contrasting with the red indicator light makes this dial one of the easiest to read we have encountered. We were especially intrigued by the tiny door which is opened by pressing the tail of the Fisher bird, to reveal the muting threshhold level set. Press to mute, at it were.

The 600-T control center incorporates the usual array of signal shapers; dual concentric bass and treble, master volume, balance, loudness contour, muting, high filter, and low filter. In addition the selector switch selects between tape head, phono, FM automatic, FM stereo, FM mono, tape play, and auxiliary sources. Furthermore there is a separate mono switch which sets the amplifier for mono operation. Finally, there is a speaker selector switch which permits using either of two separate stereo speaker systems, both sets simultaneously, or it can turn off all speakers to permit listening to earphones only. Two indicators are provided, one for FM signal strength and the other for the presence of FM stereo transmission (Fisher calls it 'Stereo Beacon').

Circuit Description

The front end of the tuner uses a 6HA5 as an r.f. amplifier, and a pair of 6CW4 nuvistors as oscillator and mixer. Following are five i.f. stages utilizing 2N2654 transistors. Limiting is applied at each of the i.f. stages. Then the standard ratio detector, and on to the multiplex demodulator. The muting circuit makes use of a pair of 2N2712's. The meter signal is tapped off the third i.f. stage.

The multiplex detector uses the time division approach, which doesn't require explanation at this time; it has been described in the past. The automatic switching circuit uses a 6CW4 nuvistor to drive a relay in the presence of sufficient 19-kc voltage. This relay automatically switches the circuits to stereo or mono output from the multiplex section, depending on the output of the 6CW4.

The amplifier and preamplifier sections are not unusual, albeit carefully designed. The preamp uses a silicon planar input transistor, an A1380, plus a 2N2614, to provide the appropriate amount of preamplification and equalization. As usual, the equalization is provided by means of a feedback network from the second to the first stage.

The high-level amplifier includes tone-, filter-, and volume-control drivers, using five 2N2614's and two 2N2613's, the latter in the first and third stages. The driver transistor for the power output stage is a 2N2148, driving a transformer which in turn drives the four output transistors (per channel). The output transistors bear strange numbers but turn out to be selected 2N2147's and 2N2148's in the well known RCA series configuration. The driver transistor drives the transformer through its emitter, thus presenting a low impedance source and permitting a transformer with a 1-to-1 ratio, which in turn permits a transformer with a rather wide frequency response. This approach, while not new in concept, is new in production equipment.

The power supply contains three silicon rectifier full-wave bridges plus an additional winding on the power transformer to supply the heater voltages for the four tubes. Transistor regulation is provided for supply voltages to the high-level amplifier.

The output stage is fused to prevent damage in the event of unusually heavy current surges for whatever reason. An impedance selector is provided to select between 8 and 16-, or 4-ohm speaker

Fig. 2. Fisher 600-T FM Stereo Receiver.

loads. At the 4-ohm position an additional load is switched in.

Performance

IHF sensitivity of the 600-T was 1.9 μv, a rather sensitive tuner by any standards. In the event that such excellent sensitivity is not needed, the input circuit has a local position (you must change connections at the antenna input terminals) which dissipates some of the sensitivity. Selectivity, alternate channel, was 53 db; capture ratio was 1.8 db; FM harmonic distortion (400 cps at 100 per cent modulation) was 0.5 per cent; signal-to-noise ratio at 100 per cent modulation was 72 db; and stereo separation at 400 cps was 37 db.

The amplifier provided 40 watts per channel at 1000 cps at 0.34 per cent harmonic distortion into a 10-ohm load. With the same load, and with less than 0.5 per cent distortion, it was within 1 db of 40 watts from 20 to 20,000 cps. IM distortion at 40 watts equivalent sine wave, with 60 and 7000 cps signals mixed 4:1, was 0.42 per cent. Over-all frequency response was 20–25,000 cps within 1 db and the power bandwidth (IHF) was 12–33,000 cps. (By the way it should be noted, in all fairness, that the power output and distortion figures we achieved would probably be even better with an 8-ohm load. We used 10-ohm non-inductive resistors for a variety of reasons, but we do acknowledge that the 8-ohm rating is somewhat more reasonable.)

Hum and noise were way down in the "mud" at −88 db. Input sensitivity for rated output was 2.7 mv at the low phono input and 5.7 mv at the high phono input. The low phono input would accept signals up to 65 mv before clipping, which should take care of all properly cut records. Tape-head sensitivity was 1.8 mv; low-level aux sensitivity was 200 mv and high-level aux was 365 mv; Channel separation at 1000 cps was 59 db.

Statistics aside, the Fisher 600-T provides one of the most musical sound reproducers Fisher has ever produced, possibly *the* most musical. We were impressed with its sound quality; bass solid, top clean and smooth. And as a tuner, definitely one of the most effortless and clean we have encountered. On our new standard antenna it pulled in 37 stations loud and clear. Impressive.

Circle 216

CONCORD R-2000 STEREO TAPE RECORDER

The Concord R-2000 is a two-speed stereo tape recorder intended for the professional or advanced audiofan. Unquestionably, its construction and features make it suitable for high-quality recording applications.

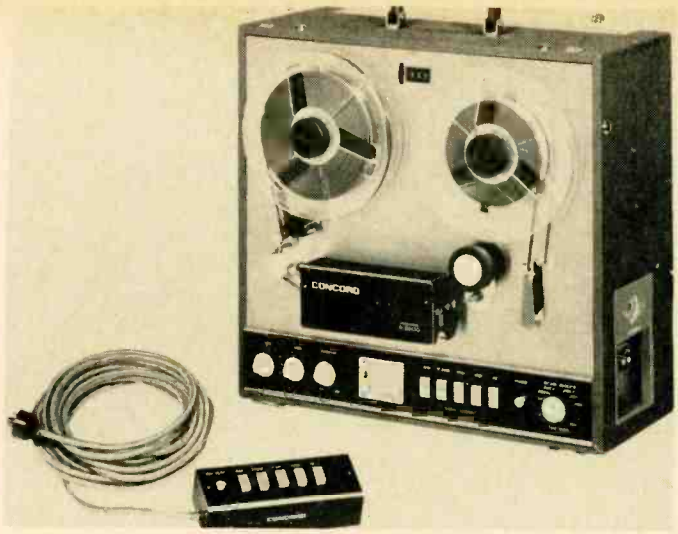


Fig. V. Concord R-2000 Stereo Tape Recorder.

The R-2000 has three motors, all of them rugged, heavy-duty, hysteresis-synchronous units. One look at these motors is enough to explain where most of the 46-lb. weight of the R-2000 comes from. The four heads are of the hyperbolic type and glass rod lifters are used rather than pressure pads. Of course, the fourth head ties in with its automatic reversal feature, which permits playing a tape moving in the reverse direction.

In order to take advantage of the automatic reversal capability, one need only form a closed loop at the end of the tape and fasten it to the reel, the machine does the rest.

Although the R-2000 we received featured ¼-track recording and playback heads, it is a simple matter to remove this head assembly and plug in other configurations which are available, including half- and full-track. Each head assembly has its own bias trimmer so that, after having been trimmed, one may interchange head assemblies at will without need for further adjustments.

The feature we enjoyed most was the remote control. The R-2000 is solenoid operated, and thus permits remote operation. The remote control is standard equipment with this machine. It permits recording, or playback, control 30-ft. away from the machine. It contains a complete set of controls insofar as tape motion is concerned. Of course one would have to set levels at the machine.

Tape handling is quite precise and smooth in the R-2000, as good as any we have encountered. The two-speeds are switch selected, and speed change is effected by electrical means rather than mechanical; the capstan motor is apparently two-speed. We were unable to spill or break tape with this machine, no matter what we did. The reason is a delay circuit which prevents going from a fast mode to a normal play mode for a length of time sufficient to allow the reels to come to a halt. Thus if one presses FAST FORWARD, and presses PLAY is when the tape moving fast, the latter command would not go into effect until the reels stopped. Speaking of fast forward, the R-2000 has the fastest fast forward or rewind we have encountered in a machine of this type. Now we know why they used such husky reel motors.

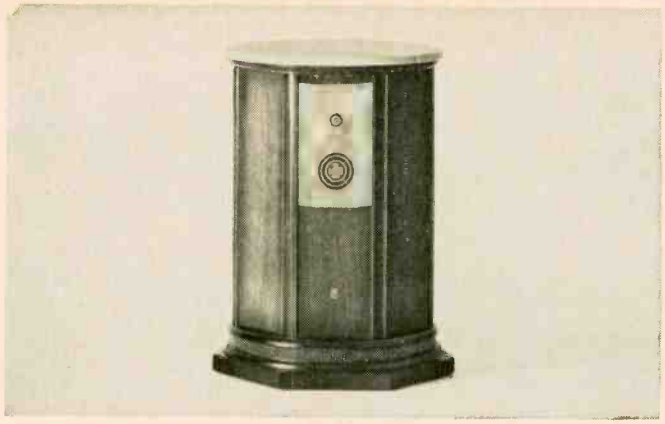
The exterior of the R-2000 is quite handsome, as evidenced by the glamor shot below. The dress plate is stainless steel, and the amplifier panel is heavy extruded aluminum as is the head assembly, and the pushbuttons are polished aluminum. The knobs and dual level indicators certainly add to the picture.

But underneath the handsome exterior lies the real beauty of the R-2000. For instance, under the dress panel the real working front plate is a solid plate of ¼-in. aluminum. Mounted to this heavy plate are a variety of heavy castings to support the weighty portions of the machine. The components are obviously heavy duty, and very neatly laid out. We noted previously the extremely rugged and heavy motors. The solenoids were very smooth acting, which partly accounts for the smooth tape handling. The capstan and the inertia roller have sizable flywheels, contributing significantly to the excellent performance.

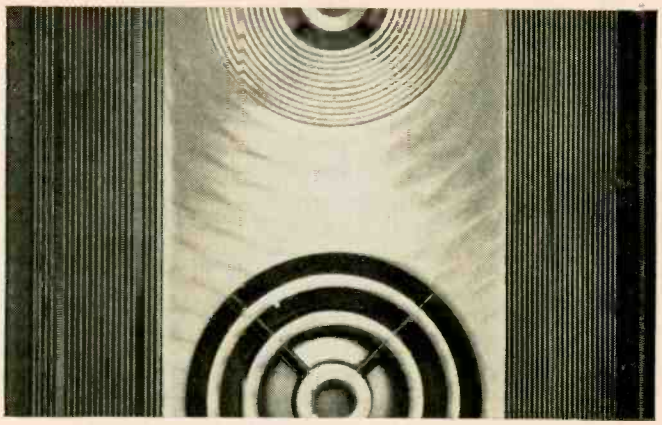
We were not provided with a schematic so that we can't detail the circuit as we usually do. All we could glean from the literature provided was that the oscillator was of the push-pull variety. We would have guessed as much from the quality of the waveform we observed on the 'scope.

With all the professional features incorporated in this excellent machine, we found ourselves wishing for just one more to cap it all off: easier access to the head assembly for editing. Most professional machines permit ready access to the head assembly so that it is easy to mark the exact location of material to be edited. The R-2000 just doesn't let

(*continued on page 51*)

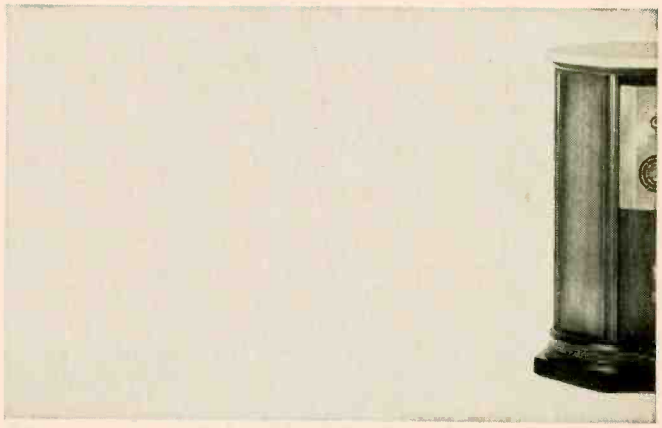


With the new Royal Grenadier

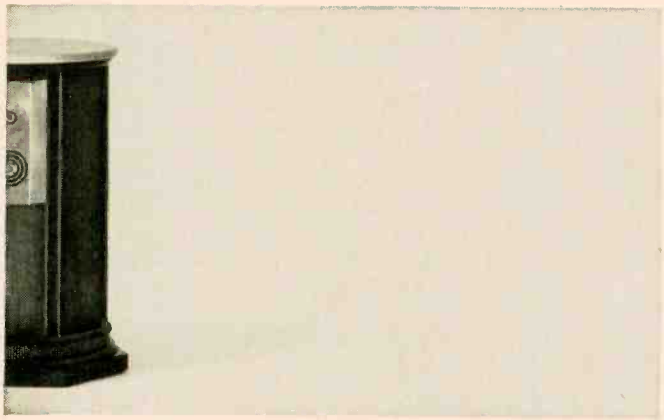


You can turn up the sound

You can turn down the sound

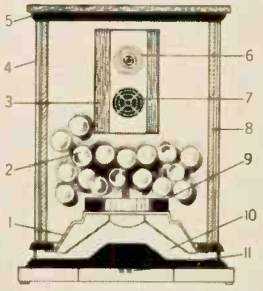


You can sit to the left of it



You can sit to the right of it

You can sit behind it



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Patents Pending

You can examine it

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RECORD REVUE

Edward Tatnall Canby *

Re-Reissue in Hi-Fi

Schubert: Octet, Op. 166. Vienna Konzerthaus Quartet and L. Wlach, K. Oehlberger, G. Van Freiberg, J. Hermann.

Westminster W 9044 mono (Collectors Series)

Here is a first-rate mono recording of fine music, beautifully recorded and played—and yet it is actually a re-reissue. More power to Westminster!

I asked especially for this one, out of many in the Collectors Series, because I fondly remember the original release and my hi-fi pleasure in playing it. But Westminster isn't being quite candid as to its real age. They can afford to be.

The jacket cooperatively lists this as a re-issue of no. 18471. Yep, I received WL 18471 back in mid-1957, some eight years ago. Same music, same artists. *But*, I discover, WL 18471 in turn was a re-issue (re-cut to RIAA) of a still earlier Westminster disc, out of the original and justly famous series with which the company began its career back in 1950. The older one is WL 5094, *ca.* 1952 I'd guess. I have it before me.

The tapes—for all three discs—must date, then, from 1950 or 1951.

I've been comparing the newest release and old WL 5094. The old one is louder and somewhat shrill; that would be, in part, the old Columbia LP curve, with steeper highs. Its surface is noisy too. But with a bit of judicious tone-control equalization it really sounds pretty good.

The brand new disc, though, is definitely cleaner, correctly equalized, and is cut at a lower (and safer) level, to take advantage of the newly quiet surfaces. But best of all is the sound—which is astonishingly modern thanks to Westminster's pioneer use of the Big Liveness technique, now the accepted norm for such music. Hardly need stereo at all.

It took a fine tape to begin with and Westminster had it—though fifteen years old. So you'd better check others in this Collectors Series, out of a technically and musically distinguished past.

Still More Baroque

Sylvia Marlowe plays Bach Harpsichord Concertos. (Nos. 1 in d, 5 in f, 7 in g.) Baroque Chamber Orch., Marlowe.

Decca DL 710104 stereo

Sylvia Marlowe is one of those artists who get ahead by sheer hard work—and she has got places. After these many years, she still plays her instrument with an occasional lack of phrasing, a pounding; but the fault is almost gone. And in these years she has so assiduously studied good Bach practice, and good harpsichord too, that she is certainly an audible authority on many of the good things we can find in such music. Moreover, she is as cool as a cucumber in these demanding works, where the keyboard player never has a split second to catch a figurative breath but just plays and plays without a pause. Many a pianist has gone to pieces under the strain, or betrayed his sheer nervousness. Not Marlowe!

Also, the lady has got herself a really excellent string orchestra here, and Decca has done an unusually nice recording job, beautifully balanced as between the solo instrument and the orchestra.

Nope, it's not "great" Bach keyboard playing, but it has a great deal of the mostest, even so.

Bach: Concertos for Two, Three, Four Harpsichords. Soloists, Ch. Orch. of the Sarre, Ristenpart.

Nonesuch H 71019 stereo

Antonio Vivaldi. (Concerti for piccolo, violin, two violins, three violins.) Soloists, Ch. Orch. of the Sarre, Ristenpart.

Nonesuch H 71022 stereo

Here are two interesting sets of multiple-instrument concerti, by Vivaldi and by Bach, played by good soloists (too many to list—except one with the odd name of Georg-Friedrich Hendel!) and by the excellent Sarre orchestra under Ristenpart that has appeared on several labels recently.

The Bach concerti, like his concerti for solo violin, are partly arrangements of other works. That for four harpsichords comes from a four-violin concerto by Vivaldi and the concerto for two harpsichords is out of Bach's familiar concerto for two violins. Both the three-instrument works are original, perhaps composed for Bach himself and his two older sons, Wilhelm Friedemann and Carl Philipp Emanuel.

What a wonderful whispering of dozens of quills plucking dozens of strings! It is a sound unique in music and virtually impossible to hear nowadays except on records, where the proper close-up balance can be attained. (Our concert halls are much too big, for the most part.) If you've only heard these on multiple pianos—try again.

The Vivaldi is less spectacular but is interesting too, and nicely played—particularly the two piccolo (sopranino recorder?) concerti, full of unbelievable virtuosity. The two-violin concerto intertwines the fiddles in inextricable arabesques; the concerto for three violins shows each one off in some detail.

Vivaldi: Concertos for Diverse Instruments. I solisti di Zagreb, Janigro. Assorted soloists.

Vanguard BGS 70665 stereo

An excellent collection of diverse Vivaldi, good cross-section of some of the main types of variety we now know in that master's enormous output. (Most of it was lost until very recently.)

There's first a charming concerto for, of all things, two mandolins; then one of the published works of Opus X, the dramatic flute concerto called "La Notte" (Night), a series of short pictorial sections neatly designed to show off flute technique and scare the daylights out of his Venice audience via musical spooks. Then a concerto just plain for string orchestra. Side 2 balances mandolins with a bassoon (one of 27 concerti for Bassoon!), all full of grunts and wheezes from down below. The final concerto is a big piece for two string orchestras, with two harpsichords, one for each, plus violin solos to boot—a work that goes back to the Venetian antiphonal music of Saint Mark's cathedral which more or less gave rise to the concerto in the first place. Stereo helps this one immensely.

Smooth, lively orchestral playing and mostly excellent solo work as well.

A Bouquet of Tartini and Nardini Concerti. Jan Tomasow; Ch. Orch. Vienna State Opera.

Vanguard SRV 154SD stereo

This solo violinist (who also conducts his orchestra) has picked a pretty bunch of late and very late Baroque concerti, not really of the Vivaldi-Handel-Bach type at all but much nearer to the Romantic, at least in Nardini. The somewhat lush Tomasow style of playing, the rather large orchestral sounds (are these Nardini's original orchestrations?) are thus not too much out of place—though the same in Vivaldi would be inappropriate.

Tartini, the older composer, is of the second generation of concerto writers in Italy—and how much the concerto changed in those early years! He is all sweetness of harmony, full of Italian sentiment, already heading towards the much-prized "Italianate" grace that went into the *galant* music of the North, out of which came Mozart and Haydn. But Tartini hasn't much to say here nor, for my ear, with much strength. Rather flabby music, this. Nardini, his pupil, is on the way to bigger things—the later, or Paganini-style, violin virtuoso concerto. His fiddle never stops a moment, and it is always out in front with all the show it can muster. Nardini was, of course, a fabulous violinist. Anybody could guess *that*, just listening. Well, so is Tomasow, the virtuoso on this record.

Purcell: Sonata for Trumpet and Strings, Incidental Music for The Virtuous Wife, The Gordian Knot Untied; Pieces for Harpsichord. Rhenish Chamber Orch. of Cologne, Kehr; Ruggiero Gerlin, harps.

Nonesuch H-71027 stereo

Only one opera, "Dido," in Purcell's catalogue, but dozens and dozens of stage works to which he wrote incidental music, some of it quite extensive. That was the then-current style, and the plays themselves must have been something to behold, in the high Restoration manner, lustily unprintable as of today!

Some of the nice names (from my notes on this record) were Sir Anthony Love or the Rambling Lady, Distressed Innocence or the Princess of Persia, The Maiden's Last Prayer, or Any Rather than Fail, The Marriage-Hater Matched, Rule a Wife and Have a Wife. . . . You'd hardly believe it from the music out of two of them heard upon this record, the Virtuous Wife and the Gordian Knot Untied. Lovely, poignant string stuff, the best of Purcell. Also a short trumpet bit and a group of

solo harpsichord pieces, the latter played in rather old-fashioned style by Ruggero Gerlin—nice, even so.

Bach: Cantata No. 61, Nun komm, der Heiden Heiland. Schütz: The Seven Last Words. Old North Singers, instruments, soloists, John Fesperman. Guest solo: Hugues Cuenod.

Cambridge CRM 417 mono

I like the Bach here. A good American choir, not too wobbly (and nicely in tune), a superb soprano solo, two good tenors and a contralto, plus the redoubtable Cuenod, whose semi-French (Swiss) voice is sincere and meaningful, if rather edgy in tone. None of it is standard "church-choiry" in sound, thank the Lord, and so this record can compete with the superb German and the excellent British cantatas we're used to on other labels.

The Schütz "Seven Last Words," one of his late works, (1645—40 years before Bach's birth) is not so satisfactory here. But then it seldom is. The trouble is, the music seems to ask for slow tempi, much halting and hesitating; the serious subject tends further to set a mood of blackness. Things move along awfully slowly. It seems to me that a faster pace in the recitative and quicker connections between the short sections would do wonders towards making this music a living experience, and never a dull moment. It's pretty funereal in this version as, alas, it is in most others too.

Is there a stereo? Must be. They sent me mono.

Solo, Duo, Trio

Bach. Unaccompanied Suites Nos. 1–6. Milton Thomas, viola.

Concert-Disc SP 503 (3) stereo

Paganini: The 24 Caprices. Emmanuel Vardi, viola.

Epic BSC 149 (2) stereo

These two monumental albums of solo viola music—no accompaniment—have opposite values and interest, complementing each other rather oddly. Neither the Bach nor the Paganini were composed for viola. The Bach was for the larger cello; whereas the Paganini Caprices were for the smaller violin.

The Bach Suites, originally for the cello, are lighter and happily thinner on the more flexible and higher-pitched viola. (The cello as played today is an uncomfortable instrument for the suites at best.) Moreover, Mr. Thomas offers an immense virtue—he plays beautifully in tune, even in the most difficult double-stops. And so the basic meaning of the music, which is wonderful for any ear, has an easy time penetrating to the listening mind. This even though Mr. Thomas' playing style is rhythmically a bit old fashioned, i.e. with a lot of rubato, an uneven pacing for poetic effect. (The new style is to do everything in strict time.)

This recording, then, is a good bet simply as Bach, good for any interested listener who enjoys the composer. Also an interesting comparison with the same music as played on the cello.

The Paganini Caprices are another story. Musically they are of slight interest, if pleasant; and they are here played on a bigger, more unwieldy instrument than the original, rather than the other way around as in the Bach. Perhaps it is inevitable, then, that Mr. Vardi's feats of virtuosity on the viola should sound pretty squeaky and scratchy to the uninitiated. Inevitable, too, that many a passage should be startlingly out of tune; for what more can you expect, if you insist on playing upon the big, clumsy viola what was written for the lightest, most devilishly expert violinist of all, Paganini himself!

I suggest that the Vardi Caprices are strictly for the technical-minded string player, who may find the Vardi viola feats exciting. I don't. Half the time I can't make head or tail of the musical sense.

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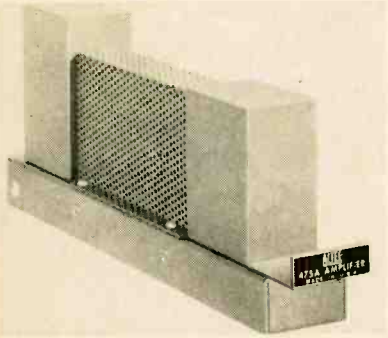
NEW PRODUCTS

• **Solid-State Preamplifier-Booster.** The new Altec 475A has been designed, electrically and mechanically, to function as a preamplifier, booster amplifier, or program amplifier. It is a direct plug-in replacement for the tube-type Altec 458A preamp and 459A program amplifier utilized in the 250 SU control console. The new unit employs all silicon transistors which permit the amplifier to operate continuously at 85-deg. C without derating and still provide operational stability not attainable with tube-type amplifiers. The noise figure of this amplifier is −127 dbm, with unterminated input. Total harmonic distortion

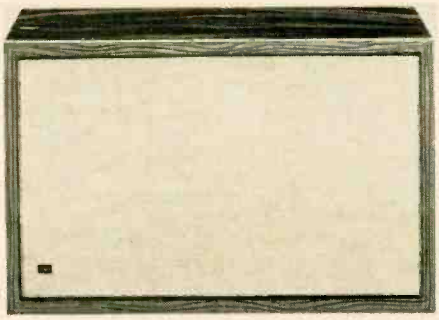


does not exceed 0.25 per cent from 50 to 20 kc at +27 dbm output capacity, and is less than 1.0 per cent from 20 to 20 kc with a +27 dbm output. Overload recovery time is 5 microseconds for 100 per cent overload. By utilizing transformers on both input and output with multiple impedance ranges, complete isolation is afforded for ease of matching the 475A to associated equipment. All necessary wiring and impedance selection, via strapping, is accomplishd on the tray socket, allowing the 475A amplifier to be interchanged with any other 475A regardless of its circuit function or position. **Circle 200**

• **Low-Priced Receiver.** The Lafayette LR-400 incorporates many deluxe features in its new AM-FM stereo receiver. 30 watts of power are provided. The FM section features a nuvistor front end giving 2.5 μv sensitivity for 20 db of quieting. Variable afc is provided. A "Stereo Search" circuit identifies a multiplex station with a time signal through the speakers. The multiplex separation provided is 25 db at 400 cps. Amplifier specifications include a

frequency response of 20–20,000 cps ± 2 db and a power output of 15 watts per channel at 1 per cent harmonic distortion. Hum and noise is −55 db at low level inputs and −68 db at high level. Output impedances are switch selected for 8 and 16 ohms. Also included is a front-panel earphone jack. Dimensions are 17¼ W × 5⅝ H × 12¼ D. Retail price is $159.95 for the LR-400 with its 16 tubes, 9 diodes and EM-84 tuning eye. An enclosure is included.
Circle 201

• **New Speaker Systems.** R. T. Bozak, known best for large-sized systems, has just announced three new speaker systems of "bookshelf" dimension. All use full-size Bozak components, with a new cabinet design that is said to give the sound a spaciousness formerly possible only with far larger systems. The cabinets are matte-finished walnut with natural-linen grille cloths, finished on all four sides for horizontal or vertical placement. The Sonata II, Model B-211 (shown) is the smallest, measuring 23⅛" × 14¼" × 11½" deep. It has one B-199A bass speaker and a single B-200Y treble unit, with an LC network that crosses over at 2500 cps at a 6-db-per-octave rate. Frequency range is 50–16,000 cps, impedance is 8 ohms and recommended amplifier power is 20 watts rms. The Concerto II and Concerto III,



models B-312 and B-313 respectively, use the same 24½" × 17¼" × 12½" deep cabinet. Concerto II is a two-way system using the B-207A coaxial speaker whose response is 45 to 16,000 cps with a 6-db-per-octave crossover at 2500 cps. Concerto III adds the B-209B midrange speaker and N-10102A crossover to achieve a three-way system with improved mid-range characteristics. Both the Concerto II and III systems are rated at 8 ohms and recommended amplifier power is 20 watts rms. It is worthy of note that the Concerto II can be later converted into a III and that the standard components contained in either can be transferred to larger cabinets for increased performance capabilities. **Circle 202**

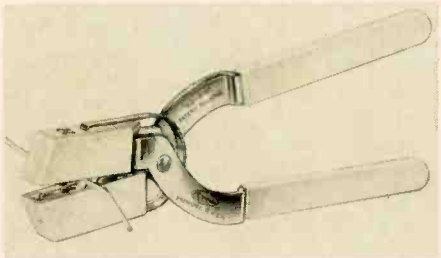
• **Easy-to-Istall Automotive PA System.** The Ampli-Vox Sound Cruiser, Model S-310 converts any automobile, in a matter of minutes into a sound truck. The speakers are pre-mounted on a board equipped for car roof strapping. The 32-watt all-transistor amplifier plugs into the cigar lighter receptacle of the car, automatically polarizing the system. The amplifier draws an idle current of 40 ma at 12 volts. It will provide 32 watts EIA music power and offers a frequency response of 50–15,000

cps. Distortion at full output is rated at less than 5 per cent. Speaker outputs for 8 or 16 ohms are provided. Inputs for microphone or other high level inputs are provided. Controls include a master volume, aux volume, aux standby, and tone control. The two implex horn speakers provided with the system are capable of handling full amplifier output. They are weatherproof and will not be damaged by rain, snow or temperature extremes. Also included with the system is a hand-held noise-canceling microphone, supplied with a five foot coil cord and equipped with a push-to-talk switch. The system is available at a retail price of $169.95. The amplifier alone retails at $79.95. Accessories available include a.c. or flashlight battery adapters. **Circle 203**

• **Complete Tape Recorder.** The latest addition to the Ampex 2000 series tape recorder line is the Model 2075. This is a self-contained high-fidelity tape recorder-player with built-in amplifier and speakers. It features an oiled walnut cabinet, brown color-coordinated top plate and a flush folding carrying handle. The result is a unit that will blend into a living room

and yet retain the advantage of portability. The new model is otherwise identical to the model 2070, which is offered in a black vinyl-clad luggage-type carrying case. Suggested list price of this new unit is $529. All of the Ampex 2000 series units feature drop-in threading and automatic reversing allowing for the play of both sides of a four-track stereo tape without the need to rewind or flip reels. **Circle 204**

• **Precision Wire Stripper.** A high-accuracy stripper that will remove insulation mechanically without nicking the conductor, and with absolute reliability, is announced by Clauss Cutlery. The head of the tool grips and centers the wire. A precision blade scores the insulation without



touching the conductor. The result is an ease of operation that allows even the unskilled to do a perfect job the first time the tool is used. Eight color-coded tools for wire sizes #18, 20, 22, 24, 26, 28, 30, and 32 are available. **Circle 205**

• **Self-Stick Pressure Pads.** Recordists with machines using pressure pads know that best recorder operation demands occasional change of these parts. Worn pads cause tape squeal, flutter, or improper head contact of the tape. Robins Industries has made available a replacement kit that contains self-sticking and pre-cut pads for simple replacement. They are supplied in a package of 44 pads in two thicknesses, pre-cut to fit most recorders. Each pack also contains uncut, but preglued, felt pads to take care of unusual size requirements. All that is required, once a proper size is selected, is to remove the old pad, and apply the new by peeling the protective backing paper from the adhesive surface. List price of the item, catalog number TPP-2, is $1.00.
Circle 206

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- ☐ MR 71 fm stereo tuner
- ☐ MR 67 fm stereo tuner
- ☐ MC 225 stereo power amp
- ☐ MC 240 stereo power amp
- ☐ MC 275 stereo power amp
- ☐ MA 230 stereo amp/preamp
- ☐ MX 110 stereo tuner/preamp

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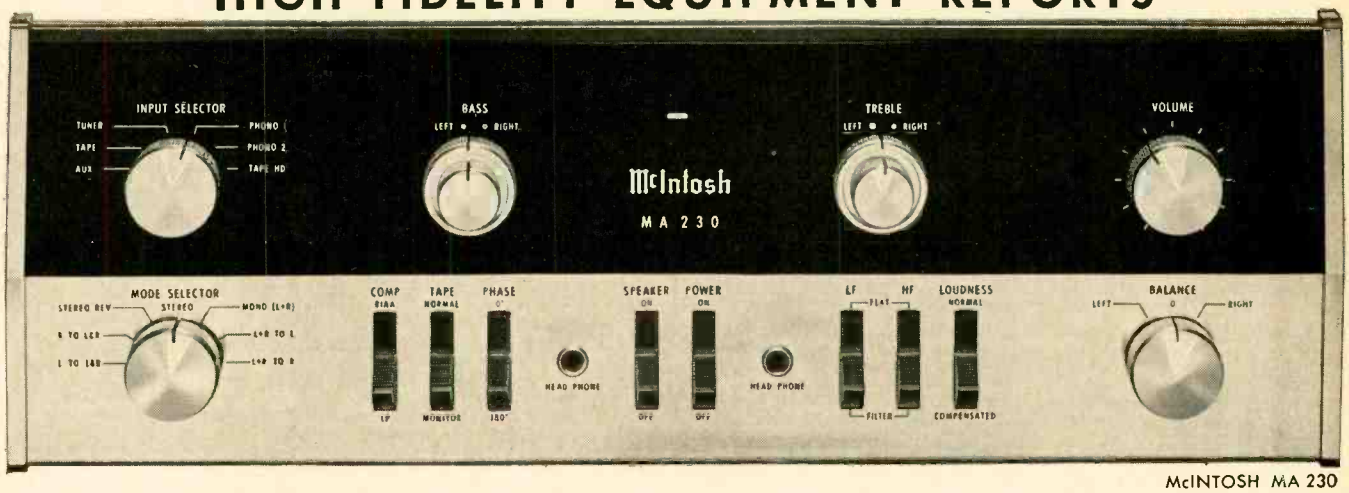

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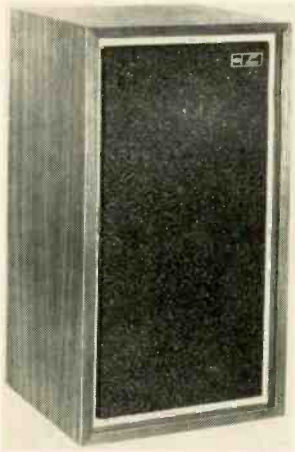
Circle 126 on Reader Service Card

• **Restyled Tuner Kit.** The Heath deluxe, all-transistor AM-FM stereo tuner kit has had a face lifting. The new cabinet is fashioned in walnut with a matching walnut-finished, hinged, lower face plate, charcoal upper face plate, and refracted lighting. The tuner features 25 transistors, 9 diodes, automatic stereo switching, and stereo indication. Individual AM and FM tuning meters are provided. Features also include a stereo phase control for



maximum station separation and minimum distortion; emitter-follower output stages to eliminate hum and high-frequency loss; filtered left and right channel outputs for "beat-free" recording; adjustable FM squelch; flywheel tuning and a zener regulated power supply. Kit assembly is made easy by factory assembly of the FM front end and five stage i.f. board. They are prealigned for drop-in installation. Desigated the AJ-43C the tuner sells for $129.95. **Circle 207**

• **Compact Speaker.** This new bookshelf unit offers full range performance from multiple speakers without the usual disadvantages of crossover networks. On the theory that LC networks are responsible for resonance, phase shift, and distortion in multiple speaker systems, ADC's new Model 303A Brentwood avoids electrical crossover from woofer to mid-range speakers. Instead a single 8-in. driver functions as two separate speakers through a principle called, by the manufacturer, "Frequency Discriminating Decoupling." With this design, different portions of the cone of a single speaker are made to handle different frequencies separately. True woofer performanc, down to a claimed 35 cps with low distortion, is provided by a high-compliance, extremely linear, suspension. A compliant section near the voice coil, however, independently handles mid-range frequencies to 6000 cps without an electrical crossover. This section decouples the larger, outer portion of the cone from the voice coil above the low-frequency range, preventing breakup and distortion. Above 6000 cps a separate, Mylar-domed tweeter is used. A simple series capacitor is used to block bass frequencies. Over-all system frequency response is claimed to be 35–20,000 cps ± 3 db. Harmonic distortion, with a 1-watt input, remains below 5 per cent down to 33 cps. Dimensions of the oiled-walnut finish cabinet are 23¾" × 13" × 11¾". List price is $95.00. **Circle 208**

Industry Notes . . .

• **AKG-Norelco.** AKG microphones, manufactured by Akustische U. Kino-Geräte G.m.b.H., Vienna, Austria, will henceforth be labelled Norelco microphones by North American Philips Company, Inc., sole importers of these microphones into the United States. Mr. John H. McConnell, Audio-Video Sales Manager for Norelco, located at 100 E. 42nd Street, New York, N. Y., stated that "the decision to brand these microphones with a Norelco trademark stems from the need to merchandise amplifiers and other sound system components under one strongly identifiable mark." All Norelco Sound Systems products, including these microphones, are warehoused and will continue to be serviced at the new North American Philips warehousing and service facility at 30-10 Review Avenue in Long Island City.

• **University Opens East Coast Warehouse.** LTV University, a division of Ling-Temco-Vought, Inc., of Oklahoma City, announced the opening of an East Coast warehouse and service facility in White Plains, New York. This makes the fifth regional warehouse and service facility LTV University has opened throughout the country. The other facilities are located in Portland, Oregon, Los Angeles, San Francisco, and Chicago. The new facility is located in the former headquarters of LTV University at 80 South Kensico Avenue, and as a further convenience for their dealers, LTV University has arranged for its former phone number—914-WH 6-7700. This new facility has more than 30,000 square feet of warehouse space and will service 15 North and Mid-Atlantic states, which include all of New England, New York, New Jersey, Pennsylvania, Maryland, Washington, D. C., Delaware, West Virginia, Virginia, North Carolina, and eastern Ohio (Cleveland, Akron, Youngstown, Canton and neighboring cities). Warehouse stocks will include all the diverse lines of products manufactured by LTV University.

AUDIOCLINIC

(*from page 4*)

use one box and connect it as follows:

Connect a short length of rotator cable to the back of the box. Then wire the cable to a female socket having the appropriate number of pin connections. Make a diagram of the pins to which the various wires are connected. Match this diagram with the wiring of a male plug connected to the cable coming from the rotator on the roof. When the plug is inserted, the control box will operate normally. Additional male plugs can be placed at each control box location. Naturally, the control-box line cord should plug into the wall outlet at each location.

If you use two control boxes, remember to be careful that the rotator is synchronized with the box in use at the time. If you do not do this, the direction indicated will not be that of the actual antenna heading. Further, there is danger that the antenna rotator motor may be damaged because of this lack of synchronization. Much depends upon the type of rotator. Æ

EXHIBITOR DIRECTORY

1965 Los Angeles High Fidelity Music Show

EXHIBITOR	ROOM
ACOUSTIC RESEARCH, INC. Loudspeaker Systems, Turntables	102G
ACOUSTICA ASSOCIATES Console Systems, Loudspeaker Systems, Tuner/Amplifier Combinations	52D
ALTEC LANSING CORPORATION Amplifiers, Loudspeaker Systems, Loudspeakers, Tuners, Microphones, Transformers	131H
AMPEX CORPORATION Home Entertainment Equipment, Tape Recorders	33C & 34C
AUDIO DYNAMICS CORPORATION Phonograph Cartridges, Loudspeaker Systems, Tone Arms, Accessories	117H
AUDIO MAGAZINE AUDIO Magazine, Books on High Fidelity and related subjects, Lectrodex Cumulative Periodical Index	68F
BENJAMIN ELECTRONIC SOUND CORPORATION Automatic Turntables & Record Changers, Benjamin Stereo Phonograph, Phonograph Cartridges	116H
BOGEN COMMUNICATIONS DIVISION Lear Siegler, Inc. Tuners, Amplifers, Turntables, Tuner/Amplifier Combination, Accessories	81G
THE R. T. BOZAK MFG. CO. Loudspeakers, Loudspeaker Systems, Loudspeaker Enclosures	95G
BRITISH INDUSTRIES CORP. Loudspeakers, Loudspeaker Systems, Garrard Automatic Turntables & Record Changers	93G, 94G & 118H
CASTAGNA see EMI	60E
CITATION see HARMAN-KARDON	107H
DAVID CLARK COMPANY, INC. Stereophonic Headsets, Accessories	39D
CONCERTONE, DIV. OF ASTRO-SCIENCE CORP. Tape Recorders, Tape Decks, Loudspeakers, Head Demagnetizers, Microphones, Accessories	14B
DUAL see UNITED AUDIO	96G
DYNACO, INC. Amplifiers, Preamplifiers, Tape Recorders, Portable Radios, Microphones, Tuners, Phonograph Cartridges, Electronic Kits	67F
EICO ELECTRONIC INSTRUMENT CO., INC. Amplifiers, Tuners, Tuner/Amplifier Combinations, Tape Recorders, Loudspeakers, Electronic Kits	9A
ELAC see BENJAMIN	116H
ELECTRO-VOICE, INC. Loudspeakers, Loudspeaker Systems, Tape Recording Microphones, Loudspeaker Enclosures and Kits, Amplifiers, Tuners, Tuner/Amplifier Combinations	129H & 123H
ELPA MARKETING INDUSTRIES, INC. Turntables, Tone Arms, Phonograph Cartridges, Accessories	103G
EMI-SCOPE ELECTRONIC Loudspeakers, Portable Phonographs, Tone Arms	60E
EMPIRE SCIENTIFIC CORP. Phonograph Cartridges, Tone Arms, Turntables, Loudspeaker Systems	108H
ERIC ELECTRONICS CORP. Amplifiers, Tuner/Amplifier Combinations, Tuners	5A
FISHER RADIO CORP. Tuners, Tuner/Amplifier Combinations, Amplifiers, Stereo Master Audio Control, Loudspeaker Systems, Radio Phonograph Consoles	87G, 85G & 88G
GARRARD see BRITISH INDUSTRIES	93G, 94G & 118H
GOODMANS OF ENGLAND see UTC	59E
GRADO LABORATORIES, INC. Phonograph Cartridges, Tone Arms, Turntables, Loudspeaker Systems, Accessories	72F
HARMAN-KARDON, INC. Subsidiary of Jerrold Corp. Tuner/Amplifier Combinations, Amplifiers, Tuners, Preamplifiers	107H
KENWOOD ELECTRONICS, INC. Tuners, Amplifiers, Tuner/Amplifier Combinations	128H
KOSS/REK-O-KUT Stereo Headphones, Tone Arms, Accessories, Turntables	106H

EXHIBITOR	ROOM
JAMES B. LANSING SOUND, INC. Loudspeakers, Loudspeaker Systems, Loudspeaker Enclosures, Amplifiers, Preamplifiers	78G & 79G
LEAR SIEGLER see BOGEN	81G
MARANTZ COMPANY Amplifiers, Preamplifiers, Tuners	22B & 21B
McINTOSH LABORATORY, INC. Amplifiers, Preamplifiers Preamp/Amplifiers, Tuners, Multipath Indicators	76F
MIRACORD see BENJAMIN	116H
NORTH AMERICAN PHILIPS CO., INC. Tape Recorders	28C & 32C
ORTOFON see ELPA	103G
PE see ELPA	103G
PICKERING & COMPANY, INC. Phonograph Cartridges	75F
REK-O-KUT see KOSS	106H
3M COMPANY, REVERE-WOLLENSAK DIV. Tape Recorders and Accessories	40D & 44D
ROBERTS ELECTRONICS, INC. Tape Recorders, Tape Decks, Accessories, Microphones, Loudspeakers	16B & 20B
H. H. SCOTT, INC. Tuners, Tuner/Amplifier Combinations, Amplifiers, Consoles, Electonic Kits, Loudspeakers	109H & 115H
SHERWOOD ELECTRONIC LABS. INC. Tuners, Tuner/Amplifier Combinations, FM Stereo Adapters, Equipment Cabinets, Loudspeaker Systems, Crossover Networks	101G
SHURE BROTHERS, INC. Phonograph Systems, Phonograph Cartridges, Tone Arms, Microphones	122H & 124H
STANTON MAGNETICS, INC. Phonograph Cartridges, Turntables, Tone Arms, Loudspeaker Systems	57E
STRATOPHONIC see HARMAN-KARDON	107H
SUPERSCOPE/SONY Tape Recorders, Tape Decks, Microphones, Loudspeaker Systems	63E & 64E
TANDBERG OF AMERICA Tape Recorders, Radios, Loudspeakers, Microphones	56E
TANNOY (America) LIMITED Loudspeakers, Loudspeaker Enclosures, Loudspeaker Systems	38D
TELEX ACOUSTIC PRODUCTS/ TELEX MAGNECORD TAPE RECORDERS Tape Recorders, Headsets	86G
THORENS see ELPA	103G
TROUBADOR see EMPIRE	108H
UNITED AUDIO PRODUCTS Turntables, Tape Recorders, Tape Decks, Loudspeakers, Phonograph Cartridges, Portable Phonographs Loudspeakers, Loudspeaker Systems	96G
UTC-SOUND DIVISION Goodmans of England	59E
UNIVERSITY LOUDSPEAKERS, DIV. LTV Loudspeakers, Loudspeaker Systems, Microphones	86G
UTAH ELECTRONICS Loudspeakers, Loudspeaker Systems	80G
VIKING OF MINNEAPOLIS, INC. Tape Recorders, Amplifiers, Tape Duplicators	136H
WATTS see ELPA	103G
WHARFEDALE see BRITISH INDUSTRIES	93G, 94G & 118H

JAZZ and all that

Bertram Stanleigh

Stan Getz Greatest Hits
Prestige Mono PR 7337

Twelve numbers recorded originally on 78's in 1949 and 1950, shortly after Getz's departure from the Herman Herd to work with small groups of his own. This is, indeed, Getz at his very highest pinnacle, and the set includes his famous "Too Marvelous for Words." Piano, bass and drums back Getz in all numbers, with Al Haig on piano for eight tunes and Tony Aless on the remaining four. Gene Ramey, Tommy Potter and Percy Heath, and Stan Levey, Roy Haynes and Don Lamond each contribute four numbers on bass and drums, respectively. Sound on this issue is not up to present day standards, but the marvelous playing more than makes up for the noisy surface sounds and the distant miking of bass and drums. Fifteen years ago Getz expended more ideas on a single tune than he now manages to inject into an entire evening of performances. There is no bombast or filler, just crisp, bright and inspired improvisation from beginning to end.

Bechet of New Orleans
RCA Victor Mono LPV 510

Another of the excellent *Vintage Series*, this platter features Sidney Bechet on both clarinet and soprano sax in sixteen recordings made between 1932 and 1941. While Bechet's waxings span a much wider period than is represented on the present disc, and many of his greatest recordings are missing from the present collection, there is no cause for disappointment with this offering. It contains a wealth of truly great performances that include such stars as Tommy Ladnier, Sidney de Paris, Henry "Red" Allen, Charlie Shavers, Jelly Roll Morton, Willie "The Lion" Smith, Hank Duncan, Cliff Jackson, Earl Hines, Albert Nicholas, Mezz Mezzrow, Baby Dodds, Zutty Singleton, and Sid Catlett. A host of traditional New Orleans numbers are offered, including "I Thought I Heard Buddy Bolden Say," "Maple Leaf," "Weary Blues," "12th Street Rag," "Shake It and Break It," "Save It Pretty Mama" and "Baby Won't You Please Come Home." An unusual 1941 recording of "Sheik of Araby," in which Bechet plays clarinet, soprano sax, tenor, piano, bass and drums by means of a series of overdubs is represented in a previously unissued version. The same superb care that Victor has lavished on transfers in its previous *Vintage Series* releases results in such stunning presence and bright, fresh sound that it's very difficult to keep in mind that some of these masters were cut more than thirty years ago.

John Coltrane, Kenny Burrell, Jackie McLean, Mal Waldron: Jazz Interplay
Prestige Mono PR 7341

Charlie Rouse, Donald Byrd, Jackie McLean, Ray Bryant, Frank Foster, Arthur Taylor: Hard Cookin'
Prestige Mono PR 7342

Wardell Gray Memorial Album
Prestige Mono PR 7343

Art Farmer & Donald Byrd: Trumpets All Out
Prestige Mono PR 7344

These four two-record sets are all reissues of discs that have been unobtainable for several years. Each offers highly worthwhile material that makes its return a cause for rejoicing, and, best of all, Prestige has brought these two-disc sets out as "bonus packs" selling for the price of a single disc. The Wardell Gray set consists of twenty numbers cut between November 1949, in New York, and December 1951, in Los Angeles. Gray is heard with five different groups. Among his collaborators are Al Haig, Hampton Hawes, Clark Terry and Art Farmer. Farmer and Byrd's *Trumpets All Out* was previously issued as two singles called "Two Trumpets" and "Three Trumpets"; trumpet number three is Idrees Sulieman. *Hard Cookin'* quite properly reshuffles the credits so the the sidemen on these two discs receive their fair share of honors. Originally these two platters were *Taylor's Wailers* on Prestige and *Taylor's Tenors* on New Sounds. I don't know the original titles of the two Coltrane platters, but they are excellent examples of his work during his formative period. Wise collectors will pick up these sets as soon as possible, since bargains of this kind are seldom made available for long periods of time.

Vince Guaraldi Trio: Jazz Impressions of Charlie Brown
Fantasie Stereo 85017

The Charlie Brown in the title is the sad young hero of the popular comic strip, *Peanuts*, by Charles Schulz, and the set consists of the original soundtrack of a forthcoming television documentary on Mr. Schulz and his popular characters. Titles of the disc's nine selections will immediately excite violent anticipation in all *Peanuts* fans: "Oh, Good Grief," "Pebble Beach," "Happiness Is," "Schroeder," "Charlie Brown Theme," "Linus and Lucy," "Blue Charlie Brown," "Baseball Theme" and "Freda (with the Naturally Curly Hair)." But whether or not the musical score relates successfully to the film is a matter that cannot be determined at this point. By itself, the disc is a work of sheer delight. Easy and relaxed, it stands up very well without benefit of a visual image: only "Schroeder," with its quotation from the Beethoven *Minuet in G*, seems less than a complete entity. Any Guaraldi fan, or any fancier of light, deft, airy piano jazz will welcome this release, even if he belongs to that small group that dislikes *Peanuts*. For the much larger group that adores Master Brown and his cohorts (your reviewer is a stanch member of the latter contingent) there is the added delight of twelve 8 × 10 inch color reproductions of Charles Schulz originals, suitable for framing. The sound is splendid.

George Gruntz Quintet: Bach Humbug!
Philips Stereo PHS 600-162

A collection of baroque composers, including Telemann, Byrd, Couperin, Lully, Handel, Pachelbel, Dowland, Rameau, Frescobaldi and Corelli, but no Bach. From time to time this quintet pours forth some wildly improvisational music that is much closer to real jazz than the efforts of the Jacques Loussier Trio or the Swingle Singers. The instrumental timbre, consisting of harpsichord, flute, clarinet or soprano sax, bass and drums, is also more sympathetic to the original material. But this is a strangely uneven release that suffers from excessive formalism in the original statements of the music and a lack of overall polish. The high points, such as the opening Telemann composition, hold out real promise for a successful blend of eighteenth and twentieth century styles, but numbers like the extract from Handel's *Water Music* are stiff, awkward and painful. AE

EQUIPMENT PROFILE

(*from page 40*)

you get close enough. This is not important for most uses of the machine.

Performance

The R-2000 is a two-speed machine, 7½ and 3¾ ips. At 7½ ips frequency response was within 2 db from 30–16,000 cps, at 3¾ ips it was within 2 db from 40–12,000 cps. Wow and flutter at 7½ ips was 0.11 per cent and at 3¾ ips it was 0.18 per cent. Signal-to-noise ratio was 56 db. Rewind time for a 1200-ft. reel was 45 seconds. Speed accuracy was within 0.2 per cent.

In sum, the Concord R-2000 is an excellent machine well suited for its intended audience in many applications. In its price category, less than $700, it merits serious consideration by those who want a rugged and reliable machine which performs its functions extremely well. Circle 217 Æ

KNIGHT-KIT MODEL KG-870 TRANSISTOR STEREO AMPLIFIER

Neat, compact, easy to build, and satisfactory in performance—that in a nutshell sums up the Knight-Kit KG-870. For in its metal cabinet measuring 3½-in. high, 13-in. wide, and 13-in. deep over knobs and fuse post beats a medium-power transistor amplifier which at just under $100 is a good buy in anyone's money. The walnut case is a little larger, costs $6 more.

In appearance it boasts a gold-finish front panel at the top, a black section which mounts selector, volume, and loudness controls, and a slightly recessed white portion at the bottom mounting four slide switches, pilot light, and a headphone jack. The knobs are of anodized aluminum, with the bass and treble tone controls of the dual-concentric type. The scratch and rumble filter switch is controlled by a knob having four positions—flat, scratch, rumble, and scratch/rumble. The slide switches are: tape monitor, channel reverse, stereo/mono, phase reverse, and power.

The selector switch has four positions: tape head, phono, aux, and tuner. Two sets of inputs are provided for the aux position—one with a sensitivity of 0.5 volts for rated output, and the other for a 2.0-volt input signal. The tuner input requires 1.0 volts for rated output, and the tape output for that signal is 0.5 volts. 1.0 volts at the aux 1 input gives a 0.8-volt output for a recorder, not affected by volume or tone-control settings.

Tape-head input sensitivity is 2 mv for rated output, and phono is 3.0 mv. Tone controls give either a boost or cut of about 15 db at 50 and 15,000 cps. and the loudness control, flat at maximum,

gives progressively greater contouring over a range of 40 db. The line power fuse is accessible on the rear panel, while separate fuses for the positive and negative d.c. supplies are located inside. Since they do not fuse the speaker circuits, they are not likely to blow unless a filter capacitor should fail.

Circuit Description

The output stage consists of two transistors per channel, fed from positive and negative supplies so that there is no d.c. component in the output.

Output stages in transistor amplifiers are usually of not more than about three configurations: complementary pairs, full-bridge, or half-bridge. The complementary-pair circuit requires matched PNP-NPN pairs, and transistors of these types at high powers are expensive. The full-bridge circuit is easier on the transistors, but requires four per channel. The half-bridge circuit requires a complicated input unless driver transformers are used, and needs either a split power supply or an output capacitor and a single power supply. The use of the output capacitor merely exchanges some of the limitations of the transformer for those of the capacitor, and the latter tend toward introducing their own problems—notably a reduction in damping at low frequencies where it is most needed. The conventional half-bridge circuit, when driven by transformers, has the common junction of the emitter of the top transistor and the collector of the bottom transistor at a d.c. potential above ground equal to half the power supply voltage, and thus requiring a capacitor to couple to the speaker if d.c. is to be kept out of speaker leads, as it should. In the KG-870, the common junction is at ground potential, and the output transistors are fed from a power supply balanced to ground by equal amounts. In place of conventional resistors in the two emitter circuits, a tungsten-filament automobile-type lamp is used—one which has two filaments in the same envelope. One of these is used as the emitter resistor of each of the output transistors, and any unbalance of the transistors results in a slight change in the relative resistances of the two filaments so as to restore balance. Though this is a difficult phenomenon to describe, let it suffice to say that a high degree of balance is maintained, and the circuit is dynamically self-correcting over a wide range of signal levels. It also offers sufficient protection to the output transistors to provide reliable operation. The coupling transformer permits choosing the operating potentials for the bases so that the common output terminal of the stage remains at ground potential, thus eliminating the large output capacitors.

Having considered the output stages, we go back to the "front" of the amplifier. Two transistors are employed in the preamp section, followed by a voltage amplifier stage which brings us to the recorder output and the input point for the high-level sources. From this point, the amplifier consists of a tone-control driver, another voltage amplifier stage, loudness control amplifier stage, another voltage amplifier, and an emitter follower which feeds a power transistor serving as a driver. The emitter of the driver stage is transformer-coupled to the bases of the output transistor, using separate secondaries for isolation of the d.c. voltages in this stage. The left-channel output is fed direct to the speaker terminal strip, while the right-channel output is fed to its terminal strip through a d.p.d.t. phase-reversing switch. Both channels are fed to the front-panel headphone jack through series resistors which not only reduce the level to a value suitable for headphones, but also reduce the signal to the speakers, so that when the headphones are plugged in, the speaker level is reduced appreciably (about 30 db for an 8-ohm speaker and 25 db for a 16-ohm system). The phase-reversing switch does not affect the headphones.

The power supply employs a silicon diode bridge rectifier with the center tap of the transformer grounded so as to provide two equal positive and negative potentials, both with inductance-capacitance filtering. A total of 10,000 μf of capacitance so hum is a minimum.

Construction

The physical arrangement of the KG-870 is unusual. About one quarter of the chassis area is occupied by the power transformer and the filter components. The center of the chassis accommodates the six power transistors *on the underside,* in sockets mounted inside, and with the housings bolted tightly to the .093" black anodized chassis for efficient heat radiation. Of the six power transistors, the two toward the front are the drivers, and the four at the rear the output

(*Continued on page 59*)

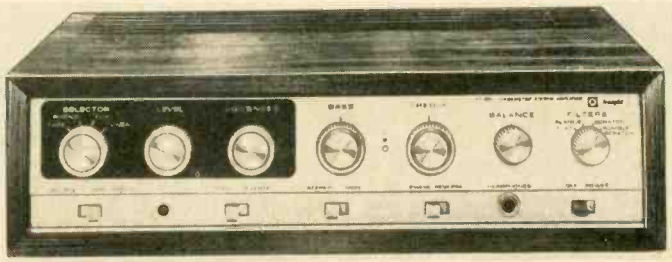


Fig. 4. Knight-Kit KG-870 all-transistor stereo amplifier.

Circle 109 on Reader Service Card

GRAUER

(*from page 26*)

7-3, 7-4, and 7-5 showing the effect of successive damping increases. Too much damping causes undue loss of bass with the optimum amount providing flattest response curve 7-2, with little acoustical peaking.

It was also found that when the speaker is properly damped resistively, the moving mechanism is less affected by cabinet standing waves and resonances at all frequencies, because the resistance also serves as an effective isolating element, preventing cabinet resonances from affecting cone motion (the air resonances must "get through" the resistive holes in order to reach and affect the speaker cone, and in "getting through" they are seriously attenuated), as well as directly and positively controlling the cone motion of the speaker. The resistance, used in the way described, is effective in two directions at the same time.

Other performance aspects not shown in these curves, but noticed audibly during experimentation, and which appear to concur with theory, are that the electro-acoustic conversion efficiency decreases as more damping is used, and that the power-handling capacity rises somewhat. When a speaker is properly damped by resistance, there is less chance of overdriving it with excessive bass signals, because of the very heavy air loading on the cone. The transient response is also greatly improved, and a surprisingly fine performance can be put in by an inexpensive speaker, especially in the bass range, where transient or impulse response is likely to be poorest. The damping limits overshoots and hangover on bass pulses, providing a degree of control approaching units having more powerful magnetic circuits. Of course, unlike powerful magnetic damping, resistive damping is wholly dissipative, and causes some loss in efficiency, over a discrete range of bass frequencies, where it may well be desirable, because the response is substantially leveled. Carried out too drastically, however, it will cut down bass output, as shown in the curves of *Fig. 7*.

In special applications it will be found that resistive damping is most conveniently applied in front of the cone. This can also be used to filter acoustically the highest frequencies, where this is desirable. The low-frequency effects, however, will be similar to behind-the-cone damping. Combined front and back damping may also prove useful.

In some cases it may be found that higher-frequency speakers can also benefit from resistive damping.

In many cases it will be found that little damping besides this resistive speaker damping is necessary in a system. If need be, the air resonance Q can be damped by port-damping material, and standing waves by absorbent lining.

One detrimental effect noticed during testing was a peculiar knocking, noisy-type sound, when too much damping was used. Excessive resistive damping tends to close off the speaker from the cabinet, and with small systems it may not always be possible to get enough damping to level off the impedance curve. Briggs has noticed a similar noise when foam-suspended speakers were mounted in small cabinets.[2] The effect has to do with a certain minimum volume of air which has to be behind the cone.

In such cases it is suggested that the maximum resistive damping that does not knock be applied, and additional damping necessary be realized in a different form—such as port damping, or damping on the walls, until proper system performance is achieved. In these cases, which are often the smaller cabinets, resistive damping may be considered to be a "step in the right direction," while for larger systems, a couple of cubic feet and up, it can usually provide the answer by itself.

In all cases, it is assumed that proper equipment is available to ascertain the effect of changes for adjusting the system to optimum. Without accurate verification, the "designing" becomes a series of guesses about what to do, what has gone wrong, and what will correct the wrong(s). The results, needless to say, can be very disappointing, because one is never quite sure what he has done, and what remains to be done. The best procedure includes repeated impedance, frequency, transient, and listening tests, so that proper information is obtained for further adjustments.

A patent application covering the resistive damping designs and constructions described in this paper has been filed by the author. Æ

[2] G. A. Briggs, "Loudspeakers," 5th edition, pg. 205.

INZIDE AUDIO

(*from page 10*)

ufacturers and learn for themselves what is involved in componentry. Also of considerable value is the concept of travelling clinics, an idea pioneered by McIntosh. In these, the consumer can bring his components for an evaluation of its capabilities and, at the same time, the manufacturer can display his own equipment."

"Finally, there must be dealer promo-

tions directed to acquaint the new consumer with the virtues of component music systems."

"The IHF is the logical organization to implement these concepts. The major shows, particularly, should be under their sponsorship. Therefore, it is the IHF that must provide the leadership needed to implement these changes and improvements."

Mr. Horowitz injected this somewhat disquieting thought.

"The IHF indeed must be motivated to discuss and act in order to make the necessary changes. I fear only the complacency of the membership. Change has always come too slowly."

Mr. Horowitz and Mr. Kuby summed up as follows:

"The market for components is there. And, there are people who will come to properly presented audio shows to see new equipment. We do not feel that we are reaching this market now. We do feel that action is required now. We would be more than happy to sit down with the rest of the IHF membership in a sincere quest for valid solutions."

We Must Project the "Right" Image

Oscar E. Kraut, President of KSC Systems, Inc., a relatively new firm which manufactures speaker systems had same thoughts about shows. Though a new manufacturer, Mr. Kraut has had long association with the component industry. His comments bear the authority of a background as a sales representative, and as a retail salesman.

"The New York High Fidelity Show has been running for more years than most Hi Fi Shows appearing around the country. Since it is arranged and conducted by the Institute of High Fidelity, an organization of and for component manufacturers, we may assume that the show is indicative of their aims and the image they are trying to create in the mind of the interested public.

"In the first shows, more than a decade ago, the mere appearance and existence of audio components was enough to create interest and attract attention. But times and conditions change and the formerly sharp line between components and consoles is no longer sharp; the *ne plus ultra* approach of the component manufacturer has evolved into stressing decor until now, as evidenced by the last Show, we seem to have arrived at the "Superior Packaged Console."

"My basic point is that the large radio console manufacturers are quite capable of pleading their case before the public without *our* help. We should plead our own cause before the public. (That is, if we can agree on what it is; meaningful standards would be of help in clearing the confusion.)

"It is time that we began to talk again about the audio *component* market. Any table model radio reproduces sound that is audible, recognizeable, and sometimes even enjoyable. But those who want to hear music most accurately reproduced find components their answer. That should be our story and image.

"I do not believe that the High Fidelity Show is obsolete since it is another medium for showing our wares. What *is* missing at the NYHF Show is intelligent direction toward locating and educating an increasing component market.

"A high fidelity show should include symposia for the average layman—on music reproduction, acoustics, and how we hear. Also live music demonstrations.

"It is the manner in which the component industry presents itself at a show that will help it evolve to a respected profession, or devolve to a trade to be absorbed by a constantly improving package console industry, better equipped to reach the market."

On the Way

In conversations with the IHF we were told that there are exciting plans in the works for reaching the "right" and larger audience. It is too early to spell these plans out, but they have indicated we will get a full countdown as soon as the plans are completed. *Æ*

HERMAN BURSTEIN

(Note: To facilitate a prompt reply, please enclose a stamped, self-addressed envelope with your question.)

Herman Burstein
280 Twin Lane E., Wantagh, N.Y.

The "Best" Tape

Q. What is the best make and type of tape for me to buy for home recording?

A. The Tape Guide cannot comment on specific items of audio equipment. I can only say that the best tape for you is the one which sounds best to you on the particular tape recorder that you are using. Generally speaking, the brand name tapes put out by companies of good reputation are the best tapes. Their superiority is evident not only in their high-frequency response and cleanness of sound, but also in such aspects as freedom from annoying dropouts, freedom from squeal, absence of cupping and curling and edge-stretching, constancy of level within the reel and from one reel to the next, immunity to flaking and embrittlement, and so on.

Intermittent Dropouts

*Q. I own a **** tape recorder, and ever since I bought it I have been getting intermittent dropouts on my recordings. These dropouts occur randomly and last for a fraction of a second. I have tried all means of solution but am completely stymied. Changing microphones didn't help. I have resoldered connections, installed a new input jack, and new mike connectors. I have checked tubes and tube voltages, traced the signal with a 'scope, and checked the audio and bias signals at the heads for a sign of "intermittency." I talked to a serviceman who indicated the problem was mechanical rather than electrical; but I have watched the tape carefully and seen no correlation between the dropouts and tape movement. Any ideas?*

A. If the dropouts occur both on live recordings and on recordings from radio and phono, I am inclined to agree that the problem may be mechanical. It is possible that the tape guides are slightly out of alignment, permitting the tape to weave and thereby lose contact with the heads. Are you using top quality tape that is relatively free of dropouts?

If your problem occurs only on live recordings, it may be that excessive signal into the record amplifier is causing the amplifier to block momentarily. When you record from a tuner or phono disc, you deal with waveforms that have probably undergone substantial limiting. But when recording live, you may be getting much greater peaks that cause blocking. Try reducing the input signal, despite what the record level indicator shows. Also, you might have an authorized service agency carefully check the electronics for faulty components.

Can NAB = CCIR?

Q. I plan to play American prerecorded tapes, which require NAB equalization, with a tape recorder having European CCIR equalization. Can I compensate for the difference between these two characteristics with the tone controls of my audio amplifier?

A. If a tape is recorded according to the CCIR curve but played back with an NAB machine, I think you can come pretty close to flat response by using a little bass cut and a little treble boost in playback.

Automatic Tape Head Demagnetization

Q. A friend of mine has a tape recorder that he has used since 1957, but he has never demagnetized the record-playback head. Yet the machine sounds as good as it ever did. He says he was told that the machine provides automatic demagnetization of the head. How can that be accomplished? I sure have to take care of the heads on my own machine.

A. Self-demagnetization of the record and erase heads may occur by virtue of a series of damped oscillations when oscillator current to these heads is shut off. However, it does no harm to take out insurance by periodically using a head demagnetizer, particularly if the head has been subjected to a strong current surge or to a physical shock. If a different head is used for playback than for recording, a demagnetizer is still required for the playback head.

Plus-8 dbm into 600 ohms

Q. The output of my tape recorder is described as "plus-8 dbm into 600 ohms, balanced or unbalanced. Will feed a high input impedance amplifier directly with approximately two volts. Can be connected for plus-4 dbm by restrapping." Would any impedance matching be necessary in connecting my tape machine to the input of a good quality audio preamplifier, say one having an impedance of 250,000 ohms at the high-level input?

A. No impedance matching is necessary. You can connect the output of your tape machine directly to the high-level input of the audio preamp.

Eliminate Erase Head?

Q. My tape recorder has quarter-track heads. I want to know if it would be possible and workable to eliminate the erase head and install a half-track record head in its place, and add a switch so that I could record either half-track or quarter-track.

A. Unless the half-track record head has the same characteristics as the quarter-track one, different amounts of bias and audio current will be required for each one. Your switching arrangement could be considerably complicated by this factor. Moreover, if different bias and audio current are required, adjustments will be needed in reading record level (and bias level) with the VU meter. Finally, in the absence of an erase head you would have considerable difficulty in editing tapes. Æ

Major Modifications

*Q. I am the proud owner of a **** tape recorder. There are several modifications which would increase the machine's value to me, and any advice you might offer would be deeply appreciated. The changes are: 1. Installation of a switch to defeat the erase head in the record mode (I measure 4-db improvement in signal-to-noise ratio when playing a blank tape versus a tape exposed to the erase head); 2. installation of neon lamps to ignite at the 3 per cent harmonic distortion level; 3. installation of a switch to allow me to read bias on the VU meters.*

A. It is outside the scope of the Tape Guide to advise on extensive technical modifications such as those you have in mind. Hence I can touch only lightly on your questions. If you defeat the erase head, you will have to provide a substitute load to take up the oscillator current that would normally go to this head. Otherwise there will be an increase in bias current through the record head, with a resulting drop in treble. Installation of the neon lamps is a commendable idea, but you will have to choose the signal point carefully to find the neces-

sary signal voltage and to avoid excessive loading of the signal and resultant distortion. To read bias, insert a small value resistor (such as 100 ohms) between the record head and ground, and measure voltage across this resistor through a variable resistor adjusted so that the meter reads 0 VU at proper bias.

Input Impedance Matching

Q. I have a microphone with a rated impedance of 1 megohm at 1 kc. I should like to use this microphone in conjunction with the transistor record amplifier described in the May 1963 issue of AUDIO *on page 18. What sort of connection would yield the best results?*

A. The input resistance of the record amplifier to which you refer appears to be 10,000 ohms. It is apparently intended for use with dynamic and other microphones with moderately high impedance, that is, up to about 10,000 ohms. Your microphone, however, appears to be a piezoelectric type judging from its very high impedance. If connected to a 10,000-ohm load, it would exhibit very considerable signal loss, becoming more severe as frequency decreases. You might try leveling out the response by placing a large capacitor—perhaps about 0.2 or 0.3 μf—across the output of the microphone. However, this would greatly attenuate the over-all signal level. I doubt that the resultant signal would be strong enough to drive the record amplifier. In sum, I think you need a different microphone with the record amplifier in question.

Tape Machine Distortion

*Q. In reviews of tape recorders, I have noted that even the finest home machines show unusually high distortion percentages. Do professional recorders also exhibit such high distortion, which is appreciably greater than produced by other audio components? I own a **** tape recorder (one of the very finest) and distortion has never been apparent to me at normal recording levels. It seems that one would readily hear IM distortion that runs as high as 5 per cent.*

A. Professional as well as home machines exhibit higher distortion, particularly IM, than other audio components. Apparently the ear is not bothered too much if harmonic distortion is kept below 3 per cent. The signal level that produces 3 per cent harmonic distortion on tape will usually produce appreciably greater IM—5 to 10 per cent or more. However, such distortion levels apply to peak signals, which are present only a fraction of the time. Most of the program material will be 10 to 20 db below the peaks, and distortion will be correspondingly (although not proportionately) lower. It seems we still have a lot to learn about distortion, its various forms, and its effects on the ear. Æ

EQUIPMENT PROFILE

(*from page 52*)

stages. On the inside, between the two sets of power transistor sockets is the driver transformer, and on a hinged printed-circuit panel behind are the two stages preceding the driver, as well as the two two-filament lamps. The left third of the unit is occupied by the preamplifier, voltage amplifiers, and tone-control and loudness-control stages. This entire section, built on a printed-circuit board, is covered by a shield, and another shield is provided for the low-level input jacks. The selector switch is at the rear, conveniently close to the input jacks, and reached from the front panel by a long shaft, simplifying wiring. It has always seemed to us that it was simply inviting trouble to run input leads all the way from the back panel to the front, and then, usually, back again, and it certainly complicates construction. Transistor locations, both above and below the chassis, are shown on a pressure-sensitive legend applied to the top of the low-level amplifier shield, and a similar legend, applied on the top of the power-supply shield, shows the locations of the two fuses in the d.c. supply. No part of the actual construction involves any special skills, even though the large printed-circuit board alone mounts 96 capacitors and resistors and twelve transistor sockets—138 soldering operations. And, of course, that is not the entire amplifier. We found no errors in the instruction book—a miracle in itself—and only two places where we would have used a longer screw or wire in place of the ones specified. This entire kit is one of the easiest to construct that we have encountered from the Knight line, and one of the neatest.

Performance

With its rated music power of 35 watts per channel, the KG-870 should be adequate for any normal listening application. It is designed to feed 8- or 16-ohm speaker loads, and is within 1 db of its rated 28 watts sine-wave power at less than 1 per cent distortion. At usual operating levels, harmonic distortion measured less than 0.4 per cent up to 10,000 cps, reaching 0.8 per cent at 20,000 cps. IM distortion (60 and 7000 cps, 4:1) under the same conditions, measured under 0.6 per cent. Hum and noise measured 71 db below rated output on phono with the gain control set for rated output from 10 mv input; on the tuner and aux inputs it was 12 db better. A 1-watt output was produced from an input of 1.2 mv on phono, 1.1 mv on tape head, 0.135 volts on aux 1, 0.51 volts on aux 2, and 0.218 volts on tuner.

The usual solidity of bass that has become the hallmark of solid-state circuitry was noticed on this transistor amplifier presumably mainly due to the high damping factor resulting from the direct coupling to the output transistors.

On the whole, we would consider this a satisfactory medium-power unit which is an ideal one with which to "get one's feet wet" with transistorized amplifiers. After that is done, you can put it into service for pleasant listening. **Circle 218**

CBS LABS OPENS NEW SECTION AT STAMFORD

With considerable fanfare and with the attendance of some 150 members of the press, CBS Labs dedicated a new research facility—an enlargement of their main laboratory building on High Ridge Road in Stamford, Conn.—on January 6. Speakers at the ceremony were The Honorable John Dempsey, Governor of Connecticut; The Honorable Thomas C. Mayers, Mayor of Stamford, and Dr. Frank Stanton, President of Columbia Broadcasting System, Inc., of which CBS Labs is an affiliated company.

The new section more than doubles the available research laboratory space, and is equipped with the most modern instrumentation.

NEW LITERATURE

• **Semiconductor Catalog.** Amperex Electronic Corp. has announced the latest edition of their condensed semiconductor catalog. Free copies may be obtained by writing to Amperex on your Company letterhead. The catalog contains special material of great interest to engineers in addition to all the basic specifications of the full line of Amperex transistors, diodes, and photosensitive devices. Separate chapters are devoted to: the Amperex reliability and quality program, with a quality control flow chart; a quick reference list of types recommended for new design and original equipment; how to choose a photosensitive device; circuits utilizing Amperex semiconductors; a full listing of available Amperex application reports. For further information, write: Amperex Electronic Corp., Slatersville, R. I. **Circle 219**

ELECTRONIC ORGANS

(*from page 34*)

can be extended to any desired length.

The manufacturer specifically warns that the Leslie organ speaker system is for use only with electronic organs.

Wurlitzer also markets tone cabinets with rotating speakers, under the trade name of Audio Radiance Tone Cabinets. In the Wurlitzer approach, the speakers are rotated so that the center-line of the speakers generate a circular plane.

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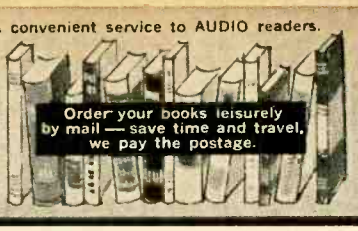

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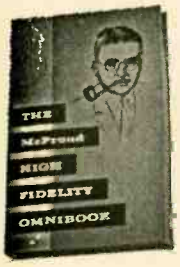

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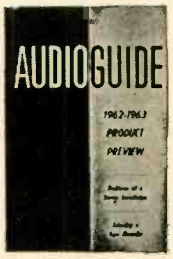

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Herman Burstein

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Figure 6 shows the mechanical details of construction.

The use of hi fi speakers for electronic organs has several limitations and of course one very important asset, the elimination of a redundant cost.

For the hi fi speaker to be useful, it must provide good bass, and also that psychological, physiological feeling of full voicing. In most cases it is solved with a physically large speaker system.

In some Hammonds and other organs, the declicking is not suppressed above 10kc, and the use of the scratch filter and treble cut on the preamp may permit the hi fi speaker to double in brass.

Where the organ depends on mechanical vibrato and tremolo and these are installed in the normal tone cabinet, the use of a hi fi speaker is negated. The speakers used in organ tone cabinets are invariably, and intentionally, inferior to speakers used in audio systems, which is the reason there is interest in utilizing hi fi speaker systems. A speaker system which may be used for hi fi systems, although designed for organ use, is the Schober tone cabinet.

The Schober LSS-10 may be easily attached to any spinet organ by the owner; installation instructions are provided in great detail since the LSS-10 is supplied either as a kit or assembled.

The LSS-10 is suitable for organs for two principal reasons. First the bass response extends down to the lowest organ note, 32.7 cps. Second, the frequencies above 300 cps (approximately middle D) are directed toward the ceiling. Intermodulation is minimized by using a 300 cps crossover point.

As mentioned many, many times before, diffusion of sound is essential in an electronic organ speaker system. To counter acoustically dead rooms, the LSS-10 projects the treble from the top, counting on the acoustically hard reflective ceiling. The result is effective dispersion.

For normal hi fi, it may be necessary to nullify the diffusion effect by means of a simple reflector at a 45 degree angle across the top. Mounting the board on hinges will make the unit suitable for both organ and records.

The criteria for a speaker system for organ use are thus quite clear: good low frequency capability, low crossover point, and good dispersion of highs. A speaker with these capabilities should also be excellent for hi fi use. Æ

TO BE CONCLUDED

[1] J. Markowitz and M. F. Nelson, "Noise generator helps create pipe-organ sound electronically," *Electronics*, November 17, 1961, pp. 130–132.

[2] J. Markowitz, Patent 2,491,674, "Rotable loudspeaker support with associated stationary baffle," December 20, 1959.

[3] D. J. Leslie, Apparatus for impinging vibrato on sound, Patent 2,622,693, December 23, 1952.

AUDIO ETC

(*from page 12*)

the *other* dealer got the credit, the guy across the street. Our industry could never rise above its own pettiness and small-time squabbling, natch. No cooperation at all. Small-range people, we Americans in the hi-fi field.

But since I don't really believe we are then I think maybe I have something. I think we should try a Permanente, U. S. style, for component hi fi. I suspect that the petty obstacles, all million of them, could in due time be overcome with a bit of industry-wide and forbearance.

Step Right Over Here Madam . . .

How about a modest pilot trial of such an idea? Could easily be expanded if successful. Say on a reasonably well populated Manhattan corner, a place where money flows (tourist and/or local) and pockets are lined with Diners Club. The IHF, the Institute of High Fidelity, should clearly be in charge, living up to its fancy name. But a managing committee for the project might also include representatives from the hi fi press and the dealers. Might even take in a rep-at-large from the great consuming public, to put a customer slant on what is desirable in the way of hi-fi exhibitioning.

And, of course, the management for this permanent, sales-generating, *order-taking* hi-fi exhibit would hire its own help and its own consultants for the actual set-up, just like a store. High-bracket department-store-type display people, perhaps, who would know how both to be impartial (as between brands) and sales-seductive. In fact, I suspect that if the idea worked, with increasing confidence building up, these people could be trusted to do their own special promoting of this or that item on occasion—special features—exactly as is now done in every department store and at every local dealer's shop. Why not? Variety is the spice of life, and of sales.

Lady customer in Oshkosh (or Tuscaloosa or Tucson) to local dealer in same town: "Oh Mr. Tweet! I heard the *loveliest* hi fi in that exhibition in New York, last week! In fact, I ordered a whatsis,

(*Continued on page 63*)

HI FI AUDIO REPS

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IBM "SELECTRIC" TYPEWRITER, Model 721; "Delegate" and "Script" rotary elements; black, red, green, brown, blue ribbons; cost $520; sell $350. Hickok Model 123 "Cardmatic" manual-conductance tube tester; cost $570; sell $200. V. R. Hein, 418 Gregory, Rockford, Illinois 61108.

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what is it?—a componizer? right away, and they said I'd get it here at home in just a few days and you'd get the credit. Now wasn't that nice? But you know, I think I liked that *other* compost . . . compizer, comploment, too—I just can't get that name right— *you* know, the one that turns on the radio right in the phonograph? Now, DO you have *that* one?"

"Why yes madam, surely! Just step right over here . . ." Æ

A LA PI-MODE

(*from page 21*)

fier a 22-ohm resistor was connected in the emitter lead of Tr_3, and the 330–430-ohm resistor below this was common to both Tr_3 and Tr_4. There has been a good deal of simplification of the circuit since it first appeared. A d.c. feedback path, through R_{17}, fixes the d.c.-coupled loop, Tr_4, Tr_6, Tr_8, to give the required quiescent current. At the same time, the d.c. loop through R_{10} from the center-line back to base of Tr_3 makes sure that the center-line is correctly located in voltage.

Over-all negative feedback, 44 db of it, is provided by R_9, across which the capacitance of 560 pf provides the gentle rounding which prevents ringing on square fronted transients. There is some justification for increasing C_6 substantially to give an earlier roll-off than this 560 pf provides.

The preamplifier shown is a current amplifier, having a low input impedance, around 20 ohms. The over-all performance shows that the total harmonic distortion at 10 w, 1000 cps, is 0.06 per cent and that the 1 watt response is 3 db down at 60 kc, while the 10 w response is 3 db down at just below 20 kc. It can be converted to a lower power level of working by making R_{22} 22 ohms instead of 15 ohms. Under these conditions the current drain is cut back from 0.4 amps, to 0.27 amps. The sine-wave output is then only 5 watts, but the "speech and music power" rating is still 10 w, tested with 25 cycles of a 1000-cps tone.

You may feel that you want more than 10 w (or, of course, 10+10 in stereo). It is not too difficult to scale this circuit up, provided that you are willing to fit the solid heat sinks which will be needed if you are to dissipate more power in your transistors. I find it interesting because it is both good and economical, and it is up in the quality region where an improvement which I can hear will cost money which will give me more pleasure spent in other ways. For each of us, that is the critical point. Æ

(The quotation under the title is from "The Waste Land," T. S. Eliot.)

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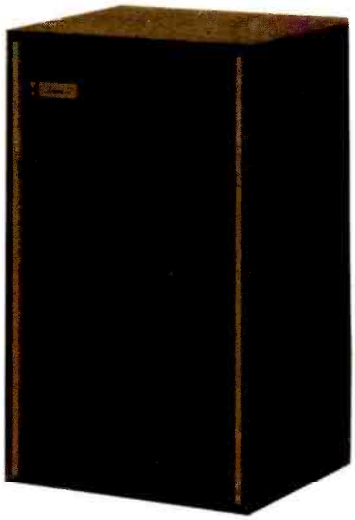

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