AUDIO

JUNE/1965

60¢

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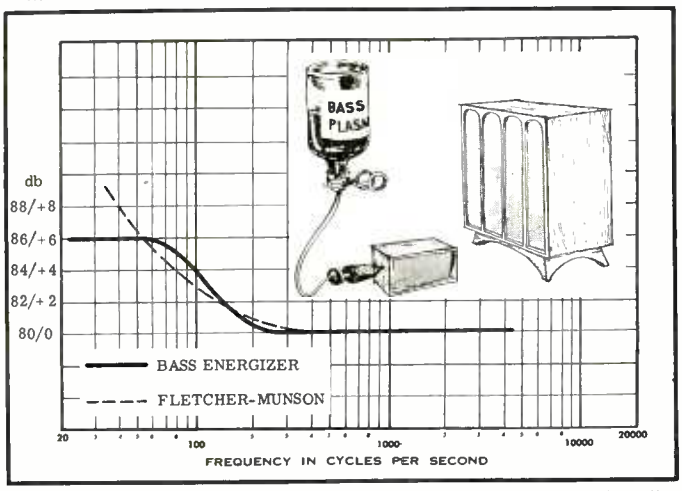
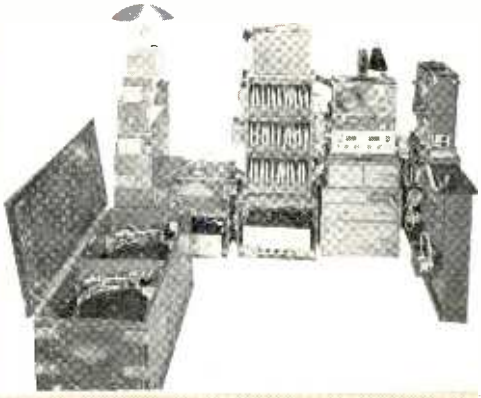
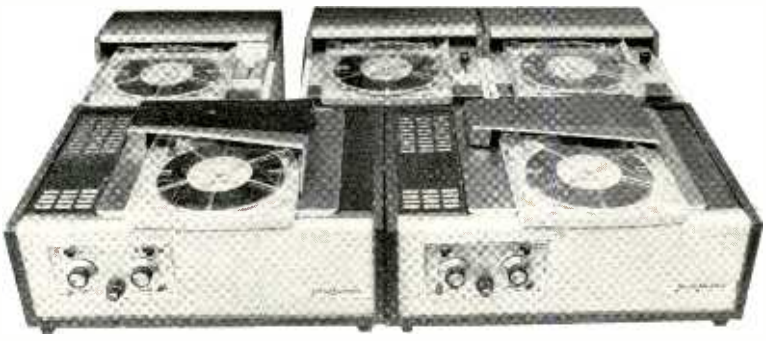
BASS TRANSFUSION





AUDIO COCKPIT



TAPE-TORTURE MACHINE

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This is the *only* tube you need for Scott's new 80-Watt solid state amplifier kit!

An ordinary light bulb? For a transistor amplifier kit? It's part of a new system Scott engineers have developed so that even a novice can successfully build a professional solid state amplifier.

The electric light bulb is an ingenious part of Scott's exclusive "fail-safe" circuit. You connect it to the back of your completed amplifier just before you first turn it on. A dim glow means you're A.O.K. A bright glow means the light bulb has absorbed excess power *before* it can burn out valuable silicon transistors, and that you must recheck your wiring.

Actually, a mistake like this is highly unlikely. The unique Scott instruction book with its life-size full-color charts . . . the fact that touchy circuits come factory-tested on preassembled modular circuit boards . . . allow even a novice to build a solid state amplifier that is in every way equal to a Scott factory-wired unit.

When you're ready for final adjustments, there is a precision test instrument, the Scott Circuit Monitor, that allows you to actually set the balance and bias of the output stage for absolutely minimum distortion without external test equipment.

When completed, your 80-watt LK-60 will have all the features of the most expensive Scott factory-wired amplifiers; heavy duty rugged silicon output stages that will drive the most inefficient speakers, military-type heat sinks to assure long operating life, Power Level Indicator, and the complete professional Scott control panel.

The LK-60 is kit-brother to the superb factory-wired Scott 260 solid state amplifier. Hi Fi/Stereo Review tested the 260 in April, and stated that it has ". . . no sound of its own. The listener hears the music . . . not the amplifier. (It) will reproduce anything that is fed into it with well-nigh perfect exactness, and without adding any sound coloration of its own . . ." Now that the LK-60 kit is at your dealer's, you can share with Scott the satisfaction of building a perfect solid state amplifier.

Specifications: Frequency Response, 10-40,000 cps; Power Band Width 20-20,000; IHFM Music Power, 80 watts; Distortion, 0.8%. Less than $189.95.

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June, 1965 Vol. 49, No. 6

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Number 22 in a series of discussions by Electro-Voice engineers

ADDING "HIGHS" TO HIGH POWER PA

JOHN R. GILLIOM
Loudspeaker Project Engineer

Sound system intelligibility can often be a complex problem, since it will vary with ambient noise level and type, useable system level and response, and room reverberation. As a result there are probably thousands of sound systems with marginal effectiveness, despite more than sufficient power handling capacity to overcome the measured noise.

The reason for the failure of these systems often lies in the design of the typical high power P. A. driver. Most drivers rated at 50 watts or more have relatively massive voice coil and diaphragm assemblies. This sharply limits high frequency response, particularly in the 2 to 7kc range. Since this range contributes significantly to intelligibility, the loss of highs has serious consequences under severe noise conditions.

Happily, most noise decreases in intensity with rising frequency, thus helping overcome the problem. But if a driver with flat or rising response in the 2 to 7kc region is used, much higher intelligibility can be assured, often with a significant reduction in the amount of power needed.

To achieve this desired high frequency response, E-V PA drivers have unusually light voice coil assemblies that maintain high efficiency to 7kc, yet handle up to 50 watts of power (in the case of the Model DC50). This power handling capacity has been obtained by the use of high temperature materials that maintain strength without adding to the moving mass. Careful design of the loading plug, plus the use of relatively large *Indox V* ceramic magnets also insures better voice penetration, even when used on conventional reentrant trumpets.

To further increase efficiency, E-V has also developed a series of compound horns that have proved unusually effective in high noise environments. Each side of the driver diaphragm is coupled to a separate horn. The highs (above 1kc) are propagated from a short, small horn mounted coaxially with the large reentrant bass horn. This assures minimum high frequency losses due to internal reflections, plus a sharp reduction in distortion at high levels.

Two such horns are available: the wide-angle Model FC100 (CDP®) and the concentrating Model AC100 for extended reach. 30, 40, and 50 watt compound drivers are offered for either type. This combination of low-mass drivers and high-efficiency horns has been found to contribute significantly to improved intelligibility under adverse noise conditions.

For technical data on any E-V product, write:
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COMING

ARTICLES

• **A Transistor Audio Oscillator. I. C. Zero.** Based on a circuit by P. J. Baxandall which was first introduced at least five years ago, this oscillator covers the range from 20 cps to 200kc cps with less than 0.25 per cent distortion. Best of all it uses only four inexpensive transistors!

• **Approximating Linear Transistor Circuit Operation.** R. R. Moore. Simplified calculations and a little 'guestimation" will enable the reader to understand a.c. transistor operation. Usually one must use complex formulae and extended calculation. The secret is transresistance.

PROFILES

- OKI 333 Stereo Tape Recorder
- Rek-O-Kut Model R34 Turntable and Arm
- Kenwood KW550 FM-Stereo Tuner

In the July 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, N. Y.
Include stamped, self-addressed envelope.

NOTE

YOU ASKED FOR IT!

I have received quite a number of letters asking what happened to my other column, "Audio Techniques." The answer was simply that very few suggestions were received, making it difficult to place this material in the magazine as a continuing feature. I figured that the average reader was not interested in the service offered by this column (to be described shortly). Apparently I was wrong because comments and ideas which could be incorporated into the column have been coming in even though the material has not appeared in the magazine in some time.

This is your column; essentially, you are its writers. In the course of experimenting with high fidelity equipment and its accessory interests, many of you have developed little and big tricks by which experimental construction can be facilitated. Some of you may have come up with some rather novel circuits which reduce hum or improve signal-to-noise ratio. Maybe some of you have come up with a good scheme for cataloging discs and tapes. Some of you may come up with some maintenance and servicing suggestions which you would like to share with other readers. When you contribute an idea to this department, you are helping countless other readers who are on the threshold of some similar discovery and who have not somehow crossed the line. You'll save hours of time for a great many people. With their saved time, they will, undoubtedly, pass along some suggestions which will help you with some stickler.

I suppose there is one very small caveat. As editor of this column I shall look at each suggestion to see if it is suitable for inclusion. Naturally, I can't try each and every idea, so read a particular suggestion carefully to see if it meets your particular needs. This holds true for any article in a way. I think it is bad policy to read and follow a particular design slavishly. A particular article should be used as a starting point for your own ideas.

Naturally, there are some exceptions to this as in all things. Someone new to the field of experimental high fidelity will find it best to follow a particular design more closely than an "old pro." Well, there it is, the basic idea of the column, "Audio Techniques." Send all comments and suggestions to me care of the address shown, just as you do when writing to "Audioclinic."

Speaker Overload

Q. The manufacturer of the speakers in my music system specifies the use of a power amplifier which will deliver no more than 35 volts across the speaker terminals.

I have added a couple of 1 ampere (3AG) fuses on the speaker lines but I am still afraid to over-drive the speakers, especially when playing organ music at a reasonably high volume.

Please tell me what modifications I should make in order to drive them at high volumes every once in a while. Aron Aharonian, Don Mills, Canada.

A. I do not know the impedance of your speakers. I suspect, however, that your amplifier will have difficulty in producing 35 volts except possibly when the speaker is connected to the 16-ohm tap and the sound level is very high.

To be safe, it is best to measure the voltage appearing at your speaker terminals under actual operating conditions.

Obtain a voltmeter capable of reading ac. Set it to the 50-volt range. Connect it to the speaker terminals of your amplifier with your speakers operating as you would normally listen to them. Observe the action of the meter. If the meter swings up to 20 or 25 volts, you know that you are actually hitting peaks of about 35 volts.

A calibrated oscilloscope is an even better indicator of peaks because the actual peak voltages will be visually displayed. As a result, you will know

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As tracking forces have become lighter, and stylus assemblies more delicate, so has the danger of damage from manual handling increased. To eliminate this hazard, Garrard has built into the Lab 80 an ingenious tone arm cueing control. This feature protects your records as no other turntable can.

The Lab 80 integral cueing control works for you in three important ways:

1. To play a single record: Press the Manual tab. This starts the motor and activates the tone arm cueing control. The arm stays suspended a safe half inch over the record. Position the tone arm over the first (or any) groove. Now, press the cueing control and the stylus lowers gently into the groove.

2. To cue a record during manual or automatic play Press the Manual tab. The arm rises and stays a half inch above the record. Move the arm to the band or groove desired, and press the cueing control. The stylus lowers slowly and accurately into the groove. With this feature, there is no necessity to lift the arm by hand causing accidental jarring or scraping of the stylus across the record.

3. To pause during manual or automatic play: When you want to interrupt the music, press the Manual tab. The arm rises directly over the record and stays there. The turntable continues to revolve. When you are ready to resume play, press the cueing control. The stylus lowers accurately and safely, and the music continues from where it left off.

Regarding automatic play: The Lab 80 is a superb transcription turntable for single play. But, in addition, it includes an exceptionally gentle, built-in record changing device, enabling you to play a stack of eight records fully automatically.

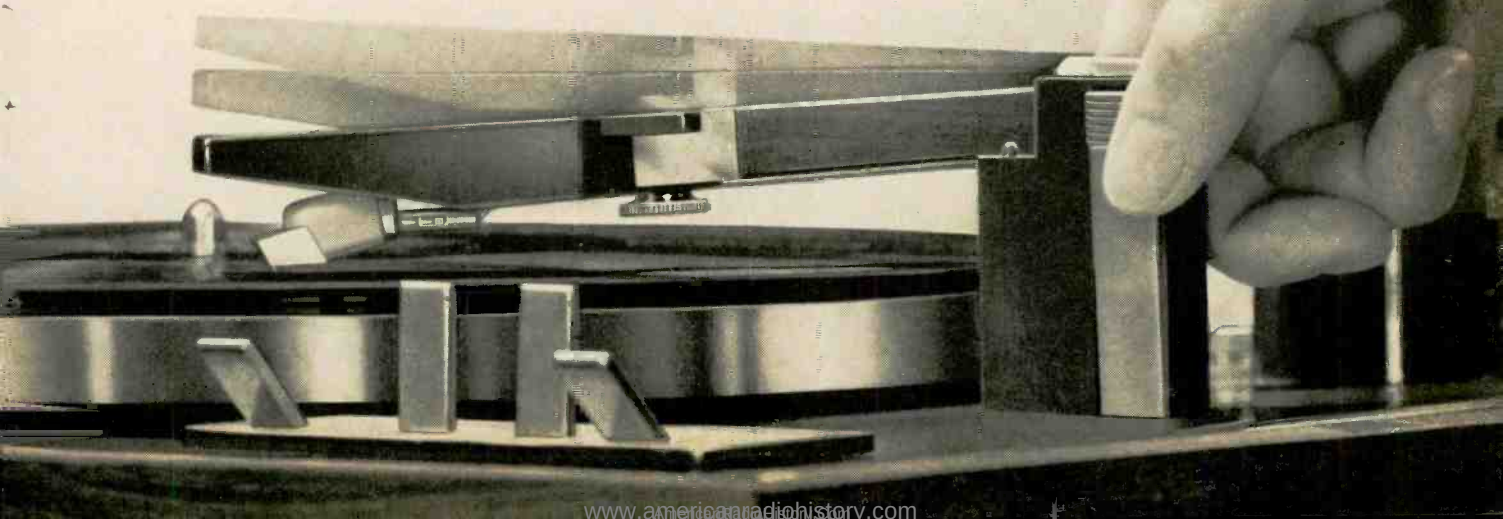
This, and the many other advanced features of the Lab 80 are fully explained in Garrard's new 32-page Comparator Guide covering the entire line. For a complimentary copy, write Garrard, Dept. GF-15, Port Washington, N.Y., or Circle No. 103 on Reader Service Card.

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.

LAB 80 $99.50 Price less base and cartridge

The Garrard® LAB 80 Automatic Transcription Turntable is the only automatic...

that performs on cue!



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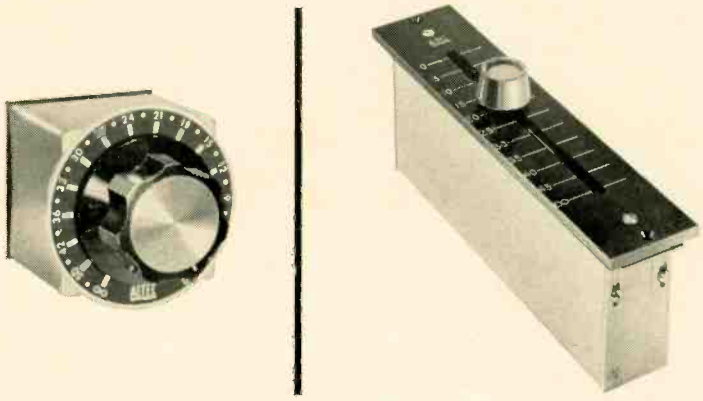
MORE NEW STUDIO EQUIPMENT FROM ALTEC

LATEST ATTENUATOR LINE ACHIEVES LESS THAN 1 MILLIOHM CONTACT RESISTANCE, LOWER NOISE, EASIER UPKEEP, LONGER LIFE



The hoped-for possibility has developed into working reality—we've managed to come up with the finest attenuators yet developed. More than 300 types are available with either solder terminals or as plug-ins, either rotary or straight-lines, and in such categories as mixers, calibrated controls, calibrated grid control pots, VU range extenders, decade attenuators, impedance matching networks, decade resistors, faders, and stereo pan potentiometers. And they're all listed in the new Altec Attenuator Catalog which we've printed as a convenient reference for your aid.

A LITTLE ABOUT A LOT OF IMPORTANT IMPROVEMENTS

You might like to know how some of these improved attenuators were engineered. For instance, "coin" silver, which is normally used to make brushes, contains copper and is subject to oxidation—reducing conductivity and raising noise level, among other things. So we've made our brushes of "fine" (pure) silver because it doesn't oxidize—it sulfides. Silver sulfide does not reduce conductivity; in fact, it actually has a helpful lubricity. We use dual brushes on all our attenuators—both rotary and straight-line models. They are independently sprung and so guided as to eliminate "stumble" from contact to contact.

ADDED DEVELOPMENTS

Our new attenuator line is designed so that we'll be able to gang up to 8 of them in tandem, enabling you to operate the whole group with one control. We've produced rotary attenuators that will give you more steps in less space. How? Instead of putting them in the conventional round cans—we're building ours in square ones. And we're using the corners (space that previously went to waste) for the wiring.

DON'T FORGET THE CATALOG

The new Altec Attenuator Catalog we mentioned above has all the technical characteristics and other relevant data on the new line. We'll be delighted to send it to you. So write today, Dept. AM6.

ALTEC® LANSING

ALTEC LANSING
A Division of LTV Ling Altec, Inc.
ANAHEIM, CALIFORNIA

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where to set the level controls for all of your signal sources so as not to exceed this voltage.

If it should happen that the fuse blows just before the peak voltage is obtained, so much the better. You will then know that the value of the fuse you have selected was well chosen. You may find, however, that you must reduce the fuse size to something less than the one ampere value you are now using to obtain better protection. Finding the correct fuse is a matter of experimentation. When the fuse blows, there is no protection for the output transformer in the amplifier. Some protection can be achieved by placing a resistor whose value is between five and ten times the impedance of the speaker, across the speaker terminals on the amplifier side of the fuse. Thus, when the fuse blows, some of the power produced by the amplifier will flow through the resistor, thus holding down dangerously high voltage which might cause arcing within the components of the output stage of the amplifier.

It is also possible to arrange a zener diode in such a way that when the voltage across the speaker terminals arrives at a certain value, the diode will conduct and not allow further voltage increases to occur. This arrangement would make it possible to eliminate the fuse, and still provide proper protection for both the speaker and the amplifier. I have done no research on this idea and throw it open to some of you. If you come up with anything interesting, I would like to hear from you.

Connecting a VU meter to an Amplifier

Q. I have just purchased the second of two vu meters (stereo) in the past few years, but I am still having the same trouble. I am not getting enough signal to get the meter to give me a good reading.

I have a 40-watt stereo amplifier which should be powerful enough. It will work when I turn the volume control up past the normal listening level, but this does not help me balance the system when listening at a normal level. I have the sensitivity controls on the meter turned up all the way, but this still does not help much. I have high-efficiency speakers, so I get more than enough volume at a level setting of 1 or 2. I think this is why I do not get a good reading on the meter. Can you suggest anything I can do to make the meter more sensitive to the low power requirements of my speakers? Ron Burstein, Temple City, California.

A. Your meter problem is a common one. You are right that the efficient

(Continued on page 56)

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SOMEDAY, THERE MAY BE OTHER FULLY AUTOMATIC TAPE RECORDERS LIKE THE NEW CONCORD 994

The 994 gives you automatic reversing ☐ Plays or records automatically three different ways ☐ Stops by itself where you want it to ☐ Threads itself automatically ☐ And, the 994 is available now!

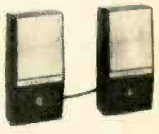
With the transistorized 994, Concord introduces a new dimension to tape recording. Some might call it modernization, some might call it automation. We think of it as *convenience*—in playing, in recording, in starting and stopping, in threading, in hours of uninterrupted listening. You can't compare it to anything because the 994 is as different from the conventional stereo recorder as the old crank-type Gramophone is from the modern record changer.

AUTOMATIC PROGRAMMING. You can program the 994 to play or record one side of a tape from beginning to end and stop automatically. Or, to play/record first one side of the tape, reverse, play the other side, then stop automatically. Or, to play/record forward and back, forward and back, continuously, as long as you like—an hour, six hours, or all day. You may change direction of tape any time you like by merely pressing the direction change buttons. These same lighted buttons automatically show you direction of tape travel.

PUSH-BUTTON KEYBOARD. The operating controls are literally at your fingertips. This is the one recorder you can operate without arm waving, and with one hand! As far as threading, that's even simpler—the 994 threads itself automatically.

After all this, we didn't just stop in designing the 994. We kept going. As a result, the 994 offers superb performance and every conceivable feature required for your listening and recording pleasure. Here's a brief sample: three speeds with automatic equalization, four professional heads, two VU meters, digital tape counter, cue control, sound-on-sound, exclusive Concord Trans-A-Track recording, 15-watt stereo amplifier, professional record/monitoring system. The 994 may also be used as a portable PA system, with or without simultaneous taping.

TWO-WAY STEREO SPEAKERS. The split lid of the 994 houses a pair of true two-way speaker systems, each containing a tweeter, woofer, and crossover network. A pair of highly sensitive *dynamic* microphones is included.



The 994 is priced under $450.* An identical recorder, Model 990 comes without speakers or microphones and is priced under $400.* Both are at your dealer's now. So why wait? Drop in for a demonstration and find out for yourself what *fully automatic tape recording by Concord* is all about! Or, for complete information, write Dept. A-6.

For Connoisseurs of Sound

Other Concord models from $50 to $800.

CONCORD 994

CONCORD® ELECTRONICS CORPORATION, 1935 Armacost Avenue, Los Angeles, California 90025
IN CANADA: Magnasonic Industries, Ltd., Toronto/Montreal

**Prices slightly higher in Canada.*

THE SIGNATURE OF QUALITY ■ *Tape Recorders/Industrial Sound Equipment/Dictation Systems/Communications Devices/Closed Circuit Television*

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Famous for
REVERBERATION...

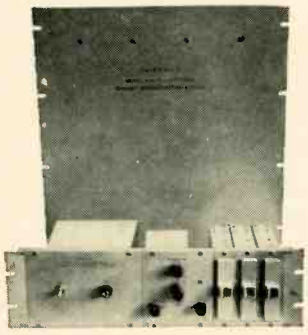
LIEDERKRANZ HALL
in New York City

For years Liederkranz Hall was world renowned for its remarkable acoustic effects and consequently it was in constant demand for recording. But even Liederkranz Hall had its limitations! Engineers could not always control the reverberation quality and time. However if you wanted to record in Liederkranz Hall today it would be impossible because, as with most old landmarks, it's destined for destruction.

But . . . don't fret, don't worry! There's a much more practical, effective, and less expensive method to add controlled reverberation to your sound.

Now reverberation comes in a compact, portable attractive and rack mountable package 24½" high by 19" wide in . . .

THE FAIRCHILD
REVERBERTRON



Unique Features of the FAIRCHILD REVERBERTRON

Variable reverb • Electronic time control • Solid state components • Rack mountable • Portable • Three time periods instantly and noiselessly selectable • Remote control without expensive servo mechanisms • Mixing network provided.

Used by studios throughout the world for its natural reverberation effects, the FAIRCHILD REVERBERTRON'S reasonable price now makes it possible for every studio to have the production plus of controlled, flexible and natural reverberation.

Priced at only $985

Write to Fairchild — the pacemaker in professional audio products — for complete details.

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10-40 45th Ave., Long Island City 1, N.Y.

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LETTERS

For Permanent Hi Fi Showrooms

SIR:

I have read with great interest Edward Tatnall Canby's column in the March, 1965 issue, suggesting a permanent hifi showroom.

AR has long believed in this type of display, and we go to considerable expense and effort to maintain two "permanent hifi shows," one on the West Balcony of Grand Central Terminal, and one on Brattle Street in Cambridge, Mass.

If the high fidelity industry had permanent showrooms (like the building material showrooms where one can inspect products in plumbing, floor material, draperies, and so on), we would not have had to set up our own showrooms. Furthermore, an industry showroom would give the consumer the opportunity to compare different brands.

EDGAR VILLCHUR
Acoustic Research, Inc.
24 Thorndike Street
Cambridge, Mass.

(What about it audiofans, would a permanent showroom be to your liking? ED.)

Acoustic Damping

SIR:

Mr. Grauer's statement ("Acoustics Resistance for Loudspeakers," March AUDIO) that a resistive pad in proximity to a cone will smooth out low-frequency response is confirmed by my experience. For those of your readers who wish to experiment with this device, let me add a morsel of advice: avoid muffling the back of a speaker with too extreme a constriction, lest you develop a cavity resonance in the neighborhood of 200-300 cps and a consequent nasal sound. A quick check on this is the sound of a male announcer, preferably live and via FM. Listen for a nasal or chesty quality.

Another point: stick to speakers of modest price. I can recommend Lafayette No. SK-98 ($9.95), a Japanese import with an eight-inch cone and a fair-sized magnet. This speaker has a dual cone, the inner one at the front being isolated from rear damping by the principal diophram. This speaker with a damping ring in a fair-sized reflex (3 or 4 cubic feet) will do a remarkable job for ten dollars. An easy way to damp it is to surround the rim with a three-inch collar of felt and stuff the space between ring and dust cover with Fiberglas. This provides some added air-mass loading and lowers resonance, as well as damps it. Further discussion of this expedient may be found in U. S. Patent No. 2,978,060, issued April 3, 1959, to the undersigned.

ALFRED H. ROBERTS
1615 Monk Road
Gladwyne, Pennsylvania 19035

(Be careful to avoid getting Fiberglas "dust" between the voice coil and magnet otherwise you may get rubbing as well as damping. Some constructors use a cotton damping material to avoid this problem. ED.)

He Built It and Likes It

SIR:

I am enclosing a series of photographs to illustrate a piece of equipment I have constructed from a circuit diagram and article appearing in May, 1963 AUDIO, entitled "High Quality Transistor Recording Amplifier."

As is the cause in all your articles presented in AUDIO, this is an excellent one and the only one of its type I've ever seen printed in any electronics magazine. Keep up the excellent work and genuinely fine articles as you have done. (*We are blushing!* ED.) I am desirous of seeing more articles on transistor equipment and especially construction articles as good as this one.

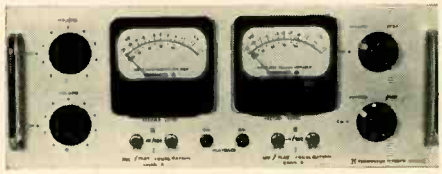

Fig. 1. Recording amplifier

The amplifier I have constructed appears in the accompanying photo (see *Fig.* 1) and is the culmination of approximately six months of frequent evening's work. Details of the equipment are as follows:

1. Constructed of two rack-panel chassis and a standard 7-in. rack-panel. The bias oscillator is constructed inside a mini-box (shielding) and fits between the two amplifier chassis.

2. The amplifiers are built on two pieces of perforated phenolic with tie-posts used throughout for ease and strength.

3. There are two completely separate and independent channels (amplifiers) along with two separate bias oscillators coupled with a capacitor on the high taps.

4. The power supply is housed in a separate mini-box (shielded) and rests in the rear of the case.

5. As suggested in Mr. Beeder's article, high quality components were used throughout i. e., low noise resistors, Ampex meters, short point-to-point wiring and the best available components. This has paid off in excellent performance.

6. This amplifier is coupled with an old mono Magnecord PT-6AH which was overhauled stem to stern (mechanically), incoporating new quarter track R/P and erase heads.

7. The whole works is placed in an Ampex 350 case giving portability and protection to all components. Playback is accomplished by using Ampex SA-10's and the total result looks great, performs like a "million bucks" and costs about $150 total.

It is probably very obvious that I am

(Continued on page 51)

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Get in the groove-any groove...

gently!

New Miracord 18H single record play turntable operates manually or automatically. Offers new cueing record band selector. Gently lowers arm and sets stylus in desired band or groove. Includes famous Miracord features: automatic pushbutton controls, Papst hysteresis-synchronous motor, heavy balanced turntable platter, transcription arm, four speeds.

Your hi-fi dealer will soon be showing the new Miracord 18H alongside the now famous Models 40 and 10H. Be sure to see it. Price is $119.50 (less cartridge and base). For further details, write direct: Benjamin Electronic Sound Corp. 80 Swalm St., Westbury, N.Y. Sole U.S. distributor Miracord turntables, Elac cartridges and other Electroacustic® audio components.

BENJAMIN MIRACORD

www.americanradiohistory.com

Announcing The New FAIRCHILD F-22 Condenser Microphone

New advanced design with low-noise field effect transistor!

The FAIRCHILD F-22 Condenser Microphone uses a field effect transistor as the microphone preamplifier. This field effect transistor has an extremely high input impedance that complements the high impedance characteristics of the condenser capsule for an outstanding improvement in signal-to-noise ratios. No complicated RF circuitry is used in an effort to improve signal-to-noise ratios. The absence of vacuum tubes eliminates the problem of noise, microphonics, and the expensive periodic replacement of the tube.

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LIGHT LISTENING

Chester Santon

The Voice of Winston Churchill
London Tape LPX 100
The Finest Hours
Mercury Tape STA 604

The usefulness of 3¾ ips tape speed for commercial releases is forcefully illustrated in the documentary recordings that have followed the death of Sir Winston Churchill. Since the stateman's historic speeches form the backbone (or entire body) of most of these recordings, the public gets far more value for its purchase dollar at little if any sacrifice in the quality of the sound. 7½ ips would be a form of extravagance in the case of the London reel, available in mono only, because it covers the high points of the Churchill oratory contained in London's bulky review of his career. The Mercury reel, available in stereo at slow speed, is taken from the soundtrack of the Columbia Pictures Release, "The Finest Hours". The voices of Neville Chamberlin, Franklin D. Roosevelt and John F. Kennedy are included in Columbia's cinematic treatment of the Churchill story. The fancier production of the Mercury release gives it a slight edge in entertainment value but the London item has more than average drama for an archive product.

Tito Tito Tito
United Artists UAS 6411
Lights! Action! Prado!
United Artists UAS 6394

The UA label manages to cram a lot of Latin action into these two releases. If your eardrums are of an uncomplaining nature, this pair of discs could easily take care of most Latin listening you may do for months to come. The first title has nothing to do with college cheers in Yugoslavia as Tito Rodriguez sings and leads his band in tunes familiar only to devotees of Latin music. One clue to authenticity in the style of Rodriguez lies in the fact that the Schwann catalog lists him under Latin American artists in the section titled "Popular—Other Countries".

Perez Prado's first album for United Artists finds him applying his patented grunt to a collection of movie tunes in Latin tempo. I prefer the Rodriguez.

Themes from James Bond Thrillers
London Tape LPM 70091
Frank Chacksfield: First Hits of 1965
London Tape LPM 70092

Tape fans are sure to find convenience in having a collection of James Bond themes all on one reel but I can't help wondering what they're going to make of the sound. Bond's creator, Ian Fleming, if we read him correctly, prided himself on being a connoisseur in just about any field that contributes to man's material well being. The sound on this reel can hardly be considered a listening luxury as Roland Shaw's orchestra plays themes from several Bond movies. It's too cheap and shrill to do justice to either Fleming or Bond.

Frank Chacksfield's reel takes an early plunge into a collection of tunes already at full tide in the first months of 1965. Considered in direct comparison with its companion release, this London tape has the benefit of a more mature approach in the arrangements. Because the arrangements don't get out of hand, the engineers have had an easier time keeping within a palatable sound framework.

Kenton/Wagner
Capitol TOA 2217

It isn't easy to believe what you've heard once this record has completed its course on your turntable. (I'm assuming you'll stick with it to the end.) Stan Kenton has apparently exhausted the once-sizable bag of tricks he has been using to dress up popular music and has turned to the classics for new "ideas." I have no objections to borrowing from the classics on the part of any arranger, no matter how pressed he may be. Pop composers as well as contemporary dance band arrangers have been fooling around with material from the classical repertoire for many years. For the most part, they've managed to do so without inducing laughter on the part of the listener by overstepping themselves. Kenton, in my book at least, has come a cropper in this project. It's one thing to take a simple theme by Tchaikowsky or Rachmaninoff and convert it to ballad or dance form. The Wagner orchestral music Kenton tackles (and struggles with) here takes on a ludicrous sound when played by a band of his size. The occasional intrusion of a Latinesque beat does not help in keeping a smile off the listener's face. If Kenton is sincere in wishing to bring Wagner's great orchestral excerpts from "Lohengrin", "Tristan and Isolde" and "Die Walkure" to a wider audience, he has only to hire a concert hall and a local symphony orchestra. The Los Angeles Symphony Orchestra is close at hand and fully capable in the works of this or any other major composer. Such an effort would earn Kenton the plaudits of the entire music community instead of the headshaking of the curious few who sample this disc.

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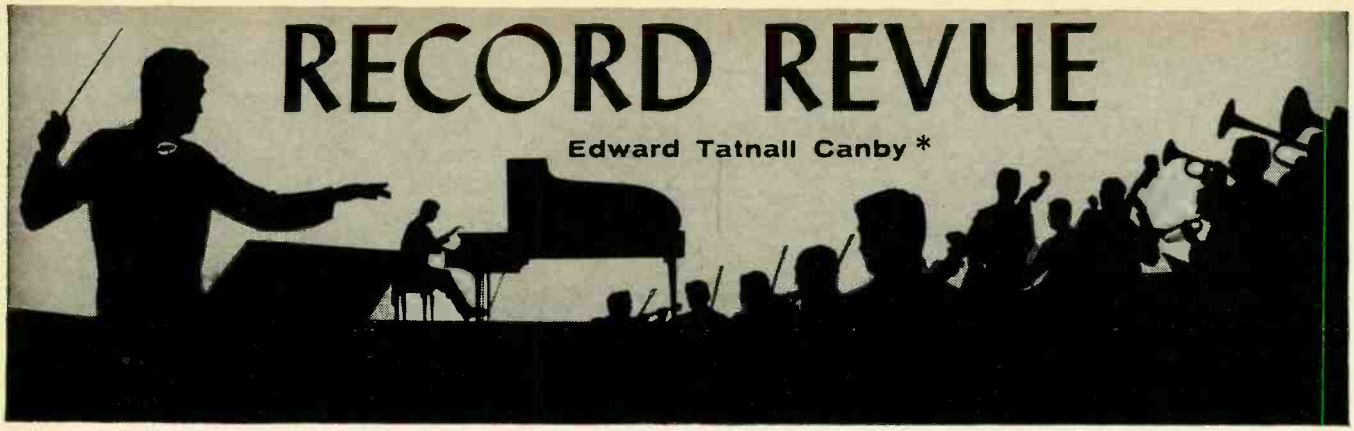

RECORD REVUE

Edward Tatnall Canby *

FOLK INTERLUDE

Jug Band Music. Jim Kweskin and the Jug Band.

VSD 79163
Vanguard stereo

You play this instrument by sort of honk-honking with your nose into the spout of an old-fashioned cider jug (or is it whiskey?). It comes out like a fog horn with a cold. One jug is plenty, and that's all they have here. The rest play any old thing, or sing, or both.

By this time it is apparent to most listeners that the dopier these folk people look and try to sound, the more sophisticated they're likely to be. The man who sings like a 'ole hill-billy pig from the faraway hills is probably a Ph.D from Harvard. Accordingly, the music itself isn't half as simple as it sounds and, in fact, is downright subtle, in a noisy sort of way. That makes it fun to listen to; for it grows with the listening. And it makes for super hi-fi and stereo.

This amiable gang features several quite different wailers and groaners (one female) plus an assorted backing of fiddle, banjos, guitars and harmonica, as well as washboards and the like. They are a bit self-conscious, too conscious of their sophisticated style to be quite natural, too much the showmen to act really at ease. Doesn't matter much. I enjoyed them.

Introducing the Beers Family.
Columbia MS6705 stereo

Now this is a funny one—after Vanguard's sophisticated juggers and bluegrassers. This family, from Montana, out of Wisconsin, is as simple as apple pie and not a pretention in a carload. They sing everything and play it too, on a batch of family folk instruments—and it doesn't matter where it came from or how. Their style is as fuzzy as the down on a peach. Anything goes, and all mixed up. Nice people, though.

As collectors of folk music know, the "real" folk don't know a thing about style or taste, until somebody tells them. They love to give you the latest tune they've picked up from the TV, or the sentimental ballad they heard Mom singing in the shower. And, until they learn better, they're apt to be ashamed of that old-time stuff they got from grandpappy, 'way back.

Now a place like Montana is no place to gather up age-old songs from ancient grandpas, right up the next creek. Out there, music comes in from wherever it comes, which might be anywhere. It's still a young, friendly country. So these Beers, for all their fine family instruments, have "inherited" exactly what one might hear in Montana (and Wisconsin) and they reel it right back with a smile, before it's even half absorbed (that takes generations), all a hodgepodge. Their singing is sort of half-classical in an untrained way, by imitation; the ballads are given out with all the flourishes of grand opera – in a modest way, of course. They are blissfully unaware of the standard English-American dead-pan ballad style, all the verses done in the same tone. And that home-style psaltery! The fiddle that Bob Beers plays is the nearest to something real, a good fiddle style though a bit slow-paced. But Martha's psaltery, just a harp in a four-legged frame, comes out with the darndest by-ear imitation-radio and semi-salon harmonies you ever heard, incongruous as well as naive. That's where the ghost of Debussy wanders in, with Chopin and the Radio City Music Hall somewhere in the fuzzy background!

No style at all, a blurry mixture of all sorts of half-absorbed influences; yet the folks themselves are very likeable and a lot of people whose own folk accomplishments are of a similar modest sort are going to enjoy them. The sophisticates, including the folk pros (city and mountain type) won't know whether to laugh or cry. It's really pretty dreadful stuff, in an amiable way.

Hedy West, Vol. 2
Vanguard VSD 79162 stereo

Hedy West is a one-style singer, who sings and plays her own excellent banjo all at the same time. She has a loud, clear and brilliant-toned voice, by now showing just a bit of night-clubby influence but still extremely musical and communicative. She has an unerring sense of style within her own way of doing things and her banjo playing is really most enjoyable, her accompaniments always exactly "right." A fine musician and an intelligent performer, too.

Hedy West is a "real" folk singer—that is, out of the country, her songs and style learnt at first hand from her own family and surroundings. She is as "eclectic" as the Beers family on Columbia in her present sources of material—but with her it is all digested and transformed into her own consistent musical production. Big difference.

The Greenbrier Boys—Ragged But Right!
Vanguard VSD 79159 stereo

This trio—it amounts to six, since all three both sing and play—is one of the fanciest in the current folk business and one of the best. As you might guess, the boys are city-bred and college-educated—City College in New York, Swarthmore, the sedate Quaker college in Pennsylvania, and the University of Wisconsin. Now they are kings of Southern-style blue grass and old-timey country music.

If you have heard the real old country records, and the grand ole op-ry type of radio, you'll find this modern hepped-up version of the old styles most interesting. Its voltage is at least twice as high—that you notice immediately. And it is much more self-consciously "mountain" in the singing, as though the boys hadn't ever seen a railroad train or a telephone, let alone a teevy. (They have, all right.) But beyond this, it is more "expert", it displays more tricks and turns, more concentration, than any old-time performer ever thought of. Within the old patterns, this city music goes far beyond the old. This is characterstic of the new "urban" folk music at its best.

The English Country Dancing Master, Vol. II The Telemann Society, Schulze.

Vox STDL 501.140 stereo

There is no music so catchy for the ear and for the tapping of the foot as the traditional dances of old England, as "country dance" fans know. It's a nice idea, in theory, at least, to get some of this music onto a record just for listening.

The trouble is, though, that the nature of the music is against such treatment. In all such dance music of repeated patterns the music itself is played over and over again with little or no variation—while the dancers provide the variety and continuity in their successive "figures". Under these circumstances, the music is superb—and the many repetitions are its most delightful feature.

Ah—but what to do when there's no dancing, only listening? This disc gives

(*Continued on page 46*)

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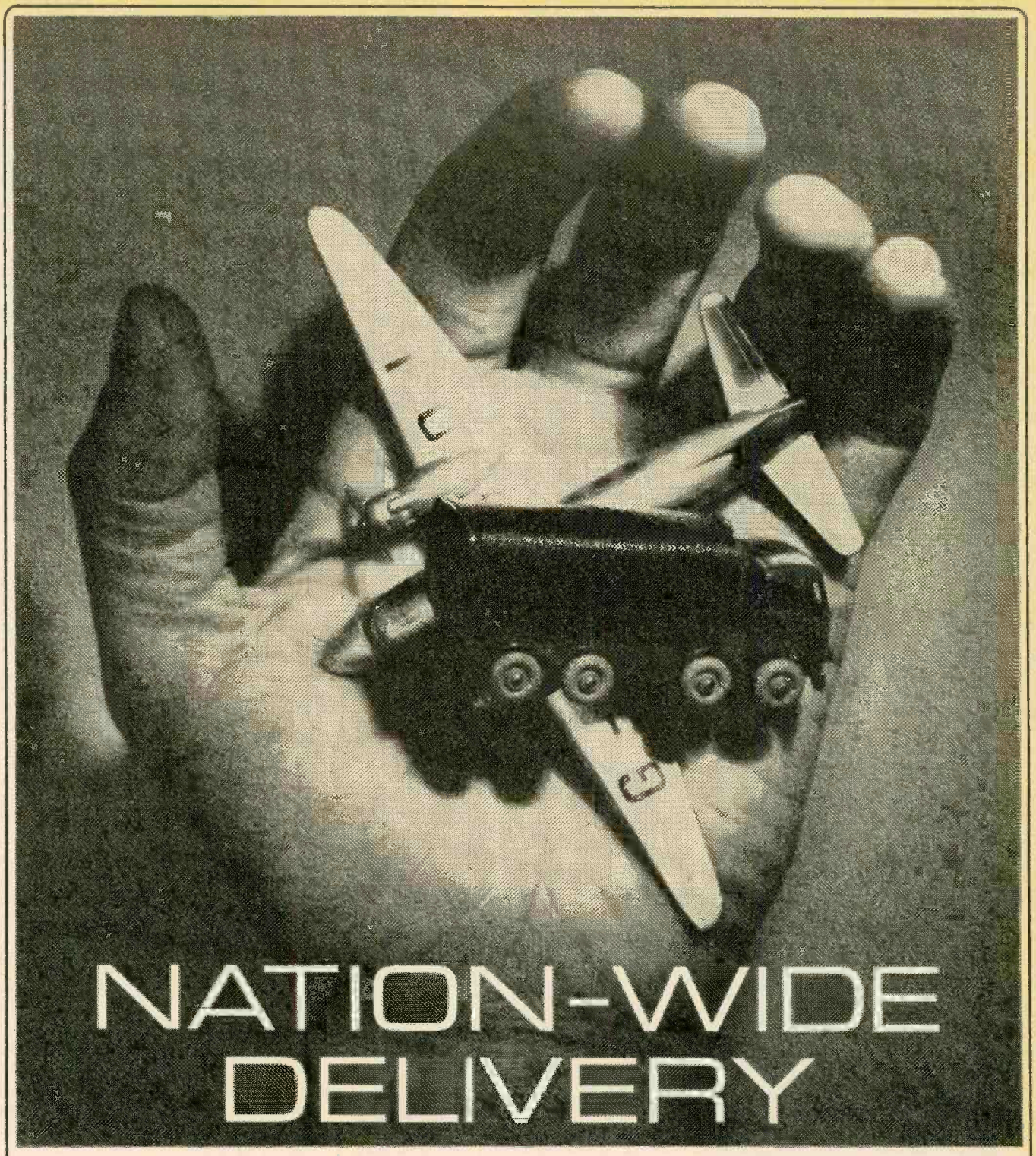

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AUDIO ETC.

Edward Tatnall Canby

THE AUDIOVIDEO TAPE DECK (CONT.)

Didn't get around to it last month as promised in the April issue—but here's the sequal to that discussion of the new Ampex V-303 video recorder and its possible implications for the future home hi-fi system.

Remember? The V-303 deck takes down pictures on quarter-inch tape, "four-track" style, with the basic configurations of the familiar home-type audio tape recorder; only the fabulous 100 ips tape speed stands in the way of an "integrated" dual-purpose deck is part of a home system. The reduction of that speed to a workable velocity in the home presents staggering engineering problems—but people like me can afford to toss 'em all aside, whistling in the dark, and see what might, or may actually happen when the engineers have got through their work. For, of course, I'm ready to bet they *will* come up with the very improvements that are necessary, and seem beyond the range of the possible, right now. It's happened before. Just a matter of refinement.

Partially linked

So let's have a look at our home system as it now exists, in the large.

You see, right now we have a big, sprawling complex of loosely inter-related home entertainments which fall into one "system" only in part, yet with a great many interconnected links, even so. More show up every month. Reminds me, somehow, of those "free" local call areas that the phone company sets up around small towns these days, within the larger phone network. Town A residents can call Town B. Town B can call Town C. But A can't telephone to C without a "long-distance" charge. (Like me in Connecticut: I can call Torrington to the East and Sharon to the West, but Sharon can't call Torrington.) Thus it is in home entertainment. The various elements don't completely inter-link. There are all sorts of partial relationships.

We have separate radios, TV sets, portable phonos, only a few of which have inputs and outputs for the hi-fi system. Semi-linked.

We have all the usual elements of the component lay-out, into which we have already integrated our stereo broadcasts, tied in with loudspeakers, phones and, of course, with the tape recorder. Discs play too, here, and are widely transferred to tape, over and above the law. All these segments are 100 percent inter-connected.

At the moment, there are two vital picture elements as well, only partially integrated. Home color slides and home movies. Integrated into hi-fi in that you may use either one of them with your tape recorder and amplifier-speaker system, via the various gadgets now on sale. Home movies have film-stripe magnetic recording too, mono. Via a separate recorder you can (if you must . . .) have stereo commentary or music for your films and slides. Beyond that, these picture areas are pretty much independent. *Except* in certain very significant aspects of technology.

Generations on Film and Tape

For instance, the 8mm home movie was the prototype original for our present tape, both in its "tape" size and in the two-direction dual-play feature, which first appeared in the Ciné-Kodak 8 'way back around 1933. I have the original excellent camera, still in perfect working order, plus thousands of feet of nice, crisp film I took back before the war. It's not at all a coincidence that even the 8mm reel is interchangeable between the two systems—the other day I used a standard 1965 tape reel on an 8mm Keystone projector I bought back around 1937, and it worked perfectly. From the two-way 8mm home film, the dual-play idea went straight to home tape, and now it has gone onward, first to the four-track modification and now to the new Ampex V-303 video recorder. Most interesting.

Moreover, that 8mm film was in other respects a development similar to those we've seen in tape. For it was preceded in the same fashion by "generations" descended from the original all-pro movie film at the standard 35mm size. First we had the intermediate type, 16mm film which was less than full pro and yet centered its use on semi-professional and educational pur-

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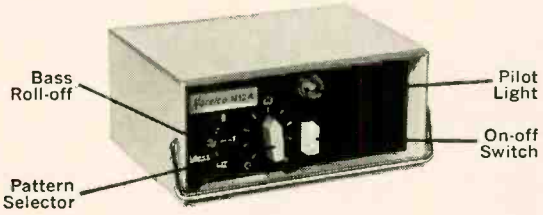
C-12A

The C-12A condenser microphone represents a significant advancement in microphone design; its development has been based upon the experience and requirements of professional sound recording studios. ■ Twin diaphragm, mylar foil ■ Exceptionally low distortion due to nuvistor low frequency circuit in the pre-amplifier ■ Nine variable patterns may be remotely selected ■ ±2.5 db deviation from frequency response curve ■ Bass attenuation: 0, −7 db, −12 db

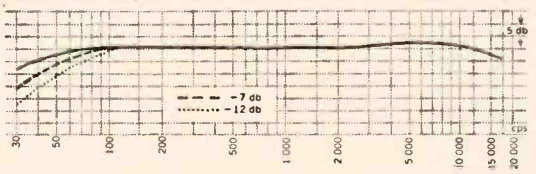
SPECIFICATIONS

Type	Pressure gradient, mylar foil capsule
Frequency range	20-20,000 cps ±2.5 db (related to published curve)
Sensitivity	−44 db (1V/10 dyne/cm²) at 1,000 cps.
Directional characteristics	Cardioid omni-directional, figure-of-eight, plus intermediate positions.
Nominal output impedance	200 ohm
Sound pressure level	At a distortion of 0.3% 150 μbar at 40 cps, 1,000 cps, 5,000 cps.
Plate voltage	110 V
Filament voltage	5.2 V ±5%
Complement	Nuvistor
Temperature	−14° to +150° F
Relative humidity	90%
Bass attenuation	0.—7 db, −12 db in Power Supply
Connectors	Cannon, entire system

POWER SUPPLY



OMNI-DIRECTIONAL WITH BASS ATTENUATION



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TK-80 SPECIFICATIONS

AMPLIFIER SECTION	
Total Music Power:	80 watts (IHF Standard)
RMS Power: (0.9% harmonic distortion at 1Kc per channel)	32 watts/32 watts
Frequency Response:	20 - 60,000 cps ±1 db 15 - 120,000 cps ±3 db
Hum and Noise:	Phono — 60 db, AUX — 72 db below rated output
Bass Control:	±10 db (50 cps)
Treble Control:	±10 db (10,000 cps)
Input Sensitivity:	MAG 1.5 mV, Tape HD 1.5mV, AUX 100mV
Loudness Control:	+10 db 50 cps, +5 db 10,000 cps (at Volume Control —30 db)
FM TUNER SECTION	
Usable Sensitivity:	1.8 microvolts (IHF Standard)
Signal to Noise Ratio:	60 db (at 100% modulation 1mV input)
Image Rejection:	55 db
SCA Rejection:	50 db
Capture Ratio:	2 db
Stereo Separation:	38 db at 1Kc
Frequency Drift:	0.02% without AFC
Special Circuit:	Automatic switching FM Stereo Tuner, Automatic Mono Stereo Indicator, Output Selector Switch, Silicon Power Transistor Main Amplifier, Tape Monitor, Muting Circuit.
Power Consumption:	50 - 60 cps, 110 - 120 volts 130 watts, (full power)
Dimensions:	Width 17¾", Height 5-13/16", Depth 14"
Net Weight:	30 lbs.

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poses, though it also was launched as a rather expensive home movie system. Then came the ultimate 8mm film—ultimate still after thirty years—which crammed four pictures into the space of one on 16mm. Purely for home entertainment.

And these film advances depended, just as in home tape, upon successive *refinements* in various areas of technology, in lenses, drive mechanisms, processing, but most of all in the film itself and in particular, the problem of graininess in the face of enormous magnification. Remarkable isn't it? For these are precisely the problems we have had with audio tape. Problems of graininess and uniformity, under conditions of high "magnification"—that is, amplification.

Moreover, tape recording (the tape and the tape machine) has moved forward from professional to home use in a strikingly similar series of steps—each one, as with film, commercially supported, aimed at a new segment of market, and aiming *towards* still another by implication, ending up with the out-and-out home entertainment market itself.

In its careful and methodical way Ampex has been especially clear-cut in this commercial progression, step by step, in the tape recorder field. First came the all-pro 300 series, abetted by the somewhat less immovable 350 line, still basically pro (even though I use one m'self). These two lines correspond to the basic 35 mm. film equipment, full-sized, and maybe the more portable newsreel type.

Then came a significant departure in the more nearly portable and then-sensational 400 line, now departed, a transitional model which was the first to show definite home-use tendencies, including the then-new wide-range response at 7½ ips via newly refined heads (do I remember *that* press conference).

And then, systematically, inevitably, the progression brought forth the 600 line—which anybody could have predicted in advance. It was still semi-pro but now really portable. Compact, simplified, it was very definitely useful for much home-type and non-pro recording, as well as pro. It still is, for both. Finally, there came the all-out Ampex home-style equipment, the 900s, 1200, 2000 series and just recently the 800 line, inserted into the sequence. Very systematic and most revealing. Now, the same thing is going on with the video line. V-303 for video corresponds to the 400 in audio.

So let's jump ahead and extend the video sequence to a theoretical conclusion. What will happen when TV on regular tape starts to integrate itself

(*Continued on page 52*)

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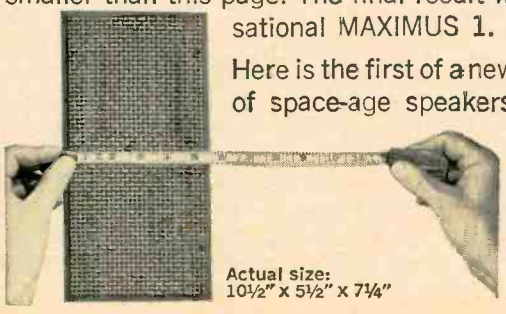

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EDITOR'S REVIEW

STEREO STANDARDS ON THE WAY

WE HAVE LONG ADVOCATED the need for performance measurement standards for high fidelity equipment. The confusing statements we have all witnessed in literature and reports concerning music reproducing equipment must be clarified. There must be only one acceptable way to report amplifier watts, tuner performance, and even speaker performance.

The last category is especially difficult, but it highlights the problem. For example, we recently read the report of an independent testing organization concerning speakers. In the absence of standard criteria they invented their own method for testing the quality of speakers. We can well appreciate their difficulty. In their desire to be objective, they apparently avoided seeking advice from those people who have had long experience in testing and making speakers. (We can understand their reluctance; after all how can they claim to be objective if they seek the advice of a manufacturer.) The test procedure they arrived at, however, leaves much to be desired in our opinion.

Let us elaborate.

The tests they arrived at were divided into two major sections: anechoic chamber and listening. The chamber tests seem pretty straightforward as far as we could tell (we assume they had proper equipment and know how to use it). We should note here that they have concluded, as does every reputable tester, that chamber tests are not sufficient. They do not tell how a speaker will respond in a room with music being fed to it rather than a sine wave. In recognition of this they determined to set up a listening panel and hide the speaker under test from the panel. So far pretty standard. But, and here's the very big but, then they charged the panel *not* to judge the music qualities or other parameters of the test system, but instead record how close it came to a "standard" system. What was this standard system? A system that the testers had decided was very good before the listening tests started. In essence, all they were asking of the listening panel was whether they could tell the difference between one sound or another, not whether one sound was bad, good, better, or best.

Is this procedure valid? It could be if the "standard" speaker were truly standard. But, another big but, how could they arrive at a universal speaker quality standard by themselves, without consulting many experienced testers, and indeed a large number of experienced listeners? We do not believe it is possible. We must conclude, therefore, that this vital part of their test procedure was not valid. We believe it would have been more valid if they had used a standard "live" sound source (see "Techniques of Making Live-Versus-Recorded Comparisons" in our Oct. 1964 issue) rather than a speaker source. In addition, they might have studied various techniques for preference testing under controlled conditions.

The point of this discussion was *not* to prove the test procedure of a particular testing organization invalid, but rather that there is a need for standard, acceptable test procedures to avoid this type of "do-it-yourself" standards. And, we are pleased to note that the Institute of High Fidelity has activated a group of standards committees to set up the needed standards. We think, in view of the existence of these committees, that the testing laboratory in question, and all other valid testing organizations, should volunteer to offer the benefit of their thinking. And the committee should invite valid testing organizations to participate, if they haven't done so already.

NOTES FROM THE EARLY DAYS OF STEREO

The following is excerpted from a special report which appeared in *Printers Ink* in their October 24, 1958 issue. This report was in response to the introduction of the Crosby multiplexing system for FM stereo, and its possible impact on AM radio. In answer to the threat, the V.P. of a large company revealed that they were about to release an AM stereo system with two clear advantages. We quote:

> "One advantage is that everyone would not have to buy new radios as they would if FM radio became the dominant system of broadcasting, because most people have AM radios already. However, they would have to go out and buy new AM radios if they wanted to enjoy the stereo benefits of the technique.
>
> "Another advantage ***** cited is AM radio's lack of high fidelity. Many people, particularly women, find it uncomfortable to attend a live concert, for example, because the extremely high notes are somewhat painful to their ears, the V.P. said. FM radio has this same disadvantage because it can reproduce sound up to and beyond the range of human hearing, ***** said. ***'s development of stereo radio has a built-in advantage, the V.P. told PRINTERS' INK, because AM automatically screens out the high notes that are painful to some people."

We don't think comment is necessary!

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Nine out of ten musical people prefer the sound of Pickering.

Nearly all musical people prefer *natural* sound. And natural sound begins with Pickering. Right where the stylus meets the groove.

Any of the new Pickering V-15 stereo cartridges will reproduce the groove, the whole groove and nothing but the groove. That's why a Pickering can't help sounding natural if the record and the rest of the reproducing equipment are of equally high quality.

To assure compatability with your stereo equipment, there are four different Pickering V-15 pickups, each designed for a specific application. The V-15AC-1 is for conventional record changers, where high output and heavier tracking forces are required. The V-15AT-1 is for lighter tracking in the newer automatic turntables. The ever more compliant V-15AM-1 is ideal for professional-type manual turntables. And the V-15AME-1 with elliptical stylus is the choice of the technical sophisticate who demands the last word in tracking ability.

No other pickup design is quite like the Pickering V-15. The cartridge weighs next to nothing (5 grams) in order to take full advantage of low-mass tone arm systems. Pickering's exclusive Floating Stylus and patented replaceable V-Guard stylus assembly protect both the record and the diamond.

But the real payoff is in the sound. At least for those who can *hear* the difference.

Pickering
Plainview, L. I., N. Y.

For those who can hear the difference.

WIN a $1000 stereo system or any of 125 other prizes! To become eligible, simply identify the musical people pictured above. See your hi-fi dealer for entry blanks and full details.

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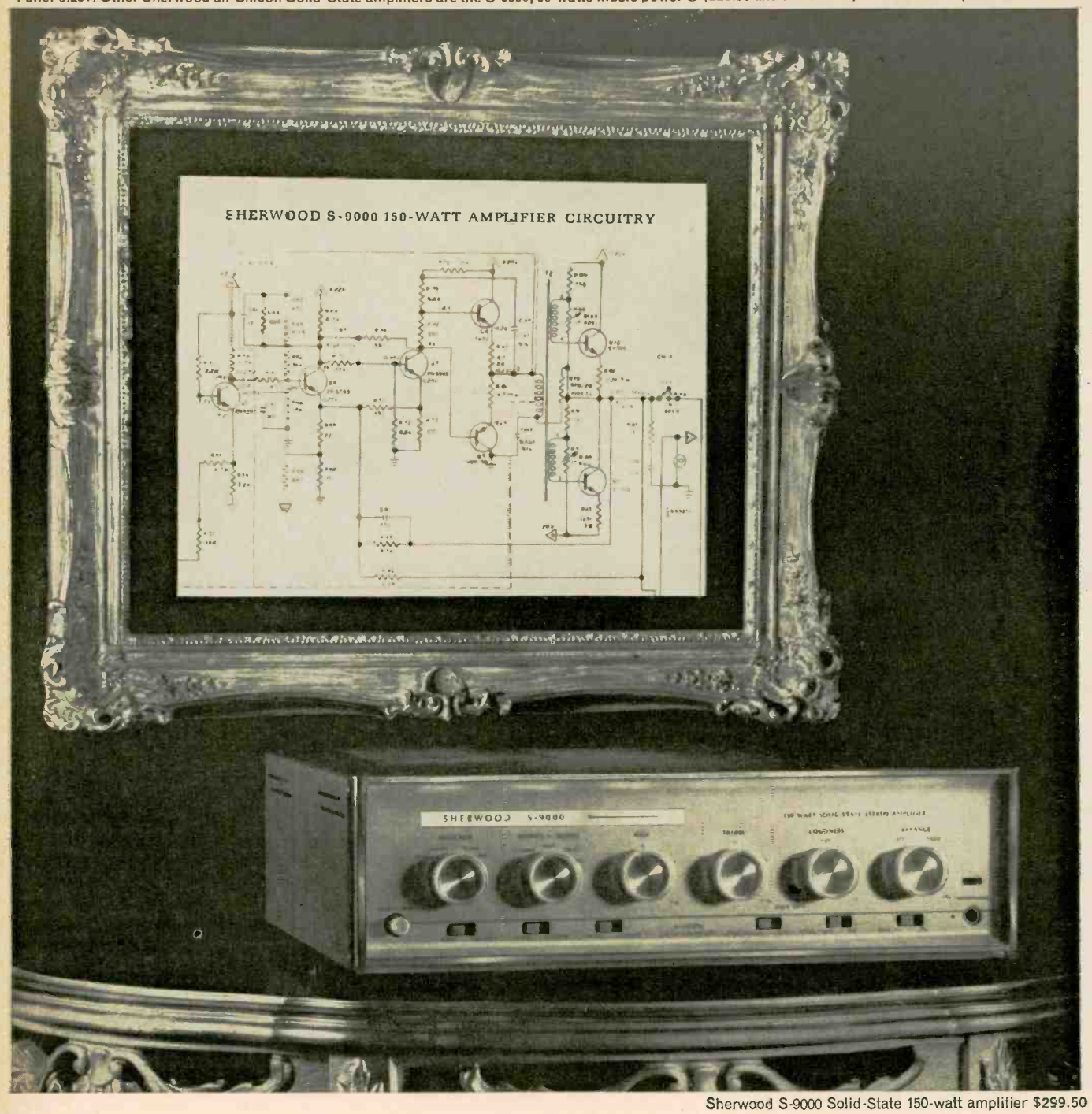
"Compare these S-9000 specs." Power output for both channels is 150 watts at ¾% I.M. distortion. Continuous sine-wave power output (two channels) is 100 watts at ¼% distortion. Power band-width: 12-25,000 cps. at 1% distortion. Hum and noise: Phono –70db, Tuner –80db. Sensitivity: Phono 1.8mv, Tuner 0.25v. Other Sherwood all-Silicon Solid-State amplifiers are the S-9900, 90-watts music power @ $229.50 and the S-9500, 50 watts music power @ $179.50



Sherwood S-9000 Solid-State 150-watt amplifier $299.50

How dare we say Sherwood is the best?

The dictionary defines *"dare"* as "to challenge one to pass a test." The Sherwood S-9000 *ALL-SILICON* Solid-State 150-watt combination preamp-amplifier consistently passes tests against any competitors' products. These tests can involve either the accuracy of its 150-watt power rating, the design of its Baxendall type controls, the reliability and coolness of its All-Silicon circuitry, its lack of distortion (rated at less than ¼%). the flatness of frequency response (±½db), the elimination of hum and noise (–80db), or the sensitivity of its phono preamplifier (1.8mv), ■ How dare we say Sherwood is the best? We can because comparative specifications, together with the experts' opinions and listening tests confirm again-and-again that *Sherwood is the best!*

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Is Magnetic Tape Long Lived?

JOHN T. MULLIN*

No one knows how long good quality tape will retain all the signal, but this pioneer has tapes which are 15 years old, and still going strong!

No one knows how long a good quality magnetic tape can last without measurable deterioration. As a matter of fact, and I speak from a background of 20 years of experience in professional recording and playback, there is excellent evidence that good tape will retain high quality recordings indefinitely.

Of course, magnetic tapes were not developed for general use in the United States until 1946 so that a first impression is that our experience can go back only that far. However, magnetic tape engineers and technicians in our laboratories for years have been testing various tapes on a 24-hour basis, punishing them with continuous wear equivalent to 100 years of normal use without appreciable change in the performance of these tapes.

In 1949, while I was recording engineer for Bing Crosby's radio shows, I taped Crosby singing a duet with Al Jolson. On the same tape is Mary Martin at a time when she was doing the musical, South Pacific." The tapes were "Scotch" Brand No. 111 manufactured by 3M Company. The tape was the same tape that was available in the stores for home recording. The recorder I used was the first Model 300 to leave the Ampex factory.

In the more than 15 years between 1949 and 1965, those tapes were stored in home garages in California, where summer heat raised inside temperatures as high as 120 degrees above zero, and in Minnesota, where the winter cold sometimes reaches 35 below.

No particular pains were taken to care for these tapes. The tapes were not played periodically or even run through a recorder to relieve tension. They were stored in their original boxes and the boxes were not sealed.

Yet, when I played the tapes a few weeks ago, the audio levels peaked at the same levels as when the tapes were recorded more than 15 years ago. Instead of being brittle, the tapes were still pliable on the reel. There was no snapping or pulling as a layer of tape came off the roll toward the playback head and there was no flaking; that is, no flakes of iron oxide fell from the tape. There were, in fact, no signs of aging except that the tape reels are the old-fashioned kind and the boxes are dirty and worn from years of storage under adverse conditions.

Most important, sound reproduction was excellent. I could detect no loss of quality at all.

*Minnesota Mining and Manufacturing Co., St. Paul, Minn.

Fig. 1. Checking 1949 tapes of Bing Crosby and Al Jolson radio programs he recorded, Mullin finds no signs of aging. Tapes were stored in original, unsealed boxes for more than 15 years in garages in California heat and Minnesota cold. When played, sound reproduction was excellent. *(Photo courtesy 3M.)*

Those of us who developed 3M Company's Professional Mastering Recorder, a machine that records master tapes from which disc records and pre-recorded tapes are made, have also made tests of machine reaction to tapes of various age. Segments were taken from a number of old tapes and were spliced together and run through test machines to determine, among other questions, the effects of age on magnetic tape. Here too we found that good quality magnetic tapes last indefinitely.

What about Lubrication?

There are those who believe that relubrication of magnetic tapes will keep them smooth and will reduce the amount of oxide that wears off on tape heads. In my experience, this has been an unnecessary and unimportant step with the tapes I have used. "Scotch" Brand tapes are manufactured with a built-in, dry, Silicone lubrication which lasts as long as the tape itself, which is to say that Silicone lubrication lasts indefinitely.

When slight ruboff does occur from extended use, the wear products from the more rugged oxide coating take on the consistency of a fine transitory powder rather than a gummy "balling" consistency of conventional coating wear products. This design feature of the tape virtually eliminates oxide building at the head gap, which is a common cause of output loss due to head-to-tape separation. Such tapes, therefore, can be used time after time and can be re-recorded after many years of age with-

Fig. 2. Tape-punishing setup at 3M testing laboratory in St. Paul. Tapes are fashioned into continuous loops and are run 24 hours a day, giving wear equivalent to 100 years of normal use without appreciable change in performance of tapes. *(Photo courtesy 3M.)*

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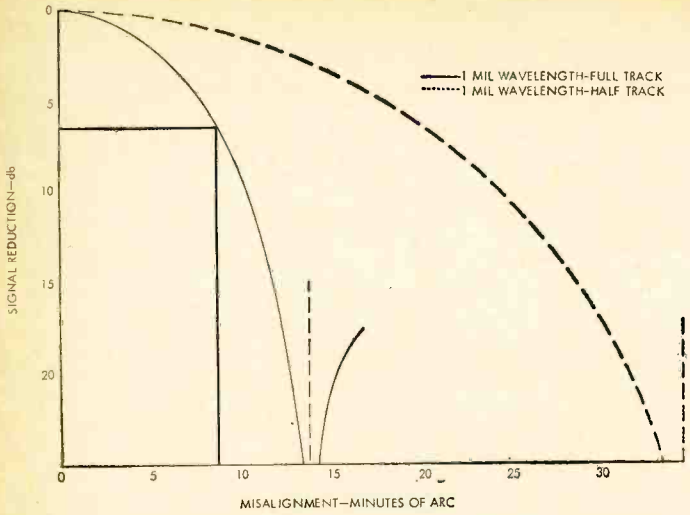

Fig. 3. (above) High-frequency signal reduction due to misalignment.

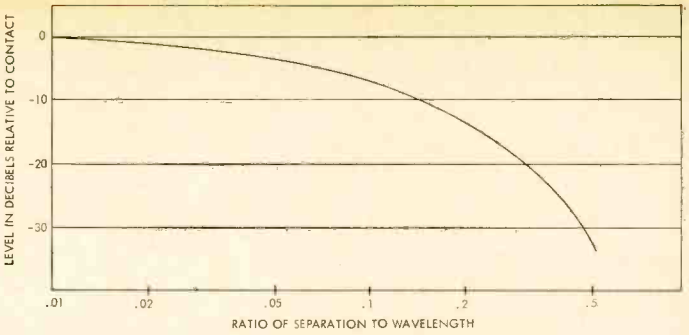

Fig. 4. (above right) Signal attenuation caused by poor contact in playback universal curve for any speed, frequency and separation.

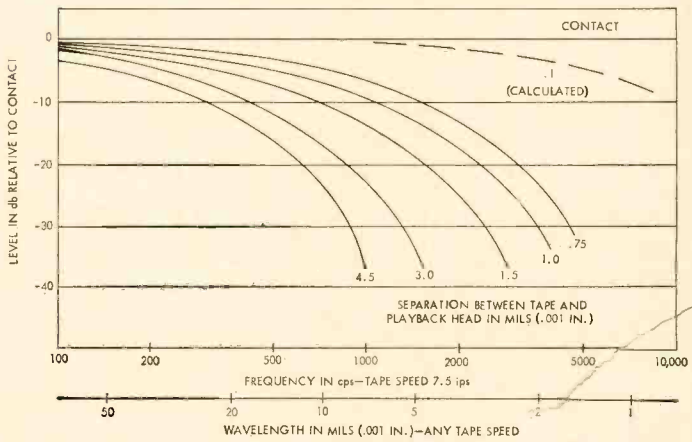

Fig. 5. (right) Signal attenuation caused by poor contact in playback as function of frequency (or wavelength) for various separations.

out appreciable loss of their ability to retain and faithfully reproduce the recorded signal.

Some lubricated tapes, such as "Scotch" Brand No. 151, use oxide formulations similar to conventional magnetic tapes. They differ only by the addition of an external lubricant layer. These tape constructions also provide the benefits of the more dependable oxide dispersions used in advanced instrumentation and computer tapes. These heavy duty dispersions offer lower static charge buildup and greater wear resistance, making them particularly suitable for continuous loop applications.

Some Rules for Preserving Tape

There are, of course, some common sense rules to consider in the handling of tapes to allow them to perform to their utmost capability. The rules are perhaps most important in the use of tape for very sophisticated applications such as those in areospace and computer work.

If the tape is wound badly, for example, the result would be bad tape tracking, resulting in poor frequency response due to distorted, rippled or warped edges. Damaged tape will not meet the playback head properly.

For reasons of interchangeability, an attempt is made to align the head gaps on all recording machines exactly perpendicular to the tape. This is very important. For example, in a full width (¼-in.) recording of one-mil wavelength, a misalignment of only eight minutes of arc will reduce the output by about six decibels (see *Fig.* 3).

Intimate contact must be maintained between tape and head gap for good frequency response. Loss of contact between head and tape, due to specks of dust, splicing adhesive lodged on the recording or playback head, scratches in the head surface or foreign matter on the tape, however slight, has a profound effect on high frequency output (see *Fig.* 4 and 5).

Storing tape in original box protects it from dust and from physical damage to its edges. Normally, cleaning of tape is not necessary but if there is excessive dust on the tape, the reels may be vacuumed and the tape can be cleaned by wiping it with a clean, lint-free, dry cloth while rewinding.

Avoid accidental exposure of the tape to magnetic fields. Weak magnetic fields will increase print signal and strong fields within a few inches of the tape may cause erasure. Don't store tape in cabinets with magnetic door latches if the tape is likely to come in contact with the magnetic latch mechanism.

In general, occasional use of recorded tapes, or simply re-winding them, improves their resistance to aging in prolonged storage.

Most cases of tape distortion can be traced to excessive winding tension, uneven winding or both. A high speed wind is usually soft enough due to entrapped air.

If you know you're going to store tapes for an unusually long time, use a polyester-backed tape. Polyester has 50 per cent better resistance to temperature change and 15 times better resistance to humidity change than acetate-backed tapes. Under ideal conditions, magnetic tape should be stored at room temperature—between 60- and 80-deg. F, with relative humidity controlled between 40 and 60 per cent. Temporary variations beyond these limits, though, generally are not harmful.

If some tapes become brittle during storage under severely hot, dry conditions, they can usually be returned to a condition that will allow playback of the information. Simply storing a brittle tape, out of its box or container, at proper environmental conditions for 24 hours should bring the tape back into balance. A simple way to restore moisture to dry tapes is to leave a lightly moistened sponge or blotter with the reel of tape in a closed container for 24 hours, being careful to keep the moisture from coming in direct contact with the tape.

A tape exposed to extreme cold should be allowed to return to normal room temperature before it is played.

Finally, occasional cleaning of the recording head, capstan, tape guides and other parts of your machine will help assure utmost wear life for your tapes. Many tape recording engineers use Freon TF or ethyl-alcohol or similar cleaning agents but, for your own machine, see your recorder operating manual.

Each of these points makes its contribution toward excellence in recording and playback but, in my opinion, the place to start is with the tape. Make sure it's a quality tape. Æ

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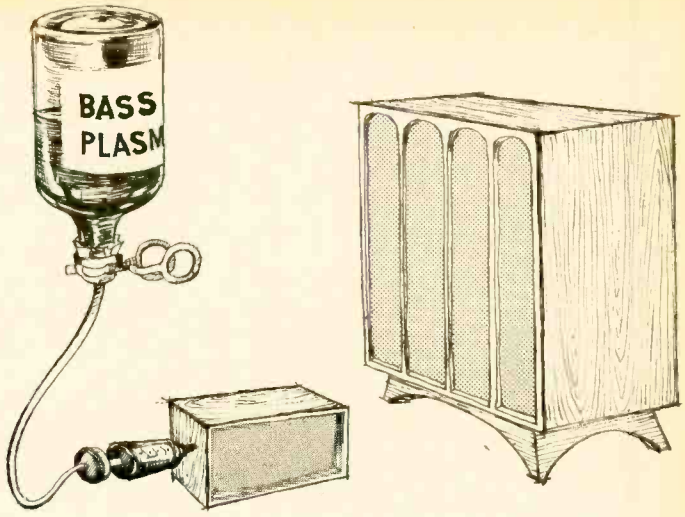
Bass Transfusion for Little Speakers



BILL YEAGER and ROGER HULL

Proper shaping of the low-frequency spectrum to conform to Fletcher-Munson can put the bass range in proper listening perspective. One can achieve this by means of experimenting with appropriate low-pass filters and T-pads, or simply by use of this device.

Loudspeaker authorities agree that it is the inherent lack of bass which prevents a small speaker enclosure from producing that full rich sound. On the other hand, some home music listeners object that large speaker cabinets occupy too much floor space. The basic problem is one of: Less Space or Less Bass?

Although the high-fidelity purists all favor the realistic sound they gain over the living space they lose, many other music enthusiasts have reluctantly accepted less fidelity from a pair of so-called "bookshelf" speakers simply because their listening area would not permit installation of larger speaker enclosures.

In other homes, it was a wifely influence which selected an all-inclusive piece of furniture known as a stereo console—usually complete with tuners (AM-FM Multiplex), stereo amplifiers, a record changer, a tape deck, a television set, shelf for record storage, compartments for extra tapes, microphones and other accessories, and, almost accidentally, a couple of cubic feet left over at the ends to serve as speaker enclosures. But, the console conformed with the decor regardless of its acoustical qualities—or lack thereof. As a result, the living room now is graced with a fancy Falsetto Provincial or a gleaming Clarion Modern; visually healthy and handsome, but suffering from a deficiency in its "bass-ic" metabolism.

Yet within that missing low-frequency range are the fundamentals of most music. The first three or four octaves encompass the low tones of the organ, piano, harp, bass viol and drums, plus those of brass and woodwind instruments. Without these bass notes, reproduced sound will lack the balance and the basic harmonics necessary for a sense of "presence" in music . . . *if* the original program material possessed it. A recording of a piccolo solo, for example, suffers very little from a lack of adequate bass.

The ability of a speaker to reproduce bass is determined by its resonant frequency; that frequency at which the voice coil, speaker cone and its suspension mechanism vibrate as a single unit. Both large and small speakers can be constructed with a very low free-air resonance; down to 25 or even 20 cycles. When a speaker is activated, its vibrations create sound waves to the rear of the cone as well as to the front. In a small speaker enclosure the stiffness of the air trapped behind the speaker tends to restrict these waves and thereby inhibit the cone movement. This can cause the resonant frequency to rise as much as an entire octave. Unfortunately, below the resonant frequency of a speaker, its response level falls off about 12 decibels per octave. Another factor affecting the problem of bass response is the character of the human auditory sense. Back in the 1930's, extensive research on acoustics and hearing was done by Fletcher and Munson. They found that there is a fading in the ability of the human ear to hear the lower frequencies; a fading which starts at about 300 cycles at normal listening levels. Therefore, the apparent loudness of a tone depends not only on its intensity, but also on its frequency. As the frequency lowers, its sound level seems to decrease. This decrease must be compensated if the listener is to hear a realistic reproduction of sound.

On most home amplifiers, the bass boost control hinges at around 1000 cycles. Attempts to compensate for a bass deficiency in the speakers by use of the bass boost control will affect the

Fig. 1. Altec-Lansing Bass Energizer.

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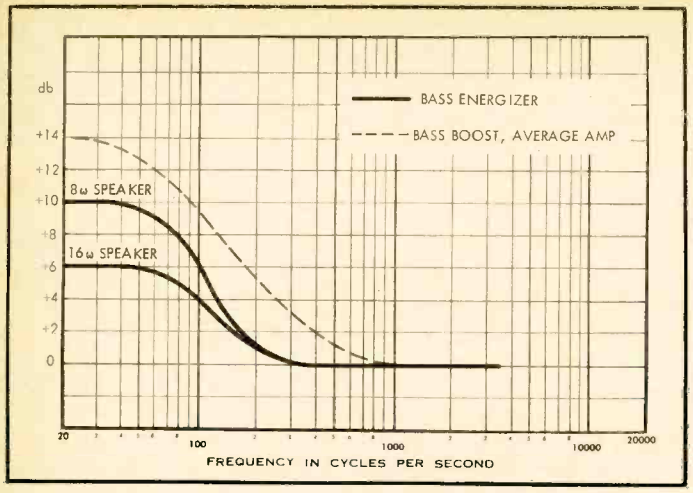

Fig. 2. Bass energizer response compared with the bass boost of average amplifier.

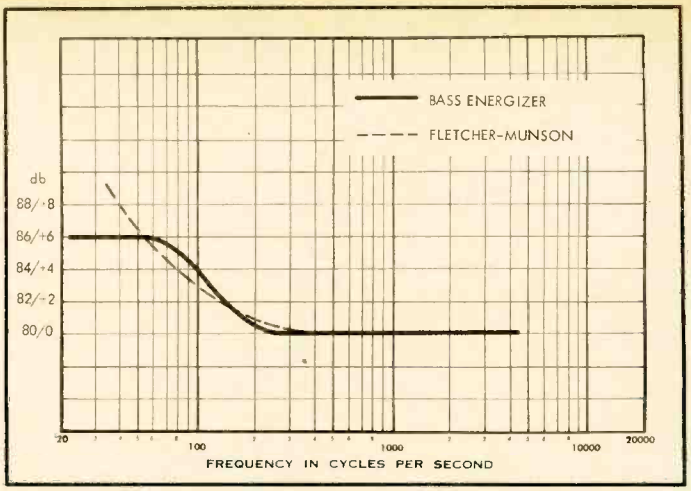

Fig. 3. Bass energizer response used with 16-ohm speakers compared to Fletcher-Munson curve for 80 db.

important mid-frequency area. If there is too much emphasis on tones within this range, a "tinny" sound will result. This is particularly true if the system uses small speakers in which the mid-range cannot be boosted without doing serious damage to the fidelity of the reproduction.

In order for a woofer in a small enclosure to approach the bass response achieved by one in a larger cabinet, there must be a gain increase in the lower frequencies, but *only* in the lower frequencies. Most attempts to solve the problem of weak bass in small bookshelf size speakers have involved some form of an amplifier. To accomplish the same thing without additional amplification devices, Mr. Alexis Badmaieff, Altec's Chief Engineer of Acoustic-Transducers, has developed Altec's new 100A Bass Energizer.

The Bass Energizer is a passive device which requires no additional electrical power. Connected between the amplifier output and the speaker input, it helps compensate for low-frequency deficiency in a speaker by providing a comparative increase in the bass response. This increase becomes effective at approximately 150 cycles and builds to full efficiency from 60 cycles on down to the cut-off of the speaker's capability. In effect, the bass energizer acts as an extreme low-pass filter which increases the fundamental bass without affecting the response of the mid- or high-frequency range (see *Fig.* 2).

This increase in bass level response approximates the Fletcher-Munson curve shown in *Fig.* 3. Assuming that the average home music enthusiast drives his equipment at a level somewhere close to 80 decibels—that is, a sound level approaching that of a mid-point seat in a concert hall (more than an atmospheric serenade but less than window shattering)—the bass compensation provided by the energizer remains within ±1 decibel of the Fletcher-Munson curve down to about 40 cycles.

Among the tests run on the bass energizer was one which compared a small infinite baffle enclosure containing an 8-inch woofer to a large bass reflex cabinet containing a 15-inch woofer. The small enclosure was equipped with an energizer, but the larger cabinet was not. On the basis of low-frequency response only, most listeners found it difficult to determine which speaker was being driven. Although the small enclosure was not the equal of the big speaker, the energizer did accentuate its bass response until it approached that of the larger cabinet.

Similar tests conducted with other speakers of various types and sizes indicated an increased bass intensity averaging from +6 to +10 decibels in every case, regardless of the size or type of speaker or of its enclosure.

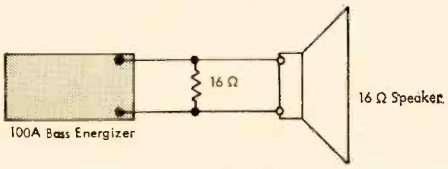

Fig. 4. Shunting a 16-ohm speaker for increased bass boost.

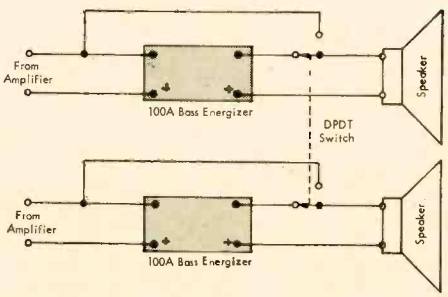

Fig. 5. Switching setup for bypassing energizer.

Another aspect of the sound reproduction problem which the bass energizer helps correct is that of "scale distortion." When music is reproduced through an amplifier with a flat frequency response and is fed to speakers at a level approaching the same degree of loudness it had in the studio, the tonal balance of the reproduction will approximate the original sound. In the recording studio, however, the level of the original orchestra may reach 100 decibels and more, a level rarely reached by a listener at home. When the reproduced sound level is less than that of the original source, scale distortion occurs; primarily because the bass is weak compared to the mid-range frequencies. At lower listening levels, orchestra and organ music will lose its luster and become flimsy and dull. To correct such distortion and to regain the tonal balance and natural qualities of such music when it is played at background level requires (once again) an increase in the bass end of the sound spectrum.

At low gain levels, the bass energizer is at its best. Scale distortion is prevented and musical "presence" is attained without cranking up the bass boost on the amplifier to its maximum position; an increase which will raise the level of all frequencies below 1000 cycles. For the owner of a stereo rig who prefers "tunes-to-talk-over", the bass energizer provides a new fidelity of sound. For the critical listener who also is an apartment dweller, it is almost a must.

The energizer is designed primarily for use with efficient speakers; speakers which use a minimum of amplifier power to reproduce the entire audio range without perceptible distortion. Technically, the efficiency of a speaker is determined by the ratio of its output

(*Continued on page 51*)

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Calibrated Stereo Control Unit

RAPHAEL F. EHAT

PART THREE

The Bauered Output Stage

The output stage (*Fig.* 7) is quite complex due to the many stipulations upon its design, but it is basically a three transistor feedback loop (PNP and NPN, common emitter, in cascade, followed by a PNP emitter follower output transistor, with both a.c. and d.c. feedback to the first emitter). The circuit is adapted from an excellent design[12] after study of several others[13, 14, 15] and the purpose at hand. A list of requirements follows:

1. Approximately 8 db of gain to make up for losses in the separation, balance, and contour controls.

2. Low distortion under variable loading conditions imposed by the powering of one to ten pairs of earphones simultaneously (a difficult requirement with transistor circuits). Maximum output is 40 mw into a 60-ohm load (600-ohm phones).

3. It is not practical to extend the amplifier's tolerance of variable loading to include one, let alone 10 low impedance phones, so an output transformer is used. It is designed and used so as to add no measurable distortion. When phones are used for considerable lengths of time the power amplifiers are shut off.

4. The low output impedance (3 ohms in phone mode and lower in speaker mode) insures excellent stability of output level when the number of phones connected are changed, and allows any length of transmission line to the loudspeaker amplifiers.

5. Inclusion of the Bauer circuit (*Fig.* 8) when phone mode is used, so that the binaural earphones can accommodate stereophonic signals. (Un-Bauered A/B comparison can be made by plugging the phones into the speaker mode output whenever desired).

6. D.c. coupling is used inside feedback loops (especially in the output stage with an open loop gain of approximately 3300) to obtain maximum low frequency stability. The second stage, Q_2, is an exception. In organ work the lowest fundamental encountered is 32.7 cps and is at the same time the most used, most important at least for the scales of C, F, and and G), and the one likely to be accented the most. Thus, response must be absolutely flat and stable to this frequency. The 16.35 cps one hears about is just not practical in either pipe or electronic organs without the expenditure of vast sums of money. The usual procedure to obtain the first octave starting at 16.35 cps is to synthesize it from a mixture of two tones a fifth apart (frequency ratio close to 3:2). This brings all fundamentals to 32.7 c/s and above. Fewer capacitors also mean great-

[12] David R. Steele, "Low-Noise Transistor Preamp.," *Electronics World*, Feb. 1960, page 57.

[13] Francis A. Gicca, "Transistorized Phono Preamp for Stereo," *Electronics World*, Aug. 1959, page 60.

[14] Dr. R. D. Middlebrook, C. A. Mead, "Transistor a.c. and d.c. Amplifiers with High Input Impedance" *Semiconductor Products*, Mar. 1959, page 26.

[15] James J. Davidson "Transistor Amplifier with High Input Impedance" *Semiconductor Products* March 1960, page 42.

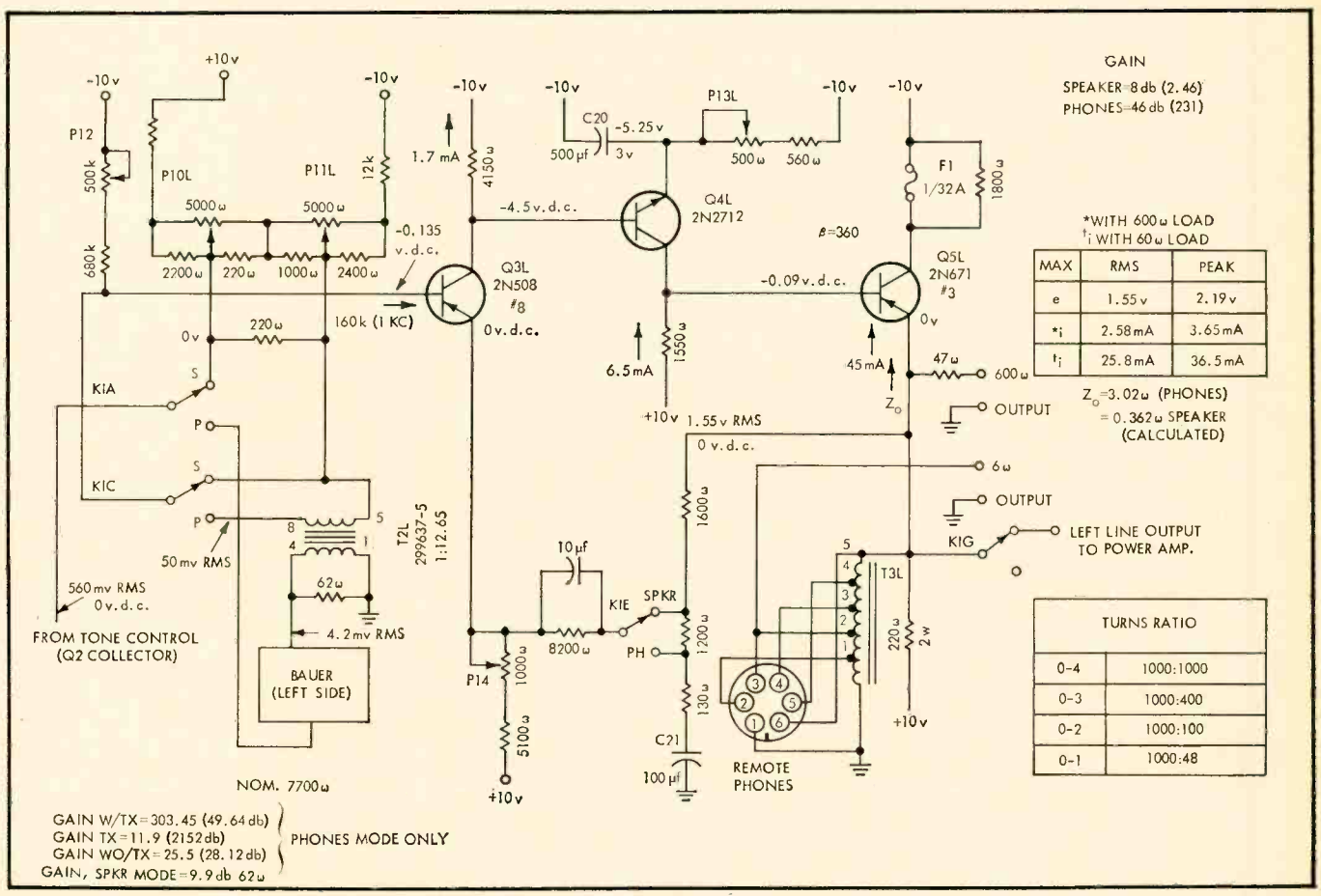

Fig. 7. Adjustable gain output stage (one channel).

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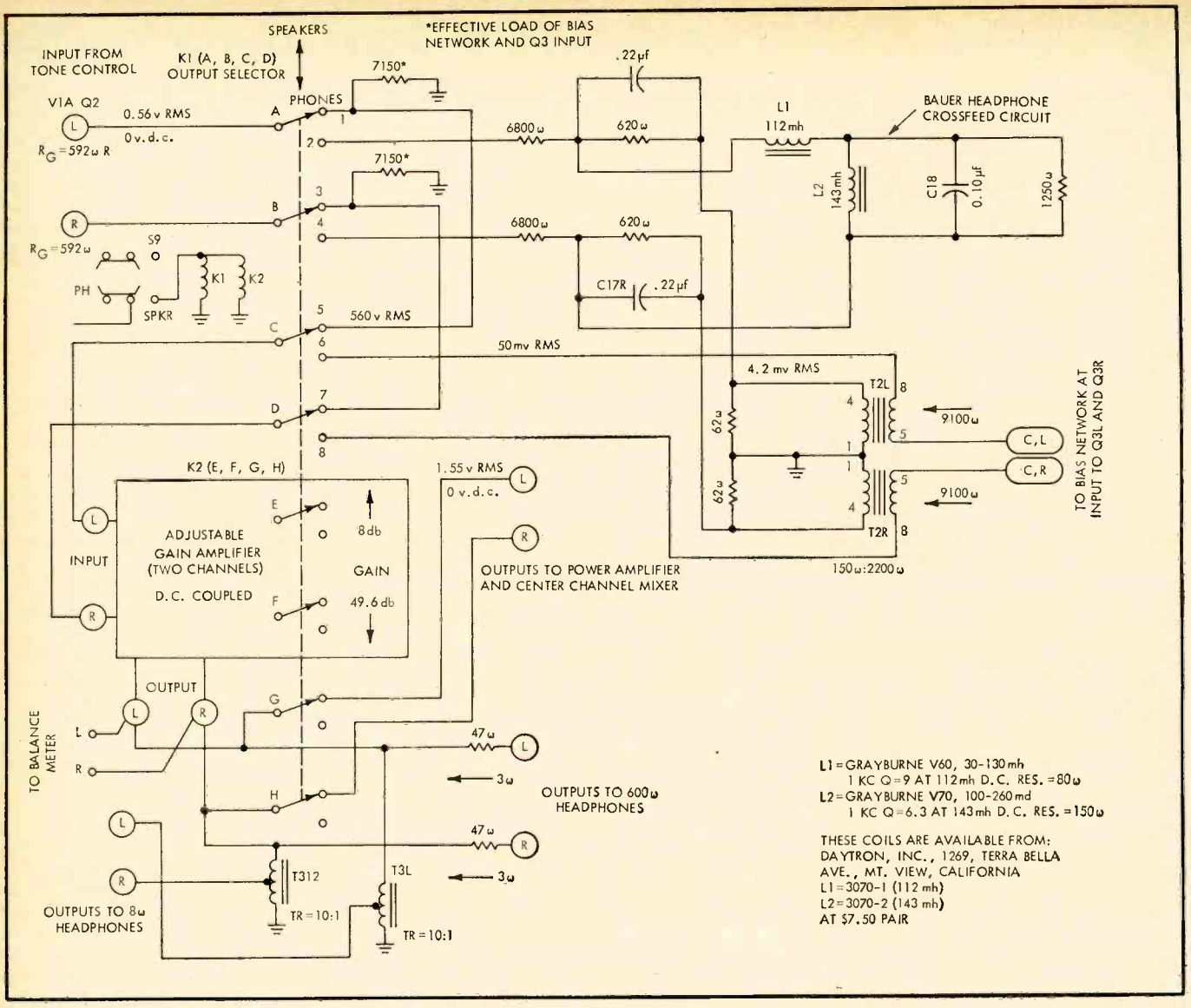

Fig. 8. Speaker-headphone correlation circuit.

er ease in controlling the low frequency response, a saving in cost, and a saving of space.

7. The feedback factor is reduced in phone mode so that voltage gain is increased from 9 to 28 db to make up a net loss not supplied by the step-up transformer used. The impedance level of the Bauer circuit is increased 12-fold to adjust its input impedance to equality with the base bias network on the first transistor of the loop (7.15 kilohms). This minimizes the transient occurring when the Bauer network and transformer following it are interposed between the tone control and the transistor (Q_3) rather than the direct connection used in speaker mode. The Bauer circuit output impedance is still low (62 ohms) and when stepped up by the transformer becomes 10 kilohms. Although the stage gain is increased in phone mode there is still about 42 db of feedback left. This keeps the stage input impedance high, although shunted by the 7 kilohm bias network. The transformer secondary is placed in series with the bias so that the 10 kilohms impedance looks into approximately 160 kilohms at the transistor base (due to the feedback) and is not shunted by the bias resistors. The transformer, operating so lightly loaded, introduces negligible distortion and gives maximum recovery of voltage gain for the turns ratio available. In addition, the secondary d.c. winding resistance of 7.5 kilohms gives minor degradation of temperature stability.

Indicating the Separation Ratio

Since we have included a dimension control[8] (the author likes to call it a separation ratio adjustment) in our control unit, it would be useful to know what the separation ratio is after it has been adjusted. This is especially true if we are analyzing experimental organ tones quantitatively, as in the author's case, or trying to improve a stereo microphone set-up, in a sound recordist's case, or just to log separation ratio adjustments for a record or tape library, in many a reader's case. It is understood that the reading obtained on a separation ratio meter will fluctuate with program content, making interpretation difficult. This does not destroy its usefulness any more than the fluctuations of a VU meter would for those with experience in its use.

An excellent device[16] which gives a qualitative indication of the separation ratio, passes the left, *L*, and right, *R*, channel signals through matrixing transformers and reads the output of a phase detector connected thereto by means of a center null meter. Pseudo stereo with no center information gives a null reading, normal in-phased stereo a rightward deflection, a monophonic signal will pin the meter to the right, and if out-phased, pin it to the left. This is fine as far as it goes, but what about an attempt to calibrate this meter in separation ratio (S.R.) units? It is evident that this is difficult using the natural

16 Ralph Glasgal, "Checking Stereo Separation and Phase, *Electronics World*, Oct. 1963, page 37.

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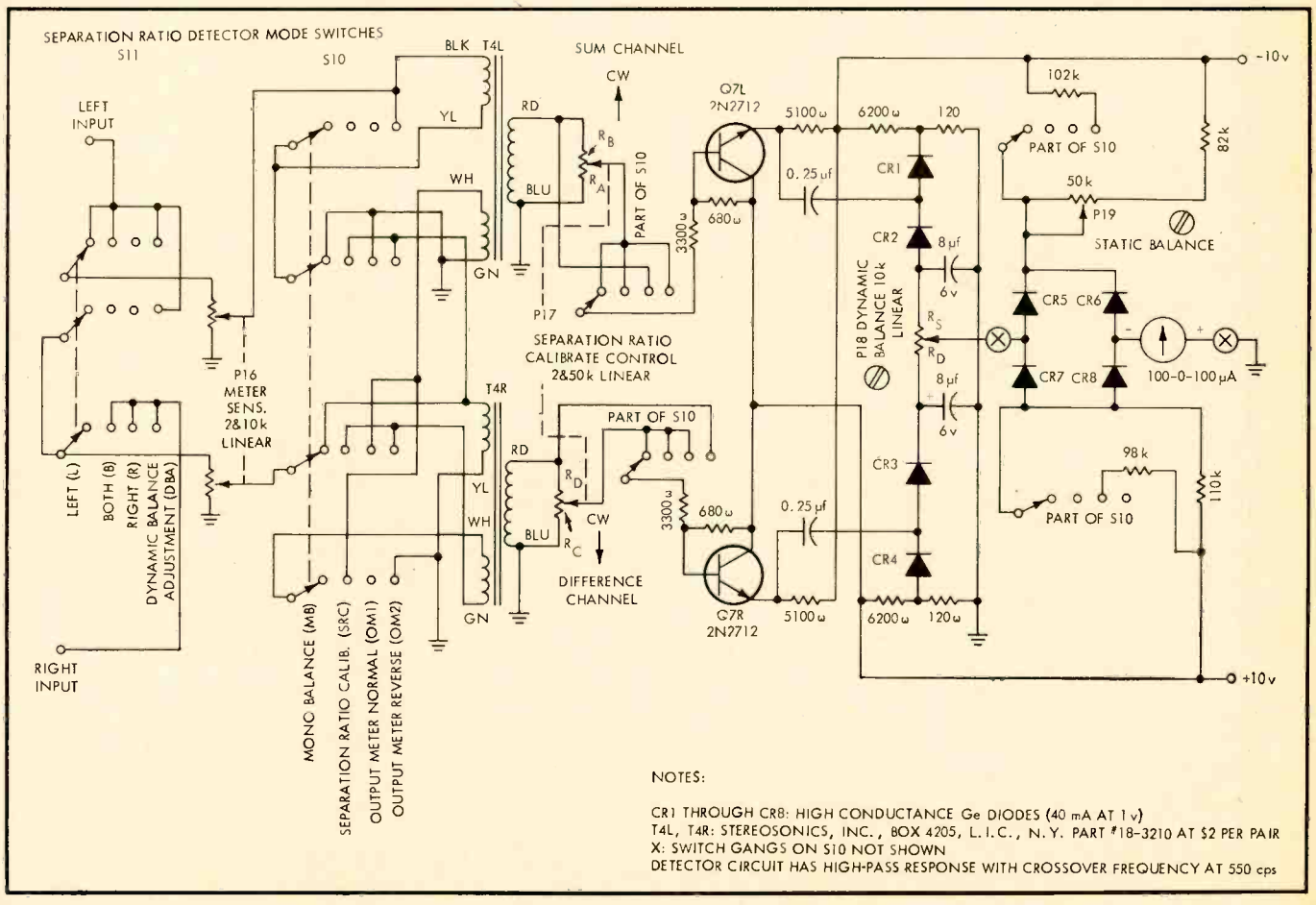
signals for measurement, the meter reading being a function of both S.R. and signal amplitude. It is interesting to speculate whether one could calibrate the scale by first limiting the signals as in the I.F. section of an F.M. tuner to eliminate the amplitude function. Although this process is highly successful in the reception of F.M. signals, it does not necessarily follow that equal success is assured for the phase sensitive detector. When reading close to monophonic signals (S.R. close to zero) or stereo signals with S.R. close to 1, one component of the complex signal is relatively small. It is known that the response of a phase detector is an appreciable function of how near to the zero axis, relatively, one senses the position in time of a wave, i.e., its relative phase. It would seem that the smaller component would be sensed nearer its peak even though limited. This difficulty can be alleviated by enlarging a reference phased signal (assumed constant in amplitude) thus making the indication relatively insensitive to fluctuations of the other signal, as long as a difference in size is maintained. In our case either L or R could be blown up and limited and the other signal compared to it in its natural state.

Nulling the Separation Ratio

However, since we are not interested in reading phase, per se, but only in detecting out-phased signal channels, and indicating the S.R. quotient which is $L-R/L+R$, expressible as an amplitude function (even though the device is basically a phase indicator if fed with constant amplitude signals) the author has not delved into this possibility. A new circuit (*Fig.* 9) will be described in which the Glasgal arrangement has been augmented so that adjustment of a "Separation Ratio Calibrate Control" will allow a null center reading for any possible S.R., the calibrate control having a dial marked in S.R. units. The adjustment and meter reading are highly independent of signal amplitude once the L and R channels have been balanced (using a variation of the circuit for this purpose). In operation, the null measurement is accomplished in the same way an impedance bridge is balanced. In our case the impedance, rather than being an unknown compared to an adjustable known using a single activating signal, is a twin or dual ganged potentiometer, P_{17}. One pot controls sum signal amplitude, the other controls difference signal amplitude, in the opposite direction, of the L and R signals which were matrixed to form the two activating signals which are applied across the pots.

The adjustable sum and difference signals are each applied through an isolating emitter follower to a voltage doubling rectifier. Voltage doublers are used not only to double the off-null deflection but also to avoid the doubt a purist would cast upon the correctness of the readings obtained were one to depend on half-wave rectifier output. Unless a conscious effort is made to control the zero axis a half-wave rectifier cannot reflect the true size of, for example, the asymmetrical signal corresponding to a tone having a preponderance of even harmonic content. The rectifiers are poled and filtered to impress bucking d.c. voltages across a "Dynamic Balance" potentiometer, P_{18}, whose adjustable center tap supplies the null indication (referenced to ground). When the sum and difference complex signals are equal as seen by the rectifiers the meter nulls at the center of its scale because the two outputs buck to produce zero volts d.c. at the meter terminals. The adjustable tap on the pot is provided so that the null obtained from balanced signal voltages occurs at the same point on the meter scale obtained after adjustment of a "Static Balance" control is adjusted



NOTES:

CR1 THROUGH CR8: HIGH CONDUCTANCE Ge DIODES (40 mA AT 1 v)
T4L, T4R: STEREOSONICS, INC., BOX 4205, L.I.C., N.Y. PART #18-3210 AT $2 PER PAIR
X: SWITCH GANGS ON S10 NOT SHOWN
DETECTOR CIRCUIT HAS HIGH-PASS RESPONSE WITH CROSSOVER FREQUENCY AT 550 cps

Fig. 9. Calibrated separation ratio detector circuit.

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for a d.c. balance. The dynamic balance adjustment in effect cancels the errors of component tolerance, particularly those of the rectifier diodes and the emitter followers driving them.

Meter Protection

The miniature meter used in the construction of this circuit can be easily damaged, not so much by the S.R. detector, but mainly by the other functions called upon in the author's system. The meter will be used to service and adjust bias of the d.c.-coupled stages of the control unit. A shorted transistor there could easily result in burnout of a meter requiring only about 25 millivolts for full scale indication. A bridge network of four diodes is interposed between the detector output and ungrounded meter terminal to protect the meter from overload. The two diodes (CR_6 and CR_8) whose junction is tied to one meter terminal are (under no-signal conditions) both operating in forward conduction, the value of d.c. current being adjusted by the "Static Balance" control, P_{19}, so that ground potential is applied to the meter. The positive and negative power supply terminals have previously been balanced so as to make this adjustment possible. The total value of resistance in series with the diodes is chosen so that when the static balance is nominally correct the current passed is also of a value such that, were it passed through the meter, it would cause a deflection from center to the desired full scale indication. In the author's circuit this value is approximately 90μA. Two other diodes (CR_5 and CR_7) offer an alternate path for this current, and being the same type of diode and reasonably matched to the first pair, also have virtually a ground potential at their junction. Thus, there is no current in the connection between the dynamic balance control slider and this second junction is in a no-signal balanced condition.

Now, let us look at only the two diodes (CR_5 and CR_6) which pass substantially equal shares of this 90μA through the current limiting resistance (which includes the static balance adjustment) to the negative power supply terminal. This balanced condition may be disturbed by causing an external current to or from the connection made at the dynamic balance control, and reflects as a corresponding disturbance at the meter terminal on the other side. The action is the analog to the transition state in the well known (and identical) "and" gate used in digital logic as it passes from "yes" to "no" and vice versa. Whenever a difference signal is allowed to preponderate over a sum signal the detector net output becomes positive and current goes into this half of the bridge. The additional current through CR_5 takes an equal amount of current from CR_6. At the same time the detector output excursion takes a similar current from CR_7, resulting in an equal increase through CR_8. Less current goes to the power supply via CR_6 than is drawn from the power supply through CR_8, and the difference is manifested as down-scale meter current. The same action in reverse occurs when the S.R. Calibrate Control is turned to the other side of balance, so that the sum signal causes the detector output to be negative, giving an up-scale deflection.

When the potential applied to the circuit exceeds that necessary for full scale deflection in either direction the current "robbing" action ceases. In the positive direction, CR_7 becomes back biased and CR_8 cannot draw more than 90μA from the power supply. CR_6 also becomes back biased and isolates the increasingly conductive CR_5 from the meter. Thus, extremely large overload potentials up to the breakdown rating of the diodes chosen, may be applied with safety, and without unduly loading the source of potential.

Monitor and Balance Connections

Among the other duties for the balance meter are the measurement of two other signal characteristics. A selector switch, S_{10}, is provided to bridge the two matrix transformers (T_{4L} and T_{4R}) across the control unit output in the proper configuration for these measurements.

For S. R. nulling T_{4L} is connected in parallel aiding for the sum output, and T_{4R} is connected in parallel bucking for the difference output.

An output meter function is provided for monitoring the composite over-all stereo signal level, useful as an adjunct to the VU meters on the individual L and R channels (in the tape recorder). This indication will include the total effect of balance, separation ratio adjustment, equalization, contour, and level adjustment on the general signal as it emerges from the control unit. Both L and R are applied in phase via S_{10} only to the sum transformer (T_{4L}), the difference channel remaining inactive. A 98k resistor is switched in to increase the current through CR_8 to zero the meter at the left side of its scale. Any signal from either or both control unit channels will register as a forward meter deflection, as long as the signal is not an outphased pure monophonic pair. The latter signal produces no deflection and can be used for detecting an out of phase condition (prior to the power amplifiers). For this test a monophonic signal is applied to the control unit inputs, or if a stereophonic signal is used, the S. R. Adjustment Control, P_1, is turned to one of its extremes.

If this extreme is the one marked "mono," and the channel reversing switch S_2 is at its "normal" position, the circuit is all wired correctly, and no deflection is obtained, then the signal in question is out of phase, and one channel must be reversed. (Although not shown in the author's system, there is no reason why the metering circuit cannot be fed from the power amplifiers rather than the control unit for checking the complete system). The Meter Sensitivity Control, P_{16}, may be marked to correlate a convenient meter deflection to a known signal level and thus a produce a calibrated, if ersatz "VU" meter.

In the Monophonic Balance position, S_{10} routes L to one winding of T_{4L} and R to one winding of T_{4R}, the other two windings being left inactive. In this function both detector channels receive equal voltages from a balanced signal, yet, since they are completely isolated for a.c. from one another, phasing and separation have no effect. The function is used for balancing the system prior to adjusting or reading the separation ratio. The test is made by first setting up or applying a pure monophonic signal as before, setting the S. R. Calib. Control exactly on the S. R. = 1 dial mark, and checking for a disturbance of the meter centering upon application of the signal. The preamp Balance Control, P_2, is then adjusted for a perfect null.

When servicing the control unit the Monophonic Balance function is utilized for setting the Dynamic Balance Control, P_{18}. However, the switching is such that a balanced signal is applied to the metering channels independent of the Balance Control. The Dynamic Balance Control can then be adjusted so that a perfect a.c. null corresponds to signal balance, remembering that the S. R. Calib. Control must be on the 1.0 mark. (For details see later section on dial calibration.)

The Calibration Problem

The next task, now that the S. R. Calibrating circuit was designed, was the little detail of marking the S. R. Calib. Control dial in S. R. units. Remembering that S. R. $= L - R/L + R$, suppose we wish to locate the S. R. = 0.5 mark on the dial. It would seem logical to split a sine wave signal between the two metering channels so that the sum channel received twice the signal voltage that the difference channel received, twiddle the S. R. Calib. Control for a null, and mark the dial. This could be done using the Monophonic Balance position of S_{10}, as then S. R. and signal phasing wouldn't even bother the reading. Designers of electronic equipment will recognize the sinking feeling one gets when the temptation for taking a short cut such as this presents itself, especially when the alternate approach is contemplated. The

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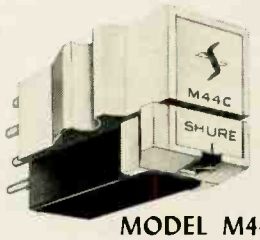

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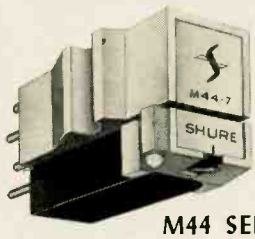

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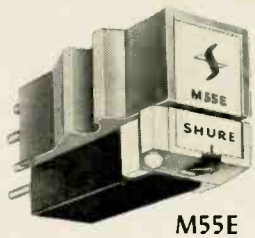

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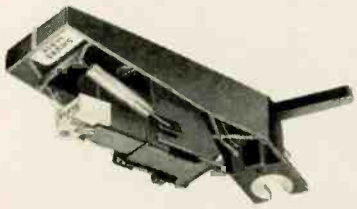

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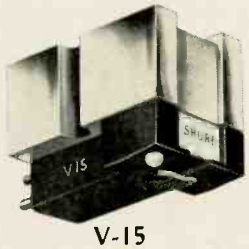

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author asks himself, "Has he really predicted what his circuit will see when the simple single-frequency sine wave is removed and in its place is substituted a stereophonic signal containing complex vector quantities? What is the cumulative effect of the circuit components upon the accuracy of that dial marking? What subtle facet of circuit theory has been overlooked along the way?"

In view of the above, the author decided upon the following procedure for the calibration:

1. Find out what a stereophonic signal is, and use its mathematical representation to identify and combine the signal components according to the separation ratio formula into a mathematical representation of a real stereo signal of known S. R. and without intelligence modulation which would prevent a steady meter reading; and 2. synthesize this signal according to the formula, using whatever test equipment required; and 3. apply this signal to the metering circuit, null the S. R. Calib. Control, and mark the dial.

The Mathematical Myth

It wasn't very long before the author saw the mathematics of a stereo signal through an aura of mystery. Surely stereo has been around too long for that, or has it? A treatment involving integral calculus was noticed[17] but the author felt that a simpler approach was possible, easily followed by the less mathematically inclined reader (including the author), and yet with the appeal of truth. Our old friend the $L \pm R$ formula would be ideal for our purpose, if only it were completely correct. An example of what I mean is the following formula, quoted from one of the references, which is typical of the formulas one encounters, but from which no quantitative data is actually extracted: SUM-DIFF. $= (L+R) - 2(L-R) = 3R - L$. A little thought will show the fallacy of this statement. More often than not, both L and R are complex vector quantities, and all who have ever been initiated into the j-operator club will recall that such quantities cannot be combined algebraically. In fact this statement is true only when both L and R are exactly the same frequency and exactly in phase, although they can be unbalanced. This is no less, or more, than defining a pure monophonic signal. It follows that the equation cannot be used for the extraction of general information.

The author decided to whip this type of equation into shape for the job at hand mainly because of its availability and innocent appearance. Needless to say, help was enlisted, and the author is happy to acknowledge the eagle eyes of three cooperative physicists,[18] who helped in developing and checking the mathematical steps.

The Stereophonic Signal

In order to describe the stereophonic signal clearly by the method chosen, and without ambiguity, it was found convenient to reappraise the definitions for L and R as normally thought of and use them in a different light. The half truth that a stereo signal is composed of L and R is abandoned in favor of the concept that these component channels are themselves, more often than not, each composed of two accountable components.

Whenever the symbol for a signal common to both channels is used it is identified by a subscript in parentheses. With this in mind, let us proceed with our definition of the stereo signal as it exists in a resistive circuit:

Let L = Unit rms voltage of total random (incoherent, uncorrelated) component of the left channel signal.

Let R = Unit rms voltage of total random (incoherent, uncorrelated) component of the right channel signal, independent in spectral nature, but by definition, balanced in integrated amplitude to the L component.

Let $M_{(L)}$ = Unit rms voltage of total reference phase (coherent, correlated) component of the left channel signal.

Let $M_{(R)}$ = Unit rms voltage of total reference phase (coherent, correlated) component of the right channel signal, which by definition is identical to $M_{(L)}$ for balanced signal channels.

$$M_{(L)} + M_{(R)} = 2M \text{ since } M\angle 0° + M\angle 0° = 2M\angle 0°. \qquad Eq.\ (1)$$

$$M_{(L)} - M_{(R)} = 0 \text{ since } M\angle 0° + M\angle 180° = 0 \qquad Eq.\ (2)$$

Since L and R have been defined as two signals of unit magnitude and both as being random or incoherent, it follows that they must remain random or uncorrelated with respect to one another, and it is proper to coin the symbol U to represent either (for uncorrelated signal component). When we wish to combine (add or mix) these quantities with themselves or with other quantities let us coin the symbol $\oplus$, which signifies an RMS addition of vectorial quantities, i.e., an addition of both amplitudes and phases. It serves also to stress the fact that we must not confuse this process with algebraic addition. We now define the stereophonic signal in terms of our symbols:

The left channel or

$$\text{LEFT} = L \oplus M_{(L)} \qquad Eq.\ (3)$$

The right channel or

$$\text{RIGHT} = R \oplus M_{(R)}. \qquad Eq.\ (4)$$

A balanced signal is understood throughout.

Should the monophonic (M) component suffer attenuation, then, by definition, $M_{(L)}$ and $M_{(R)}$ disappear equally. When they have vanished we have a pure uncorrelated (pseudo-stereo) signal with S. R. = 1.

Should the stereo components (L and R) suffer attenuation, then by definition, they disappear equally. When they have varnished we have a pure correlated (monophonic) signal with S. R. = 0.

Should the signal be outphased by accident or design, either channel can be considered the inverted one. Assuming the right channel reversed, the stereo signal becomes:

$$\text{LEFT} = L \oplus M_{(L)}, \text{ as before.}$$
$$\text{RIGHT} = [-R] \oplus [-M_{(R)}]. \qquad Eq.\ (5)$$

U/M as a Function of Separation Ratio

Although we cannot say that $L - R = 0$ or that $L + R = 2U$, because the component phases are indeterminate, we can, by definition say that

$$L \oplus R = U \oplus U, \text{ and,} \qquad Eq.\ (6)$$

$$L \oplus (-R) = U \oplus (-U). \qquad Eq.\ (7)$$

Remembering our definition of the quantities in equations *Eq. (3)* through *Eq. (7)* as being unit rms voltages across resistive circuit elements, what we have said is that their value is the square root of their individual full cycle average heating power. In a resistive circuit, power is real, positive, and not vectorial, thus combining arithmetically with other power. Recall also that power is proportional to e^2, and average power is ½ the peak power[19]; we can now say, (since $U_{peak} = \sqrt{2}U_{rms}$):

$$L \oplus R = U \oplus U = \sqrt{[(\sqrt{2}U)^2 + (\sqrt{2}U)^2]/2} = \sqrt{2}U. \qquad Eq.\ (8)$$

Another way of visualizing this process is through the concept of the addition of decibel expressed quantities[20] which states the following relationship to be true:

When L/R or $U/U = 1 = 0$ db, then

$$\frac{L \oplus R}{L} \text{ or } \frac{L \oplus R}{R} \text{ or } \frac{U \oplus U}{U} = +3.01 \text{ db} = \sqrt{2}.$$

We find that the rms difference between these same quantities to be:

$$L \oplus (-R) = U \oplus (-U) = \sqrt{\{(\sqrt{2}U)^2 + [(\sqrt{2})(-U)]^2\}/2} = \sqrt{2}U \qquad Eq.\ (9)$$

(Continued on page 57)

[17] Paul W. Klipsch, "Two Track, Three-Channel Stereo," *Journal Audio Eng. Society*, Vol. 6, No. 2, April 1958, page 122.

[18] Dr. James M. Ferguson, Dr. John P. Hurley, and Mr. Norman E. Scofield, U. S. N. R. D. L., San Francisco, Calif. 94135.

[19] "Alternating Currents" by Chester L. Dawes, McGraw Hill, N. Y., 1947, Chs. 1 and 2.

[20] A. L. DiMattia and L. R. Jones, "Adding Decibel Expressed Quantities," *Audio Engineering*, July 1951, page 15.

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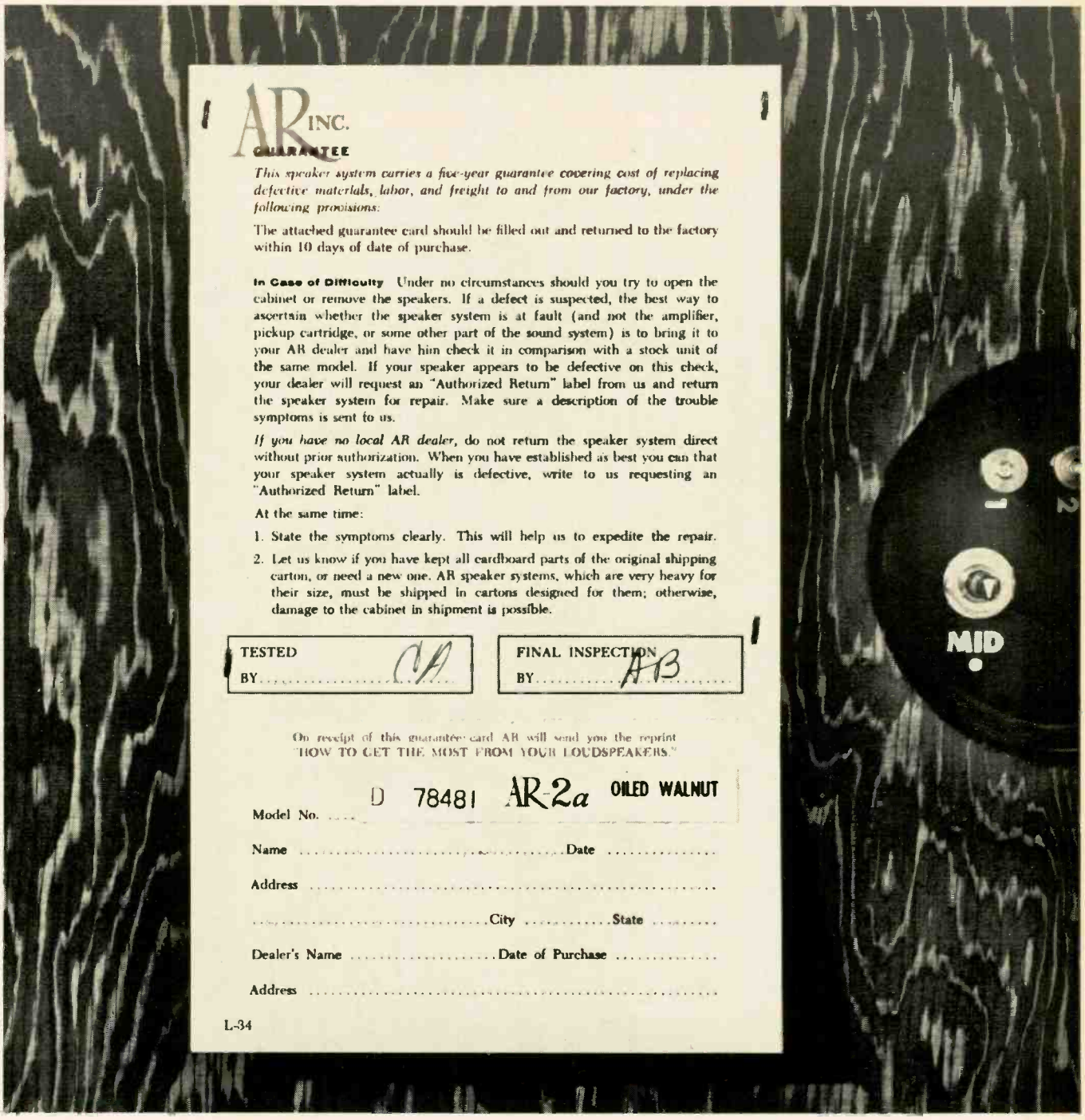

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SOUND SYSTEMS may be classified as sound re-enforcement, paging, or public address systems. All these systems have some common characteristics and some widely different ones. In general the objective of a sound re-enforcement system is to produce just enough intensity of reproduction to enable all listeners, regardless of seated location to hear clearly and without effort, all that is being said at the rostrum or on the stage. Equally important to this criterion is the necessity of creating the effect of the reproduced sound coming directly from the man at the rostrum. Succesful localization of the reproduced source of sound near the original source itself, and with just enough intensity to be heard comfortably would then constitute a "sound re-enforcement" system.

These characteristics of a sound re-enforcement system would of course be completely unsuitable for a general plant paging system. In this instance our need is to get a message across to a particular person regardless of where he may be located and sufficiently strong and penetrating to overcome environmental masking noise, and to be clearly intelligible above reverberant conditions of the area in which the listener is located. While much has been written concerning the choice of loudspeakers for such applications, little information is available on the reciprocal nature of the loudspeaker as a microphone when the paging system is also to be used as a reply system.

Such installations are very numerous: The counterman uses one to call the stockboy amongst the stock shelves; the auto service manager uses one to question the mechanic in the garage. Both of these calls may require answers, but the stockboy need not leave his particular area of work to answer, nor does the mechanic have to get out from under the hood of the car to reply. The individual being called answers without leaving his work. He listens, and replies from where he is in a tone and strength of voice which he has learned adequately energizes the distant loudspeaker as a microphone for the return message. For proper performance of such two-way systems we must look for optimum correlation between the frequency response and output level of a loudspeaker and its sensitivity and characteristic as a distant pickup microphone.

The two paging illustrations given above indicate two rather widely differing situations. The stockroom, full of shelves of paper boxes, cartons or what have you probably would be a quiet and acoustically absorbant type of room with reverberant bounce from wall-to-wall cut to a minimum because of the many intervening stock shelves. The second case illustrates a noisy area with reverberant areas between the glass and brick walls to permit easy maneuvering of the cars in the garage. In the one case, quiet and "dead," and the other noisy and "live."

Several types of loudspeakers have been used in the many variations of these two widely different situations, but they may be generally put into two groups: A cone speaker mounted in a simple box baffle suspended from or flush in, the wall or ceiling; or small to moderate reflex horn-compression driver systems mounted by means of their universal brackets to project their message into the desired area. As loudspeakers, both types have their own frequency response characteristics, directivity patterns and sensitivities. The choice of which loudspeaker to use (for speaker purposes) will be determined by type of coverage made necessary by the acoustic environment.

However, to make a choice in terms of a talk back (microphone) we have to shift emphasis on the importance of these characteristics. In fact we shall see that wide frequency response is perhaps the worst criterion of a loudspeaker when used as a microphone. The most important factor will be the correlation between the reverberant conditions of the room and the natural resonance of the speaker. When the loudspeaker acts as a microphone for a sound signal considerably removed from it, say perhaps 15 or 20 feet or even more, then the loudspeaker picks up not only the direct reply but also the reverberant images of the message and noise in the room. More often than not this ambient noise and the reverberation level is almost on par with the sound signal itself.

Although the loudspeaker finds it hard to discriminate against the unwanted components of the ambient noise and reverberation that ride along with the reply signal, yet there are characteristics of loudspeakers that make some usable as distant pickup microphones. For this discussion, a group of cone speakers were analyzed for their speaker-microphone correlation, as shown in *Fig.* 1, and a similar analysis was made for a pair of "paging-talk-back" projectors whose mouth dimensions were comparable to the cone speakers (*Fig.* 2). Because of the several curves shown in each figure, they have been smoothed out and generalized for purposes of clarity of the main characteristics involved.

Figure 1 indicates the response as speakers of three different types of cone speakers: a small 4 in. cone typical of the standard "intercom" system; a 6 in. cone of the type usually seen in sloping front wooden cabinets hung on walls or suspended from ceilings and beams; and an 8 in. co-axial consisting of a small cone tweeter mounted across the face of the woofer. This latter unit is a popularly used unit in ceiling installations using back boxes and flush mounted grills. This type of speaker has been included because of its greater upper frequency wide angle dispersion (due to the tweeter) than a simple cone, which theoretically results in greater floor area coverage *for a given articulation index*. Note that the emphasis on this latter type of speaker is not wide range for high fidelity purposes, but for communicable intelligence reasons. It was therefore included in this treatment of intelligible communication efficiency as a talk-back device.

The frequency response curves for these three cones *as speakers*, mounted in closed boxes simulating field usage,

*Manager of Engineering, LTV University, Oklahoma City, Okla.

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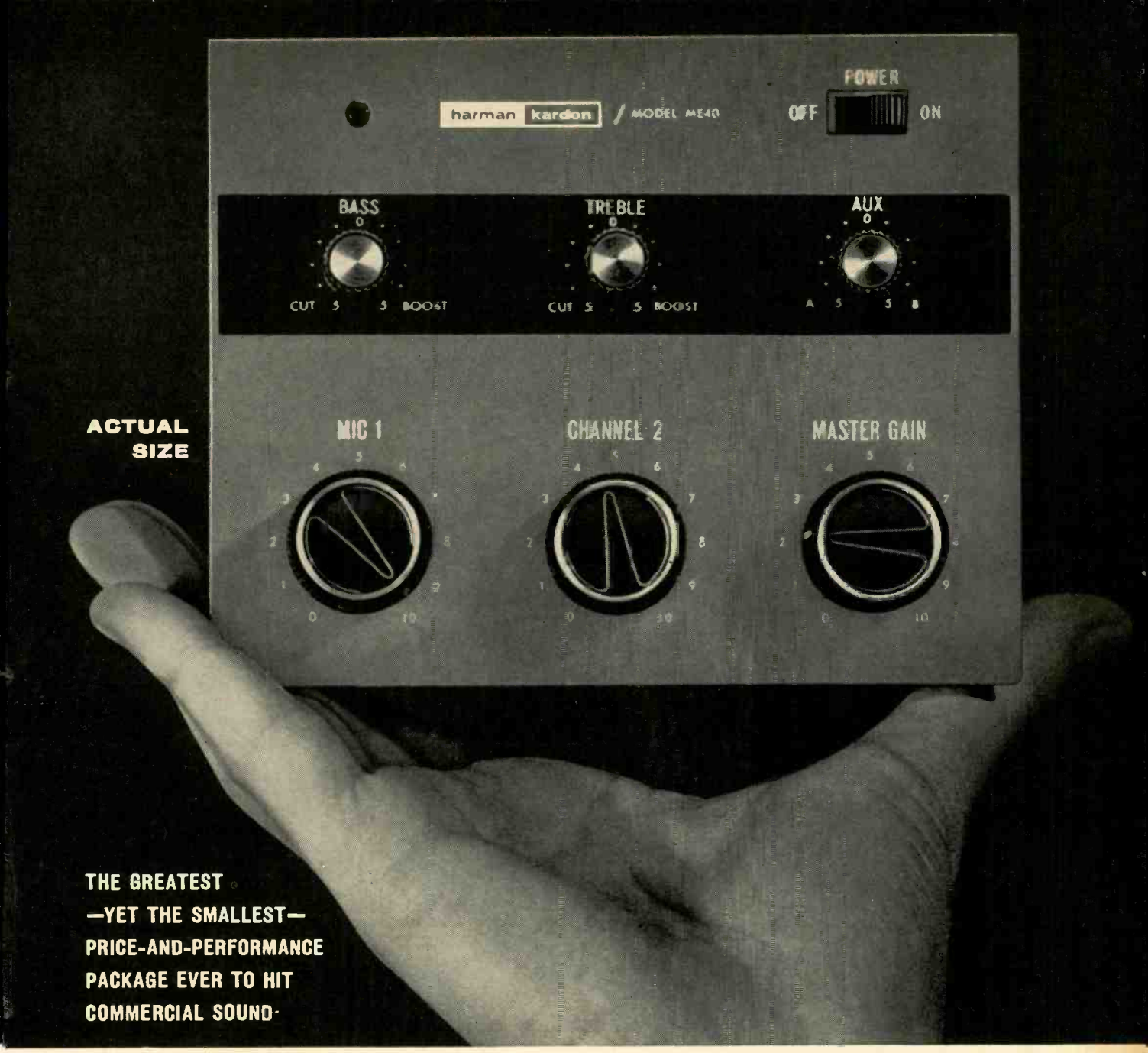

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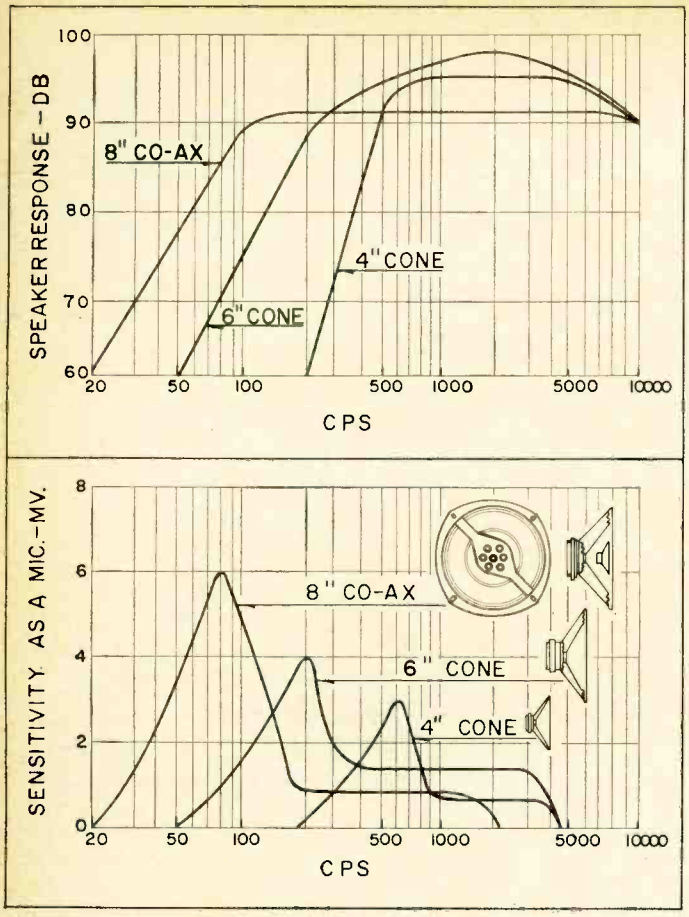

Fig. 1. Correspondence between response as speaker and sensitivity as a microphone for three cone units.

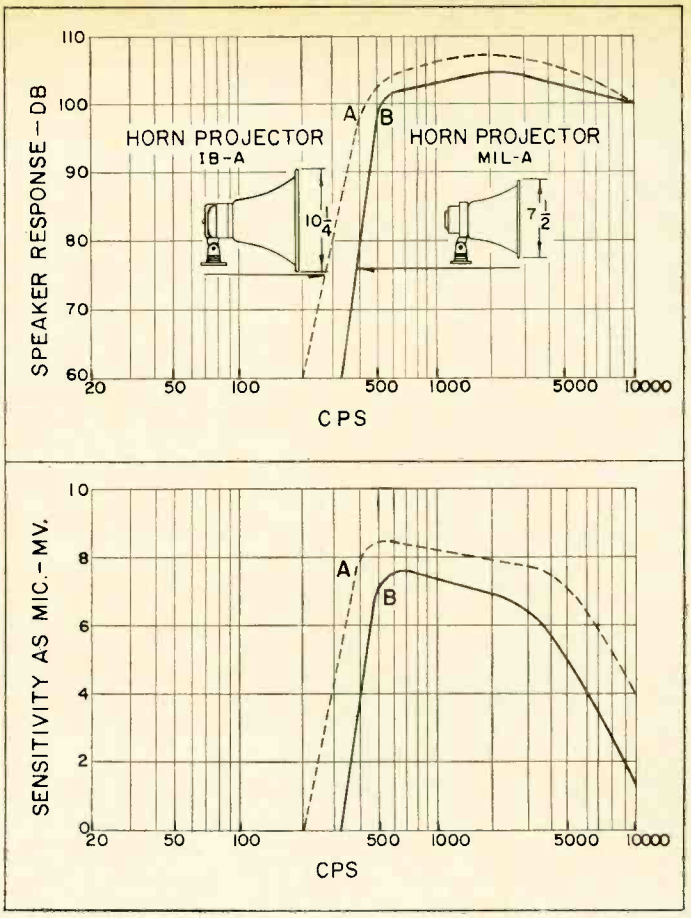

Fig. 2. Correspondence between response as speaker and sensitivity as a microphone for two horn projector units.

as shown in *Fig.* 1 are as to be expected. The 4-and 6-in. units have essentially the same middle and high frequency response; however, there is a significant downward extension of response from 500 cps to 200 cps for the 6-in. cone in reference to the 4-in. cone. Similarly, for the 8-in. co-ax there is a further frequency extension down to 80 cps before the unit begins to roll off. From these response characteristics as speakers, one would have to conclude that the order of preference for the *reproduction of sound* into a listening area would be first the 8 in. co-ax, then the 6 in. unit, and last the 4 in. unit. This conclusion may, however, be an erroneous one if the reverberant conditions of the receiving area are not taken into consideration.

Reverberation is a function not only of the room geometry, but its construction as well. Continued absorption or reflection of sound at wall surfaces determines how fast or how slow one sound pulse in the room will decay to the point where it will not interfere with the next sound pulse. Obviously, the greater the sound absorption of the walls, the less reverberation and more clarity of fast recurring speech signals. An examination of tables of sound absorption of common building materials will show that many materials quickly lose their absorption characteristic at frequencies below 512 cps. For example even materials like Acoustic Celotex, perforated and painted, has an absorption coefficient that drops from 0.80 at 512 cps to 0.23 at 256 cps and finally to 0.11 at 128 cps. For the same frequencies, another Celotex product, "Acoustical Pad" which is a metal perforated pan backed with mineral wool has absorption coefficients which drop from 0.99 to 0.25.

The significance of these brief figures on the relatively low absorption of frequencies below 512 cps of even "sound absorbant" materials, indicates that low frequencies, even under the best of conditions can lead to aggravating reverberant conditions. It follows without extended comment, that brick, masonry, cinderblock, wood, and glass construction materials will compound the reverberation problem. The importance of this increased reverberation in the lower frequency bands lies in the deterioration to the over-all message content of the loudspeaker due to the relatively long term reverberant wash of the low frequencies over the middle and higher frequencies where the intelligence of the communication exists. To make matters worse if the loudspeaker itself contributes to the over-all low-frequency content of the room by its own generated signals, then the articulation of the message suffers doubly. It seems then, that we may not arbitrarily assume that the loudspeaker with the widest response gives the best reproduction. Judgment must be tempered by its usage and its environment.

Considerable time has been spent on the relative importance of room reverberation and room noise because they become even more important when the speakers are used as remote reply microphones. *Figure* 1 illustrates the microphone characteristics of the three cone speakers used in this analysis. The striking feature of all three characteristics is the extremely peaked response at the resonant frequency of each unit with greatly attenuated response over

(*Continued on page 53*)

* Values taken from "Acoustic Engineering in Architecture," Knudsen and Harris, Wiley, 1950

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Norelco Continental '201'

New marvel of tape recording versatility

Multi-purpose 4 track tape recorder has every built-in feature for quality recording and playback; 2 speeds, 7½ or 3¾ ips provide up to 8 hours playing time on a single 7 inch reel. Fully self contained. Has dual preamps for stereo playback with external hi-fi system. Special facilities include parallel operation, mixing, pause control, tone control, portable P.A. Frequency response 60 to 16,000 cps. Weighs 18 lbs. 15¾" x 13¾" x 6¾"

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Compact 3¾ ips speed machine provides up to 3 hours playing time. New automatic record control *electronically* sets correct recording volume. Make a perfect tape everytime. Has simple pushbuttons to record, playback, wind, rewind, tape pause and stop; adjustable controls for on/off, volume and tone. Frequency response 80 to 12,000 cps. Weighs 12 lbs. 14¼" x 10" x 5".

All specifications subject to change without notification.

Norelco Tape Recorder Accessories

FOR MODEL	DESCRIPTION	FOR MODEL	DESCRIPTION
'101'	**DL 86** Leather Carrying Case	'95', '101', '150'	**TP 86** Telephone Pickup Coil
'101'	**CC 86** Texon Carrying Case	'150'	**TC 2 x 30** Tape Cartridge
'101'	**BE 86** AC Adapter	'201'	**EL 3775/21** Monitoring Headset
'101'	**RS 86** Remote Mike Switch	'201', '401'	**EL 3984/15** Foot Control
'150'	**BE 50** AC Adapter	'201', '401'	**TP 34/49** Telephone Pickup Coil
'101', '150'	**FP 86** Foot Pedal	'401'	**EL 3775/37** Stereo Headset
'101', '150'	**HP 86 EL 3775/85** Listening Headset	'401'	**2A1048** Mike Adapter
'101', '150'	**GTM 86** Close Talking Mike		

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EQUIPMENT PROFILE

KLH MODEL EIGHTEEN FM-STEREO TUNER

The KLH Model Eighten FM-stereo tuner is a completly solid-state unit which reveals its antecedents in two ways: appearance and performance.

Anyone familiar with the KLH Model Eight will recognize the Model Eighteen instantly; they are certainly a pair visually. But the KLH Eighteen is much more single-minded than was the Model Eight; it *merely* takes an FM transmission, mono or stereo, and converts it to a high quality audio signal, ready for an amplifier. In other words, just what every other FM-stereo tuner does.

The design philosophy of the Model Eighteen is definitely rooted in the KLH tradition of making as much as they can themselves to insure quality. For instance, we know that they make many of the speaker cones in their speaker systems. In the case of the model Eighteen they have gone to the trouble of making their own i.f. transformers, which is as rare as making speaker cones. Of course the payoff is in performance.

The familiar front panel sports three equal-sized knobs: volume and on-off; mono-stereo; and SCA filter out-in. In addition the tuning knob is conveniently large. A center-zero tuning indicator provides simple and accurate tuning. A stereo indicator is provided which glows in the presence of a stereo signal.

At the rear, two sets of audio outputs are provided: a fixed level pair and a pair which is volume controlled. The fixed-level outputs provide almost double the output (1.4 volts versus 0.8 volts) of the volume-controlled outputs. The impedance of the fixed outputs is 10k ohms (the others 25k) making them more suitable for long cables.

The Model Eighteen is as simple to operate as any tuner can be, and also quite easy to tune accurately. We place special emphasis on this quality because it is important for those who have wives and family to answer to. Another wife-pleasing feature is its miniscule size, a mere 9 x 4¾ x 6 inches. It isn't miniscule in performance though

One of the remarkable qualities of the Model Eighteen is its ability to pull in good signals with a hunk of wire for an antenna in most situations. Obviously, in some locations a simple antenna won't work well—areas with lots of multipath potential for instance, or very low signal level. In most ordinary areas however, the KLH Eighteen derives enough signal from that piece of wire to fully limit. It seems to need only about 10μv.

Circuit Description

The front end is fairly conventional in circuit configuration with a tuned r.f. input to an r.f. stage consisting of a T1400 transistor (we never heard of this number before, must be special). The converter is a 2N2654 and the oscillator a 2N2671. There are four i.f. stages, all containing 2N2671's. The ratio detector uses a pair of 1N541 diodes. The tuning meter, as we noted before, shows balance in the detector.

The multiplex circuit is of the time division persuasion, which is fairly common nowadays. The mono-stereo switch is set so that the audio stage derives its signal from the multiplex output in stereo position and directly from the detector in mono. Each audio output stage uses a pair of T1415 transistors, with the emitter of the first one driving the second. A goodly amount of feedback is applied over these stages.

Although the circuit is apparently conventional, it is no secret that construction techniques are as important as the circuit in FM tuners. This unit exhibits careful and knowlegable construction by virtue of a visual examination and its performance.

Performance

The most important properties of an FM tuner, as far as the user is concerned, are related to its ability to accept a wide variety and number of r.f. signals and present a low distortion audio amplifiier. In addition, a tuner must be able to withstand various degrading influences which are commonly encountered; impulse noise, strong signals in adjacent channels, atmospheric interferences, and so on.

The KLH acquits itself exceedingly well in the above areas; 31 mono stations were pulled in loud and clear on our antenna; 10 μv provides full limiting and it takes 250 mv to overload it; both distortion and intermodulation are just under 0.5 per cent; frequency response within 1 db 10-15 kc; cross-modulation index is 50 db; AM suppression 54 db; IHF sensitivity is 4.2μv; capture ratio 3.5 db; selectivity 35 db; stereo separation 32 db at 1 kc, 21 at 20 kc.

The most remarkable specification of the KLH is its price: $130.00. At that price, and with the performance it provides, the KLH Model Eighteen is a remarkable tuner buy. **Circle 184**

Fig. 1. KLH Model Eighteen FM-Stereo Tuner.

KLH MODEL SIXTEEN STEREO AMPLIFIER

Simplicity is the keynote of this all-transistor amplifier. There are only five knobs and six switches on the front panel, yet careful analysis will reveal that little versatility has been sacrificed. Though small in size (11¾-in. wide, 10½-in. front-to-back including knobs, 4½-in. high, and 14-lb. gross weight), the KLH Model Sixteen is no bantamweight performer.

Examination of the controls reveals that KLH has done some creative think-

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Fig. 2. KLH Model Sixteen Stereo Amplifier.

ing in this area. For instance the amplifier sports neither stereo reverse switch nor separate channel tone controls.

Are either needed?

Modern stereo sources, tape, tuner and disc, have become pretty uniform as to what they put in their left and right channels. Thus there really is no need for reverse switches.

In the early days of stereo it was common for dissimilar speakers to be used for the two channels. KLH believes (and we tend to agree) that today this is decidedly an exception, rather than the rule. With identical speakers on both sides, there is no need for independent tone shaping of each channel. The slight differences that acoustic environment might make between speakers can usually be taken up by the tweeter level controls.

Similarly, KLH has provided a high-cut, but no low-cut, filter. Presumably in the (justifiable) belief that a modern stereo system might have to accommodate a scratchy record, but is not likely to incorporate a high-rumble turntable.

Operation is also limited to essentials. A slide switch is labelled stereo on one side and mono on the other. That is all.

There are the other switches and knobs. A selector for the four inputs: Phono, Tuner, Aux 1, and Aux 2. There is a volume control knob, and another one for the stereo balance. Slide switches take care of: Two positions of loudness compensation; tape monitor; power on/off (for use with the front panel earphone jack).

So, you can see that KLH's designers thought long and carefully on the means and methods for making a moderate-cost, high-power unit. Our tests show that they have succeeded very well.

Circuit description

The KLH Sixteen is another example of the popular RCA series push-pull output stage, utilizing a driver transformer and low-impedance drive so that the transformer may be relatively wideband. The output transistors are 2147's, a unit which has a good reputation for reliability and ruggedness. It is also relatively costly.

The remainder of the amplifier circuit is quite ordinary: two preamp stages, with RIAA equalization achieved by means of feedback over these stages; phono "sensitivity" switch either shorts out a 330-ohm emitter resistor, or switches it in the circuit, thus changing sensitivity without materially affecting noise; and a variety of amplifier stages to provide proper level at the driver-splitter stage.

Test Results

Observing the precautions listed by KLH (speaker returns "floating," no common ground for left and right channels, input grounds isolated from output returns), we connected the amplifier for listening tests. We found it quite good, to say the least. There was more than enough power even with low-efficiency speakers. Over-all sound was clean, very transparent and substantially devoid of that harshness that some have called "transistor sound" (some call it crossover distortion, a form of distortion common to class-B amplifiers).

IM, the downfall of many solid-state amplifiers, never exceeded 1.2 per cent at any (8-ohm load) power levels up to 35 watts per channel, equivalent sine wave power. At 1 watt, we measured 0.8 and 0.9 per cent for the respective channels. At five watts it had risen to 1.2 per cent for either channel. By 20 watts it had *dropped* to 0.6 and 0.8 per cent. There it stayed until just over 35 watts whereupon it began, as is to be expected, to rise sharply.

Power response into 8 ohms was exceptionally wide. With both channels driven simultaneously, we measured 35 watts on one channel and 36 on the other, at mid frequencies. 20 cps response was down 1.0 db and at 20 kc it was down 1.5 db.

Square wave observations and frequency sweeps at normal listening levels confirmed this power bandwidth capability. There is deliberate rolloff below 20 cps that affects low-frequency square waves. At mid and high frequencies the waves are flat topped until about 5 kc when high-end rolloff becomes observable. There is no ringing. As much as 2 μf across the load, or in place of it, has no effect on stability.

Frequency response is almost identical for both channels. On the poorer one, it was +1, −2 db from 15 cps to 45 kc.

It is worthy of special note that with an 8-ohm load performance is as stated. With a 16-ohm load power output capability decreases 10 per cent. A 4-ohm load affects the amplifier similarly, except that there is a marked increase in harmonic distortion at power levels above 15 watts. Thus, this amplifier might prove less than ideal with low-efficiency 4-ohm speakers.

The rear panel contains input level switch controls for both phono and aux inputs. We checked the relationship of the phono switch to both sensitivity and overload.

In maximum sensitivity position, 2.5 mv is required for full output. Overload (observable distortion of the waveform) begins at 25 mv, a level which can be reached by high-output cartridges. Of course high-output cartridges do not need a 2.5 mv sensitivity. A switch is provided which changes the sensitivity to 6 mv and shifts the overload point to a very adequate 85 mv. This, then, except for unusually low output cartridges, is the position to use.

We checked RIAA equalization (there is no tape head input). It was within 1.0 db from 50 to 15 kc. Very excellent performance, indeed.

Considering its small selling price ($219.95), the KLH 16 is most certainly a large value. Add to this its small size and weight, the likelihood of long term durability with good performance, and the KLH Sixteen becomes a solid hifi citizen. **Circle 185**

ALTEC LANSING 604E SUPER DUPLEX SPEAKER

The saga of the Altec Lansing 604E is one of those rare instances where the consumer made clear his preference and the manufacturer heeded.

Some 20 years ago, Altec started making a speaker known as the 604 Duplex. It went through a variety of changes and improvements over the years, A through D models in specific, which enabled it to become the most widely used broadcast and recording monitor speaker in captivity. (Obviously it was as good a speaker as could be had.)

Then Altec decided to stop making the 604 since they had available an improved alternative in the 605 Duplex.

A strange thing happened then; the engineers who had been using the 604,

(Continued on page 40)

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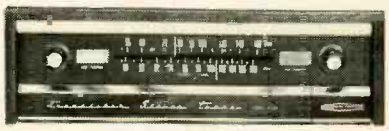

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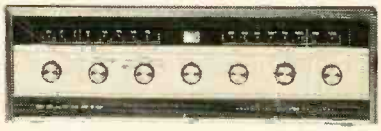

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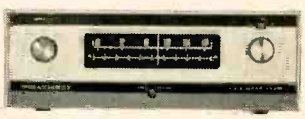

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Stereo Playback

Q. My tape recorder records mono but permits stereo playback by connecting the second channel to an external amplifier. I am purchasing a new amp/preamp, and wish to play both stereo channels through this unit. How can I accomplish this?

A. For channel 1, obtain the signal across the volume control of your tape machine. For channel 2, obtain the signal at the output jack specifically provided for it. These signals are already equalized and amplified. Therefore connect them to the high-level inputs of your new amp/preamp.

Commercial Tapes Inferior?

Q. Listening to numerous tapes recorded by various manufacturers, I can hear a definite harsh, shrill, unnatural quality to the highs and a muddled, fuzzy, distorted bass. This distortion is also evident whenever the orchestra plays anything approaching fortissimo. I have carefully and repeatedly checked all the connections of my tape machine, have cleaned and demagnetized the tape heads, cleaned the capstan, checked to make sure that all the preamp controls are set correctly, including the equalization set to "tape," and even taken the machine to the authorized service agency for a checkup; but all to no avail. The distortion I describe occurs even with some tapes which have been cited in magazine reviews for their excellent sound. Oddly enough, tapes I've made of my best records seem to sound better than the recorded tapes. What is your opinion?

A. It disturbs me to read that you "checked to make sure that the preamp controls are set correctly, including the equalization set to 'tape.'" I hope you are *not* feeding the tape machine's output into the "tape head" input of your preamp and thereby overloading the preamp, as well as producing grossly distorted frequency response. The tape machine's outputs should be connected to the high-level inputs of your preamp.

In any event, I share your experience that many recorded tapes are inferior to off-the-air or off-disc recordings on a good machine. Principally this is due to the excessive recording level employed by some commercial studios. The recorded tape you buy is something like third or fourth generation in terms of successive duplicating. Each stage of duplication results in an increase of about 3 db in noise relative to the program material. Therefore the recording studio raises the recording level as high as it dares on the original tape and on the successive copies; in this way it seeks to keep the noise level low compared with the program material.

Over-recording may be accidental as well as deliberate, due to the use of the VU meter, which reads average rather than peak level. True, the meter is usually calibrated to allow about 6 to 8 db safety margin between actual and indicated level. But peaks are sometimes as much as 20 db above average level. I understand that peak-reading meters are often used abroad.

What can you do? Complain to the dealer who sold you the unsatisfactory tapes. Complain to the editor of the magazine which published the misleading tape review. Complain to the president of the recording company. Return the tapes if possible.

Mikes, Mixers, and Xformers

Q. I would like some information regarding microphones, mixers, and microphone transformers. If the mixer has built-in transformers, do you still need transformers in the tape recorder? If the mixer has no transformers, do you have to use transformers at the mixer inputs, or can you use the transformers between the mixer and the recorder; if the former, do you have to use a separate transformer for each microphone? I am using a Magnecord tape recorder which has mike input transformers as optional equipment. I don't want to buy them unless I am sure I need them.

A. Microphone stepup transformers are used with microphones that produce very small signal voltage but at the same time have very low output impedance, permitting a long cable run without treble loss caused by cable capacitance. In contrast, a high-impedance microphone has more output voltage, but can tolerate only a few feet of cable without treble loss if it is a dynamic or other magnetic type (ribbon, and so on). The transformer, when needed, is used between the microphone and the mixer, not between the mixer and the tape recorder. The latter practice can lead to excessive noise and distortion.

If a microphone requiring a transformer is to be fed into a tape recorder rather than a mixer, the recorder must provide a suitable transformer or else you must employ an in-line transformer at the end of the microphone cable nearest the recorder. If the microphone is to be fed into a mixer, an in-line transformer is needed unless the mixer provides input transformers. The output of an active mixer (having tubes or transistors and providing gain) is fed into the high-level input of the tape recorder. Separate transformers are needed for the individual microphones.

Ask the microphone manufacturer whether a transformer is needed and about the impedance characteristics of the transformer to be used with his microphone. Make sure that the in-line transformer or the transformer incorporated in the mixer or tape recorder conforms with these required characteristics. Otherwise, performance may suffer in terms of frequency response, distortion, and signal-to-noise ratio.

Noisy Tape

Q. I have a commercially recorded tape that produces a sputtering noise during the last third of the first side. What causes this noise and how can I avoid buying noisy tape such as this in the future?

A. The sputtering noise may be due to discharges of static electricity when the tape was being recorded, probably when the duplicate was being made at high speed. The situation may be due to a poorly grounded record head in the duplicator, or perhaps to unusual atmospheric conditions when the tape was being copied. The only way you can avoid buying such tapes is by playing the tape through its entirety prior to purchase. Since this is probably impractical, the real answer is to buy from a dealer who will accept return or exchange on faulty tapes.

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Once upon a time, there was a new kind of stereo amplifier.
It's name was JBL Energizer.
JBL Energizer was very special.
Goodness, how special.
JBL Energizer never got too warm, never made noises or hummed, didn't distort a thing and wasn't microphonic at all.
Because JBL Energizer was all solid state and stayed so cool and stayed so quiet, it learned it could do what no other stereo amplifier could do.
It could hide.
It could hide right inside a JBL loudspeaker box.

See the pretty JBL Energizer?

Not if you don't want to.

Rear view of Lancer 99 showing Stereo Energizer.

Model SE401 80 Watt Solid State Stereo Energizer
Replaces conventional stereo power amplifier; sets new standard of audio perfection. Unique plug-in equalizer board integrates with specific speaker system used. Non-microphonic. Effectively non-existent hum, noise or distortion. Factory installed in one loudspeaker enclosure. Also available separately or specially integrated and installed in your present speaker system.

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EQUIPMENT PROFILE

(from page 36)

and those who heard it in friends' monitor rooms, decided that they still wanted the 604. A "black market" in 604's came into being, that is engineers were willing to pay a premium for a 604. And they did.

Of course many engineers prefer, and use, the 605; this passion for the 604 is one of those things which is quite unique, casting no reflections or aspersions. The main difference between the 604E and 605B is that the former is more efficient. Altec claims that it is one of the most efficient speakers available anywhere.

Recognizing this loyalty, Altec reissued the 604 (now called the 604E Super Duplex) with some additional improvements. Now everyone is happy.

The latest 604 consists of a 15-in. woofer and a multicellular high-frequency unit. The exponential horn throat extends through the woofer magnet, thus permitting a much longer horn development than would appear obvious from the front of the speaker. Of course multicellular horns are of special value in controlling and directing high-frequency dispersion. A 40-deg. by 90-deg. pattern is provided by the 604E.

The magnet structures of the 604E total a back-bending 26-lb. 13-oz. Undoubtedly, an important factor in the high frequency of this speaker. A dual full-section dividing network is provided with a high-frequency level control.

We recieved the 604E in an Altec 855A "Malibu" enclosure which provides about 9 cubic ft. of interior volume. An infinite baffle. In this enclosure, the 604E really shows off—that solid bottom end is as tight and full as any audiofan could want. The mid-range and highs are beautifully controlled, although one must be exceedingly careful in balancing them with the bass because of the high efficiency of the system. The 604E may feel rather cramped in a small room, and thus make balancing quite critical. The task becomes much easier in a more spacious enviroment.

In sum, the Altec 604E is a proved and well-liked duplex speaker which has won fame as a monitor speaker in critical musical applications. Indeed, its fame is the reason for its present availability; proof that the consumer *can* get what he wants if he persists. **Circle 186**

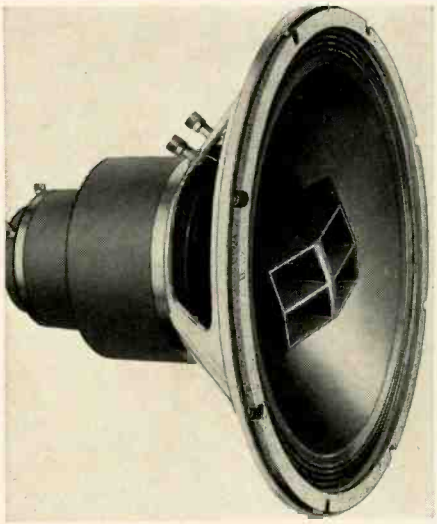
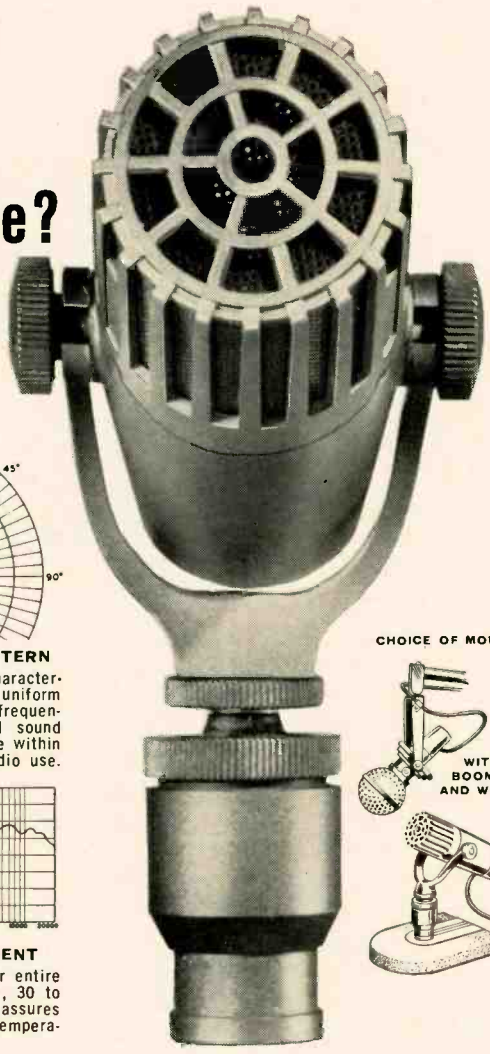
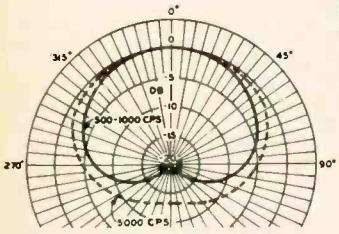


Fig. 3. Altec Lansing Model 604E Super Duplex Speaker.

what more do you need in a microphone?

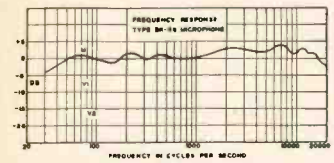
WHEN THE RCA BK-5B HAS SO MUCH...





IMPROVED CARDIOID PATTERN

The improved unidirectional characteristic provides an exceptionally uniform response over a wide range of frequencies, and attenuates unwanted sound from directions other than those within the pickup angle. Ideal for studio use.



SENSITIVE RIBBON ELEMENT

Uniform frequency response over entire audio spectrum. Effective range, 30 to 20,000 cps. Ribbon element also assures low hum pickup, immunity to temperature and humidity variations.

CHOICE OF MOUNTING

WITH BOOM MOUNT AND WIND SCREEN

DESK OR FLOOR STAND

You're looking at the business end of an RCA BK-5B...a superb unidirectional studio microphone—ideal for all broadcast, public address and recording applications. 3-position voice-music switch provides optimum response for any application. Blast filter eliminates damage from sudden noises. Inconspicuous TV gray finish. Exceptionally good shielding permits operation in high-hum fields.

ASK TO SEE THE BK-5B AT YOUR NEAREST AUTHORIZED RCA MICROPHONE DISTRIBUTOR.

For complete specifications write RCA Commercial Engineering Dept F91MC, 415 So. 5th St., Harrison, N.J.

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A Revolutionary Development from Marantz

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Ultimately you will want Marantz.

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"Best Sound Ever Heard"

NEW

EICO

3566

Solid State FM/MPX Automatic Stereo Tuner/Amplifier

Yes, letters are now coming in from satisfied EICO customers who just finished building the new 3566 solid state stereo tuner/amplifier and they say the EICO 3566 is giving them the best sound they ever heard.

We're very pleased at the response the 3566 has received, but we're not at all surprised. The 3566 was designed to enter the highest quality class of solid state automatic stereo tuner/amplifiers — and that it does! While there may be a quality contest in this top class, there's certainly no price contest. EICO has won it — hands down.

KIT: $229.95 walnut cabinet $14.95. **WIRED: $349.95** includes cabinet

Similarly powered competitive brands in this class start at above $490 including cabinet. But don't take anyone's word for it — check the specifications and listen to the 3566 at your authorized EICO dealer. We feel confident that you'll agree—the EICO 3566 is worth a lot more than $229.95 (kit) or $349.95 (wired), maybe even $450.00 to $500.00.

- *112 Watts into 4 Ohms, 75 Watts into 8 Ohms*
- *2 uv IHF sensitivity*
- *38-40 db separation*
- *5-60,000 cps response*
- *Non-falsing stereo indicator light*
- *Automatic stereo switching*
- *Interstation noise muting*
- *0.15% Harmonic, 0.3% IM distortion*
- *43 transistors, 19 diodes, 6 rectifiers*

Whether you build the EICO 3566 semi-kit — with *pre-wired pre-aligned* front-end, 4-stage IF strip and time-multiplex circuit; plug-in transistor sockets, and easy-to-follow step-by-step instructions — or buy the 3566 factory wired, you'll be proud of its superb quality and ease of operation.

If you can't get to an authorized EICO dealer, write to EICO direct, and we'll send you a beautiful full-color brochure that brings out all the beauty of the 3566 that you and your family will enjoy for years to come.

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Calculus Made Difficult

DANIEL R. BUTTERLY*

THE CALCULUS is concerned primarily with the law of growth, and this is reflected in some of its own processes. The beginner is impressed by a quality that makes the calculus unique among the various branches of mathematics, and which may be stated thus: the more we simplify a term the more involved it becomes. Take, for example:

$$e^x = (1 + x^n) \qquad Eq.\ (1)$$

Let us try to simplify this; but first we must expand it:

$$e^x = 1 + x + \frac{x^2}{2!} + \frac{x^3}{3!} + \ldots + \frac{x^n}{n!} \qquad Eq.\ (2)$$

This boils up to:

$$f(x) = f(a) + f'(a)(x + a) + \ldots + \frac{1}{n!} f^{(n)}(a)(x + a)^n + \ldots \qquad Eq.\ (3)$$

Space does not permit a further simplification.

Now another peculiarity of the calculus is that when we expand something we have no guarantee that it will ever contract again. So we are stuck with Eq. (3). Going back to Eq. (2), let us try our hand at simplifying that: $\frac{x^2}{2!}$, $\frac{x^3}{3!}$, and so on. When we need not be too emphatic, it becomes just $\frac{x^2}{2}$, $\frac{x^3}{3}$, at the expense, perhaps, of a certain amount of accuracy. In fact, where there is any doubt about the matter, one may write

$$1 + x + \frac{x^2}{2?} + \frac{x^3}{3?} + \ldots + \frac{x^n}{n?} \qquad Eq.\ (4)$$

($\frac{x^2}{2?}$ is pronounced "eggs squared over two" with a slight raising of the voice on "two".)

The operator "?" requires some further discussion. The equation

$$y = x? \qquad Eq.\ (5)$$

means that y probably equals x, may or may not equal x, or that we are just not sure what it equals. Be that as it may, it is reasonable to suppose that if $y = x?$, then

$$x = y? \qquad Eq.\ (6)$$

*Chief Calculist

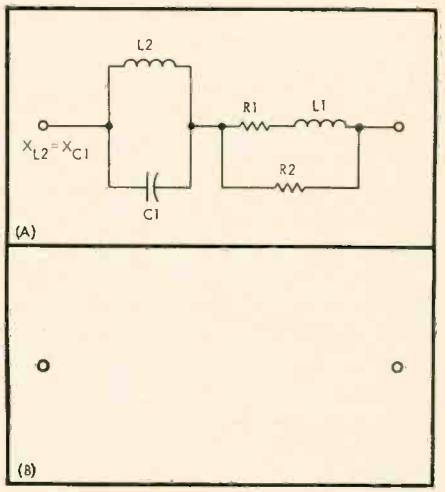

Fig. 1. (A) Series-resonant circuit; (B) simplified circuit.

This is called the Law of Reciprical Uncertainty, and merely states that if we don't know whether x equals y or not, how in the hell can we be sure that y equals x.

Now, squaring the operator merely increases the uncertainty. Thus

$$y = x?^2 \qquad Eq.\ (7)$$

means that y has a very small chance of being equal to x, or simply that we may be way off the track. But when the same quantity appears on both sides of the equation, as

$$x = x? \qquad Eq.\ (8)$$

this means that we don't even know whether x equals itself or not, and that we are in rough shape. When this procedure is applied to *Eq. (2)* we have an infinite series of question marks.

One consolation for all this is that the calculus allows us to eliminate certain quantities that we don't feel like bothering about. Take the impedance $r + jx$ when frequency f is varying at some continuous rate. We have

$$dz = d(r + jx) \qquad Eq.\ (9)$$

Now

$$(z + dz)^2 = (r + dr)^2 + (x + dx)^2 \qquad Eq.\ (10)$$

and

$$(x + dx)^2 = x^2 + 2x \cdot dx + d^2x^2 \qquad Eq.\ (11)$$

(Continued on page 51)

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Some plain talk from Kodak about tape:

Print-through and sound brilliance

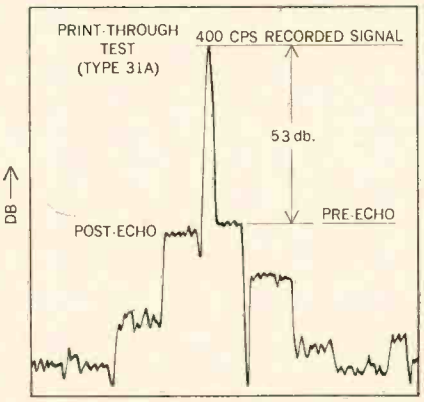
Kodak TRADEMARK

Put a magnet near a piece of iron and the iron will in turn become magnetized. That's print-through. With sound recording tape, it's simply the transfer of magnetism radiating from the recorded signal to adjacent layers on the wound roll. Print-through shows up on playback as a series of pre- and post-echoes.

All agreed. Print-through is a problem. There are some steps you can take to minimize it. You can control the environment in which you keep your tapes, for example. Store them at moderate temperatures and at no more than 50% relative humidity. Also store them "tails out" and periodically take them out for "exercising" by winding and rewinding them. What fun! If worse comes to worse, you can even interleave the layers with a non-magnetic material such as paper. Any volunteers? A better way, however, is to start with a tape that doesn't print much to begin with . . . which leads to low output problems *if* you don't make the oxide coating substantially more efficient.

And this is Kodak's solution. It's not simple, but it works, and it works well! It starts with the selection of the iron oxide. In order to achieve low print-through, the oxide needles must have the proper crystalline structure. Kodak's oxide needles have that structure . . . offering the highest potential of any oxide currently available. But oxide alone doesn't make a low-print tape.

Milling the oxide ingredients, for example, is very critical. If you mill for too long a time, the needles will be broken up and print-through will be drastically increased. Too short, and the dispersion will be lumpy. But other factors in the milling process are equally important. Like the speed at which the ball mill turns. It can't be rotated too fast, otherwise the needles will be broken up, and broken needles, you know, exhibit horrible print-through behavior. If you rotate the mill too slowly, the oxide and other ingredients will not be blended uniformly. Other factors such as temperature and the composition and viscosity of the in-



gredients must also be critically controlled. One more thing. You've got to make sure all the needles end up the same size (.1 x .8 microns) if print-through is to be kept down.

A very important contributor to low print-through is the binder that holds the oxide particles in suspension. The *chemical composition* of a binder contributes nothing magnetically to the print-through ratio. What a binder *should* do is completely coat each individual oxide needle, thus preventing the particles from making electrical contact. And that is just what our "R-type" binder does. The final step is to take this superb brew and coat it on the base. The coating mustn't be too thick, for print-through increases . . . or too thin, for then output suffers. For best results, extreme uniformity is the word. Here's where our film-making experience really pays off.

Print-through tests are a million laughs. We record a series of tone bursts . . . saturation, of course. We then cook the tape for 4 hours at 65°C. and then measure the amplitude of the loudest pre- or post-echo. The spread between the basic signal and the print-through is called the signal-to-print-through ratio. The higher the number, the better the results. Most of the general-purpose tapes you'll find have a ratio of 46-50 db. Low-print tapes average about 52 db. You can see from the graph that our general-purpose tape tests out at 53 db., so it functions as both a general-purpose tape and a low-print tape —and at no extra cost. High-output tapes with their thicker coatings have pretty awful print-through ratios—generally below 46 db. Kodak's high-output tape (Type 34A) has something special here, too. A ratio of 49 db—equal to most general-purpose tapes.

KODAK Sound Recording Tapes are available at all normal tape outlets: electronic supply stores, specialty shops, department stores, camera stores . . . everywhere.

FREE! New comprehensive booklet covers the entire field of tape performance. Entitled "Some Plain Talk from Kodak about Sound Recording Tape," it's yours free on request when you write Department 8, Eastman Kodak Company, Rochester, New York, 14650.

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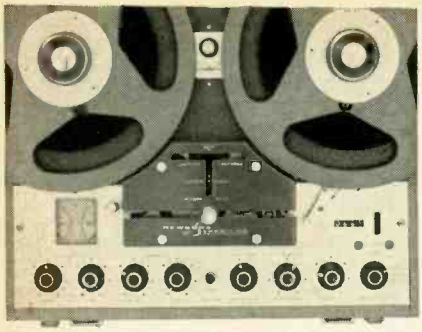

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- Sound-on-sound
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- Handles long microphone lines: built-in provisions for plug-in input transformers
- Uses Cannon microphone connectors
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JAZZ and all that

Bertram Stanleigh

Vince Guardaldi and Bala Sete: From All Sides
Fantasy Mono 3362

A light frolic by pianist Vince Guaraldi and Brazilian guitarist Bola Sete who have already demonstrated their stylistic affinity on several occasions. Guaraldi seems to have a penchant for quoting from the classics. On his last album he interjected a bit of the Beethoven *Sonata Pathetique* in his *Jazz Impressions* of *Charlie Brown*. In the present set he uses the first theme from Mozart's G Minor Symphony in *Chorro*, an agreeable bit of badinage that manages to retain its own airy identity in spite of its derivation from one of the most profound of classical masterpieces. They also manage to breathe freshness into the *Girl from Ipanema*, a charmer who has suffered unduly from a series of heavy-handed pop versions. Their deft, spritely musicianship comes across splendidly in this bright new recording.

Grant Green: Idle Moments
Blue Note Mono 4154

Backed by Joe Henderson, tenor, Bobby Hutcherson, vibes, Duke Pearson, piano, Bob Cranshaw, bass, and Al Harewood, drums, Grant Green offers four contrasting numbers. These are hardly guitar solos with accompaniment, as the album credits might imply. Each performer is given full occasion to express himself at length, but Green's lively contributions on his own *Jean de Fleur* and John Lewis' *Django* entitle him to some extra degree of recognition. Duke Pearson's *Idle Moments* and *Nomad* provide superb solo opportunities for all. Special attention should be paid to the exceptional work of Hutcherson on the former and Henderson on the latter. The recording is up to the usual high Blue Note standard.

Eric Dolphy and Booker Little: Memorial Album
Prestige Mono 7334

This is the third album released by Prestige of live recordings made by Dolphy and Little at New York's Five Spot. The tapes were recorded in 1961, a few months before trumpeter Booker Little's death at the age of twenty-three. Dolphy, who plays bass clarinet and alto on this disc, died last June at the age of thirty-four. Two long compositions, each occupying a full side, comprise the entire contents of this platter. It is very hard, indeed, to listen to this alert, vigorous music making and realize that the bright, intense creators of these sounds are no longer with us. Our loss is clearly a considerable one for these were a pair of men with an abundance of ideas and an ability to articulate them. That their futures held great promise is incontestable, but it would be unfair to suggest that these men were cut off prior to the realization of their talents. This platter contains performances of real eloquence, and the recording by Rudy Van Gelder captures effectively both the playing of the group and the atmosphere of the club. Happily the Five Spot is the haunt of serious auditors who listen in silence. Mal Waldron, piano, Richard Davis, bass, and Eddie Blackwell, drums, provide an excellent backing for Dolphy and Little. Incidentally, the cover photo of Dolphy, Little and Davis shows Dolphy playing the flute. While he was frequently heard on that instrument, he does not play it on this platter.

Nina Simone: I Put a Spell on You
Philips Stereo PHS 600-172

Nina Simone is a young lady with a remarkable voice and manner for evoking the spirit of the blues and barrelhouse. When the present set gives her opportunity to exploit these talents, she turns in some memorable performances, particularly on *Take Care of Business* and *Gimme Some*. But, like her previous albums, this set presents Nina in a wide variety of material, some of which is not well suited to her deliciously individual voice or highly personal style. The result is a collection that has a few low spots along with its peaks. But the peaks are high enough to justify a few lapses from perfection. For a vocal disc that doesn't even identify the accompanying performers, this platter offers a rather unusual innovation: an instrumental number written by Rudy Stevenson, Miss Simone's guitar accompanist. Mr. Stevenson is presumably the guitarist heard with piano, bass and drums in an attractive tune called *Blues on Purpose*.

Donald Byrd: I'm Tryin' to Get Home
Blue Note Mono 4188

This is Byrd's second attempt to combine brass, voices and a jazz combo. The results of the experiment are a total success musically. Byrd's trumpet soars in some glorious solos that are backed up by a chorus of eight voices and a brass band conducted by Coleridge Perkinson. Playing with Byrd in the combo are Stanley Turrentine, tenor, Herbie Hancock, piano, Freddie Roach, organ, Grant Green, guitar, Bob Cranshaw, bass, and Grady Tate, drums. The brass band reads like another all star collection—Trumpets: Ernie Royal, Snooky Young, Jimmy Owens, Clark Terry, Joseph Ferrante. Trombones: Jay Jay

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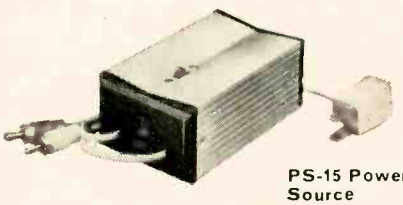
Euphonics makes the BREAKTHROUGH

...with the U-15 Miniconic Semiconductor Phono Cartridge

revolutionary new semiconductor transducer breaks all barriers that limit existing phono cartridges

- **PHENOMENAL 13 OCTAVE RANGE**
  DC to 50 kcps, ±2 db; – 6 db at 100 kcps. Smoothest, distortion-free sound, to give TOTAL MUSIC RESPONSE.
- **SILICON SEMICONDUCTOR ELEMENTS**
  First cartridge to employ silicon semiconductor elements. Delivers fabulous output—10,000 times the power of magnetic cartridges. Ideal for transistor circuits, 1000 ohms impedance. World's most efficient, stable, rugged, hum-free cartridge, with indefinitely long life.
- **LOWEST EFFECTIVE TIP MASS**
  Tracks 40 kcps 2nd harmonic pinch effects of 20 kcps fundamental; thus stylus tip stays in groove at *all* frequencies with only .5 gram needle force. No shock or modulation noise from loss of groove contact—gives *clean* highs on loudest passages —on outer *or* inner grooves.
- **ALL THE COMPLIANCE YOUR SYSTEM CAN USE— 25 MICRO CM/DYNE**
  Unequalled tracking ability at low frequencies. More important, for perfect tracking of the upper register—is the fantastically high stylus-groove resonance of 47 kcps—more than one full octave out of the pass band! THIS MAKES A PERFECT MARRIAGE OF STYLUS TIP TO GROOVE—GIVES MUSIC PURITY AN ENTIRE ORDER OF MAGNITUDE BETTER THAN EVER BEFORE!
- **ELLIPTICAL BIRADIAL DIAMOND STYLUS**
  Precision-ground, polished, individually inspected and tested for perfect symmetry. Two radii, .0002″ and .0009″, assist stylus in reducing pinch effect on inner grooves.
  VIRTUALLY NO PLAYBACK LOSS FROM OUTSIDE TO INSIDE GROOVES—*ALL* THE RECORD SOUNDS GOOD.



PS-15 Power Source

Energy Derived From External Power Source—thus saving the delicate record grooves. The U-15 cartridge is essentially a modulating device, not a reciprocal generator. Miniature type P-15 power source (above) has all cables to plug into any high-fidelity amplifier. Includes switch to feed low-level magnetic inputs or high-level auxiliary inputs.

Miniconic Phono System— Low-Mass Tone Arm with Plug-In Semiconductor Cartridge

Model TK-15-LS Miniconic Laboratory Standard Phono System. Consists of U-15-LS plug-in cartridge with biradial diamond stylus. TA-15 low-mass tone arm and PS-15 power source. Works into magnetic or auxiliary inputs. With instructions. Shpg. wt., 3½ lbs. USER NET.....87.50

Model TK-15-P Miniconic Professional Phono System. As above, but with U-15-P plug-in cartridge with .5 mil diamond stylus. Shpg. wt., 3½ lbs. USER NET.....71.50

Model CK-15-LS Miniconic Laboratory Standard Phono Conversion Kit. Consists of U-15-LS cartridge (with biradial diamond stylus) for standard heads and PS-15 power source. Works into magnetic or auxiliary inputs. With instructions. Shpg. wt., 2 lbs. USER NET.....55.00

Model CK-15-P Miniconic Professional Phono Conversion Kit. As above, but with U-15-P cartridge with .5 mil diamond stylus. Shpg. wt., 2 lbs. USER NET.....39.00

NOTE: For broadcast and recording studio use, 16″ low-mass tone arm and or power source with 600-ohm output also available. Write for details.

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Features exclusive "Edit-Eze" cuing and editing. Superb 30-18,000 cps frequency response for finest mono or stereo recording with three hyperbolic heads. Monitor-off-tape, Sound on Sound, Erase-Protek, automatic shut-off, tapelifters, are but some of the many features to let you thoroughly enjoy high quality tape recording.

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Circle 131 on Reader Service Card

Johnson, Jimmy Cleveland. Henry Coker. Benny Powell. French Horns: Jim Buffington, Bob Northern. Tuba: Don Butterfield. The bigness of the sound is probably more effectively captured in the stereo version than in the mono copy sent for review.

Lucky Thompson Quartet:
Lucky Strikes
Prestige Mono 7365

One of the great names that has been associated with the Stan Kenton of an earlier day is tenor saxophonist Lucky Thompson. Backed by Hank Jones, piano, Richard Davis, bass, and Connie Kay, drums, he swings lightly through a series of eight numbers that includes *In a Sentimental Mood*, *Fly With the Wind*, *Mid-Nite Oil* and *I Forgot to Remember*. On four of the tunes he's heard on soprano sax. Thompson is the possessor of such an easy, affable performing manner that no end of technically intricate feats are tossed off in a relaxed, disarmingly simple style. This is a record that can be appreciated on many different levels for various reasons. It's easy listening, virtuoso playing, fine music making, and it is also clean, crisp Recording. Æ

RECORDS

(*from page 10*)

you the conventional answer: just play each piece a time or two, no more. Ugh!

There are almost forty items on these two sides (including one set of variations) with all manner of different playing media, from solo recorder to dance orchestra. Tantalizing, but also enough to make you ill—for every dance stops short just as it gets started. If you've ever danced country, or folk, or square, you'll be driven out of your mind. Imagine forty dances in a row, not one of which gets beyond the first figure or two!

Well, many a tune will catch your fancy even so, and a lot of people haven't danced and won't be bothered at all by the cutting-short. Richard Schulze's arrangements tend to be thick and rather heavy in the harmony (too thick for dancing, of course) and the playing is often on the dogmatic side—yet often, too, it has excellent rhythm and verve. This volume seems to me an improvement over the first.

Hamza El Din. Music of Nubia.
Vanguard VSD 79164 stereo

This enterprising young educated Nubian is a bit too sophisticated for his own good. His Nubian folk music, genuine enough in the essentials of its melody, it seems, is arbitrarily played on a conveniently exotic instrument that isn't any too authentic—the Egyptian Oud, a relative of the lute. He learned to play it in Cairo, then went back home "collecting" for it—now he has been voyaging as far afield as Vanguard's ever-alert recording studio, both playing and singing.

It's interesting music convincingly projected, but the sense of the collector at work, "interpreting" his people, is oddly unavoidable and it put me off. Æ

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INZIDE AUDIO • LARRY ZIDE

The recent death of C. J. LeBel, at the age of 59, is sad news. Anyone close to the audio industry knew him as a rare individual. He was the first President of the Audio Engineering Society and permanent Secretary of that organization. He was also a Vice President of Audio Devices, Inc., a company he helped found in 1937.

C. J. Lebel was an active member of several engineering societies, in addition to his AES association: He was a member of the Acoustic Society of America, the Society of Motion Picture and Television Engineers, the Institute of Radio Engineers and the Institute of Electrical and Electronic Engineers.

We will all miss him.

Industry News and Notes

● **Hartley Products** Company, manufacturers and marketers of the Hartley-Luth line of high fidelity loudspeaker systems, has moved its executive headquarters and national sales offices to Ho-Ho-Kus, New Jersey. The speaker manufacturing facility remains at Holland, Michigan.

The company operated out of rather cramped quarters in the Bronx since 1950. The new site (we're told that the country is lovely) "provides us with far better stocking and shipping facilities than we had at the old plant, and will enable us to handle our increased volume of business much more efficiently" according to company president **Bob Schmetterer.**

● Joseph Benjamin, president of **Benjamin Electronic Sound** Corporation, announced the appointment of **Morris Rauch** as chief engineer. Mr. Rauch had joined the firm as a staff engineer two years ago. Prior to that time, he was, for five years, a project engineer at Harman-Kardon.

According to Mr. Benjamin, this appointment is in line with the company's expansion program in research and development for the electronics industry.

● And speaking of **Harman-Kardon,** I find no less than three releases from that company on my desk. The first informs us that **Burt Brooks,** former sales manager of United Audio, is now product and promotion manager at H-K high fidelity division. Burt knows his way around the high fidelity industry. Before United Audio, he had been an assistant sales manager for Rek-O-Kut and, even earlier, sales manager for the Brociner Company.

The second release states that **Walter Goodman,** H-K parent company Jerrold's manager of distributor sales division and H-K marketing manager is now appointed a vice president of the Jerrold Company. Mr. Goodman is now responsible for the Jerrold distributor sales division (home TV reception products and equipment for TV distribution systems); the Jerrold industrial products division (electronic instruments); and the products marketed by the Harman-Kardon high fidelity and public address divisions.

The third H-K release announces a full-scale consumer promotional campaign in support of the all-transistor Stratophonic line of stereo components.

In addition to the usual components advertising media, *Time* Magazine and *The New York Times* Magazine are already in use.

● Take note of a hot promotional campaign by **Magnecord.** You may have seen their ads. They are offering free a new 1000 series recorder of your choice for the oldest operating model of their famous PT6 series.

The PT6 was originally introduced in 1946 and, since that time, over 58,000 units have been sold. As the machine on which we cut our tape "eye teeth," we can testify to its qualities and durability. It was, and in some cases remains, the best medium weight broadcast recorder in the business.

The release that was received doesn't say if the PT6 owner needs to turn in his unit in order to collect his prize. We fear that if this is the case, the campaign may backfire: Anyone with one of those old PT6 units would never give it up for a new model. And, this is no reflection on the 1000 series units.

● **John Koss,** President of **Koss-Rek-O Kut,** manufacturers of the well known Koss line of headsets and the equally well known Rek-O-Kut turntables, announces the appointment of Mr. **Curt Wemple** as Comptroller-Treasurer of this company.

Mr. Koss, who was recently elected as an officer and member of the Board of Directors of the IHF, also announces in addition that he personally has taken over the active marketing management of Koss headsets and Rek-O-Kut turntables.

● **Murray I.** Rosenberg takes over the sales manager post at Scope Electronics, U. S. distributor of EMI loudspeakers. Everybody remembers Mr. Rosenberg as marketing Vice President of Harman-Kardon, but few remember his connection with CBS-Columbia for four years. His marketing experience should be a major asset to Scope.

(*Continued on page 56*)

problem solving microphones by SHURE

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Model 414A 100,000 ohms or more
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PROBLEM:
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SOLUTION:
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background noise a problem?

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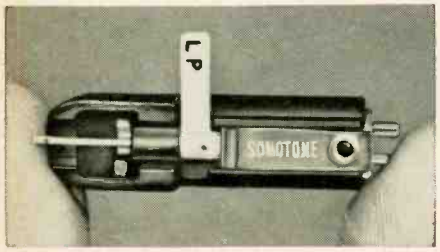
NEW PRODUCTS

Low-Mass Ceramic Cartridges. Sonotone has begun delivering a new group of miniature stereo ceramic phono cartridges. They are being called "Micro-Ceramic" because of their one-gram weight and one-in. over-all length. This brings these ceramics in line with the current trend to low-mass cartridge/arm combinations and at popular prices. In spite of miniaturization, these cartridges will fit any standard arm. Four separate models are offered, each with a specific function. Model 25T (shown) features high compliance and low tracking force. Output voltage is 0.2 v; compliance is 15 x 10^{-6} cm/dyne; tracking force is 1 to 3 grams; and separation is 27 db at 1 kc. Model 26T offers



high output as its primary virtue. Output voltage is 0.5 v; compliance is reduced to 5 x 10^{-6} cm/dyne; tracking force recommended is 3 to 6 grams. Separation is 22 db at 1 kc. The Model 27T is designed for use with transistor inputs. Capacitance is 4500 pf; output voltage is 0.25 v; compliance is 5 x 10^{-6} cm/dyne; recommended force is 2 to 6 grams. Separation is 22 db. The last model is the 28T. Output is 0.35 volts; compliance is 9 x 10^{-6} cm/dyne; tracking force is 2 to 4 grams; and separation is 22 db. All four models are equipped with a flip-over stylus assembly. The assembly is mounted in high-resistance rubber which allows it to "pop back" unharmed when jarred. Various stylus combinations are available including 0.7-mil sapphire or diamond with 3-mil sapphire. **Circle 201**

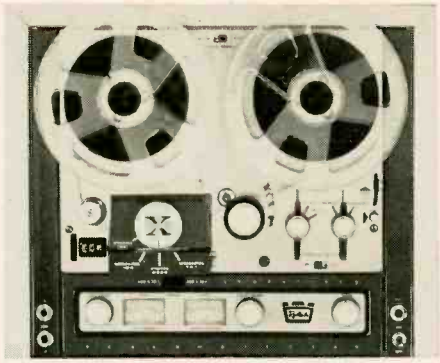
Solid-State Receiver. Harman-Kardon has added a new transistor receiver to the three already in their Strataphonic line. This is the Model SR-400, the first of this line to feature built-in AM reception in addition to FM-stereo. Frequency response of the amplifier is quoted as ± 1 db from 6 to 25,000 cps. IHF music power output is 36 watts, 18 per channel. Other specifications are: usable FM sensitivity, 2.9μv; spurious response rejection, better than 60 db; AM sensitivity, 50 μv/m. Square-wave rise-time is given

as 5 microseconds. The SR-400 includes a D'Arsonval tuning meter; stereo indicator light; contour switch; high and low cut switches; balance control; combined channel bass and treble controls; tape recorder output; two convenience outlets; a function/mode selector. Dimensions are 14½ wide x 4½ high x 11½-in. deep. List price is $309.00. **Circle 202**

Portable Sine-Square Generator. As the illustration shows, an apple, tools, a sandwich and a book are fitted travelling companions for the new Waveforms portable generator. It's only 5 lb., 6 x 4½ x 6-in. in dimension, small enough to fit into a briefcase with room to spare. All solid state in design, the generator will provide sine

or square waves from 10 cps to 12 mc. Calibration accuracy is quoted as ± 3 percent + 0.1 cycle. Sine wave distortion is 0.25 per cent at 1 kc, 1 per cent at 1 mc, and 2 per cent at 2 mc. Output level is 3v. into 50 ohms; 6v. open circuit. Over-all response is ± 1 db. It can be attenuated from a maximum of 3v to 300 mv, 30 mv and 3 mv steps. Finally, square-wave rise-time is given as 0.5 μsec. Price of this unit, the model 511A, is $700. **Circle 203**

New Tape Deck. A record/play head with a 38 micro-inch gap and a separate Cross-Field bias head are two reasons advanced for the excellent slow-speed high-frequency specification of this new Roberts Model 1770-D four-track stereo deck. 7½ ips frequency response is given as 30 to 22,000 cps ± 3 db; 3¾ ips speed offers 40 to 15,000 cps ± 3 db. At the slowest speed of 1⅞ ips, with the same ± 3 db tolerance, response of 40 to 12,000 cps is claimed. The deck provides these three speeds through a combination of motor speed change and capstan bushing diameter substitution. 15 ips speed is also available



with the use of an accessory. The 1770-D is a complete deck transport with stereo preamplification featuring two high-level, low-Z and two low-level, low-Z outputs. Front panel microphone inputs and rear deck high-level inputs are provided. Tape drive is from a hysteresis-synchronous motor. Total wow and flutter is 0.12 per cent. Dual, separate, VU meters, a sound-on-sound switch, pause button, tape-use indicator, head-shift lever, and record safety button round out the practical versatility of the deck. Price is $379.95. **Circle 204**

High Sensitivity THD Analyser. Hewlett-Packard's new total harmonic distortion analysers have 0.1 per cent full-scale display at maximum sensitivity, measuring distortion down to 0.03 per cent at any frequency from 5 cps to 600 kc. These units also measure hum and noise as low as 50 μv. Input signals as low as 0.3 volts rms may be analysed on all scales including the lowest. The input attenuator permits the meter to measure signals up to 300 volts. Input impedance is 1 megohm shunted by less than 60 pf; both input and output are floating. The output delivers, at high level, an isolated duplicate of the

waveform under examination in the meter. There are two models: 331A and 332A have solid-state tunable circuits which reject fundamentals by more than 80 db, while passing harmonics as high as 3 mc. Model 332A differs in having a precision AM detector for distortion analysis of modulation envelopes on carriers as high as 65 mc. Both may be used as a high impedance a.c. voltmeter, flat from 5 cps to 3 mc, with thirteen ranges from 300 μv to 300 v full scale. Model 331A is priced at $590; Model 332A at $620. **Circle 205**

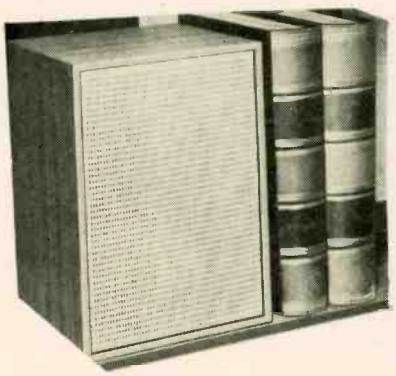
Weatherproof Speaker. Reduced on-the-job costs for multiple PA speaker installations is one of the benefits to be reaped from the new HU-15NT paging and talk-back speaker released by Atlas Sound. The feature that makes this possible is a built-in weatherproof line transformer with impedance, 70.7 v, and 25 v taps. Modular construction facilitates access to speaker and transformer components for service. The speaker contains a "power reminder" indicator to reference the power tap to use. An adjustable mounting bracket is included. Specifications are: power,

25 watts: impedances, 45, 90, 180, 325, 670, 1000, 2000, 4000, 8000 ohms: 70.7 v power line taps, 15, 7.5, 2.5, 1.25, 0.65 watts: 25 v power-line taps, 14, 7, 3.5, 1.9, 0.92, 0.3 watts: frequency response, 250-13,000 cps; sound level, 123 db measured 4 feet on axis at rated power; dispersion, 100 deg. Dimensions of the speaker are 9¾-in. bell diameter and 9-in. depth. Price, with transformer, is $45.25. **Circle 206**

Low-cost Amplifier. In a high-style, low-silhouette cabinet, this new economy stereo amplifier from Lafayette Radio offers a full range of controls plus many conveniences. It qualifies as an audio center. Pertinent specifications include: 15 watts per channel; frequency response, 25 to

25,000 cps ± 1.5 db; harmonic distortion at 15 watts is 1.25 per cent. Hum and noise: mag phono, −56 db; tuner, −75 db. The rear panel contains a speaker impedance selector for 8- or 16-ohm speakers. Also on the rear apron is a hum control and a.c. convenience outlet. Dimensions are 12⅞ wide x 5⅛ high x 8½-in. deep. Shipping weight is 20 lb. Retail price is $59.95. **Circle 207**

Compact Speaker System. Making its initial appearance in the United States is the Isophon compact speaker system, the KSB 12-20. Ideally suited for stereo because of its small size (9⅞ x



6¾ x 7⅛ inches), the KSB12-20 boasts a frequency range which would do credit to a larger system—60-20,000 cps. Power handling capability is 12 watts rms and 20 watts peak. Impedance is 4-8 ohms. Price is stated as being low for a speaker system of this quality. **Circle 208**

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Dad says McIntosh is the best. He keeps telling his friends about the three-year service contract he got with his McIntosh. He says you can't go wrong when you buy a McIntosh. You get a money back guarantee of performance.

Mom likes our McIntosh stereo too. She's always asking Dad to turn it up. She didn't like our old stereo, said it hurt her ears.

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Audio Cockpit with Twin-Double Speaker System

Fig. 1. Audio Cockpit with "pilots" chair in position.

MANY WIVES are under the impression that operating an audio system is as complicated as flying a plane. Maybe so, if one is to judge by this installation—but it certainly is an audiofan's dream.

This system, in the home of Ernest Schoedsack of Santa Monica, Calif., is unusual in that it is double.

An antique Zanzibar chest contains two Grado turntables with Audiotex mats, each turntable with an S.M.E. tone arm.

One cartridge is the Ortofon Professional with elliptical stylus; the other is a Fairchild F7, with battery-powered pre-preamplifiers.

The chest also contains two Shure preamplifiers, the power supply for the AKG C60 condenser microphone, and the remote control unit for the principal tape recorder.

The program material from either turntable plays into the first Sony 777 two-track stereo tape recorder, and is monitored by AKG headphones served by the tape recorder preamplifier. Volume control and channel balance are handled by the recorder controls, as there are no controls on the Shure preamplifier.

The second recorder is used for tape duplication, or transferring from quarter-track tape to two-track, for handling convenience.

The "pilots" armchair, a leather recliner not shown on the cover (see *Fig. 1*), is mounted on a revolving base for obvious reasons.

The output of the first tape recorder feeds directly into two Acoustech solid state stereo power amplifiers, which drive two stereo pairs of E.M.I. speakers (twin double in horseplayers parlance). The outer pair of speakers are DSL 529s, the inner pair are the larger 711A's. By switching on either or both stereo amplifiers, either pair of speakers may be played separately, or all four played in concert. Æ

Fig. 2. Twin-double speaker system.

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LETTERS

(*from page 6*)

enthused about this equipment. It is performing so well that another one is in the planning stages now, with four separate amplifiers feeding two sets of heads on an adjustable scale to give a reverberation effect on playback. Maybe even a switching arrangement to several heads or variable (switched) delay. Incidentally, I have tried a reverberation unit (K-10) between the amp and pre-amp on playback and the results are excellent.

DWIGHT L. CHAMBERS
3718 Narragansett Avenue
San Diego, California 92107

(*That new unit sounds fascinating, perhaps Mr. Chambers will submit it for publication and share his ideas with the rest of us.* ED.)

CALCULUS MADE DIFFICULT

(*from page 42*)

Since d is indefinitely small, d^2 is awfully small, and d^2x^2 vanishes. $2x \cdot dx$ doesn't exactly vanish; it just sort of chickens out, because if d is as small as all that, then no matter what you multiply it by you won't get much out of it. This leaves you with

x^2, *Eq. (12)*

and since the same applies to $(r + dr)^2$, we have also

r^2 *Eq. (13)*

This is what happens to the series-resonant circuit in *Fig.* 1(A). But since r_1 is a very large resistance, then r_1^2 is awfully large, at least, compared to r_2. We have, then

$r_1 >>>> r_2$ *Eq. (14)*

which means that r_1 has an awful lot of ohms. Therefore, its shunting effect on r_2 is negligible. r_2, on the other hand, has a very small resistance compared with r_1, because if Eq. 14 is correct, then $r_2 <<<< r_1$ *Eq. (15)* by the Law of the Reciprocation of Relative Quantities.

r_2, then, has almost no ohms to speak of, and may be regarded as a virtual short circuit. However, a glance at *Fig.* 1(A) tells us that L_2C_1 is a parellel impedance having an infinite resistance at resonance. Since this is virtually an open circuit, the short circuit r_2 isn't short-circuiting anything, and so may be disregarded.

Figure (B) shows the equivalent circuit of *Fig.* 1(A) after all the negligible values have chickened out. Its advantage from a standpoint of wiring and production is obvious.

It's all in knowing how. Æ

BASS TRANSFUSION

(*from page 22*)

sound pressure level to its electrical input power level. Although the experts may tend to differ slightly, generally they agree that an efficient speaker will produce a sound pressure level of approximately 90 to 92 decibels and more from a distance of 4 feet with an input of 1 watt. Not so technically, the owner of the usual high-fidelity system probably has an "efficient" speaker if it will reproduce good quality sound at normal to high listening levels with the amplifier gain control set to only about 1/4 to 1/3 of its maximum position.

A 16-ohm device, the energizer has an insertion loss of 6 decibels from 150 cycles up when it is used with a 16-ohm speaker, and a loss of 10 decibels when attached to 8-ohm speakers. This, in effect, is a relative increase of from 6 to 10 decibels in the frequency range below 150 cycles. This 10 decibel increase explains how, at relative sound pressure levels, an 8-ohm speaker in a small enclosure can imitate the bass response of a speaker mounted in a much larger cabinet. It is possible to provide a 16-ohm speaker with the full 10 decibel rise in low-frequency response by shunting the speaker input with a 16-ohm wire-wound resistor as indicated in *Fig.* 4.

Because the bass energizer requires an increase in amplifier power, it should not be used with low efficiency speakers unless they are driven by an amplifier with sufficient output to overcome the insertion loss. A more than sufficient listening level may be achieved with a relatively small 15- or 20-watt power amplifier when the energizer is used with efficient speakers. If used with an amplifier which is capable of 50 to 75 watts or more, the energizer will produce satisfactory results with inefficient speakers. However, although tests

You can't tell the difference between the Oki 555 and any other stereo tape recorder

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You lift it. It's a remarkably lightweight complete portable stereo tape system. So compact it weighs less than 25 lbs.

You check for tubes. It has none. It's solid state (all transistors...27 of them).

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And its price is less than you'd expect to pay. $349.95*.

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conducted with an inefficient speaker driven by a 25-watt power amplifier indicated an improvement in the low frequencies, it also made it apparent that the output power capability could leave a true hi-fi bug a bit frustrated.

Many stereo addicts are unaware of the potential destructive power involved when a large power amplifier is used with efficient speakers. Such a combination can "blow out" the speakers if excessive power is applied to them. In addition to its major function, the installation of a bass energizer in such a system permits it to act as a protective device also. With an energizer installed, a 16-ohm, 35-watt rated speaker may be coupled to a 70-watt power amplifier with absolute safety. Twice as much protection is provided when a 16-ohm speaker is connected as indicated in *Fig.* 4, or when an 8-ohm speaker is used.

Some listeners may prefer a dual purpose stereo system which may be used at both low (background music) and high (neighbor annoying levels. The addition of a simple DPDT (double pole, double throw) switch allows the energizers to be switched into and out of the circuits as the need arises. *Fig.* 5 shows the installation circuit for connecting this switch. The inclusion of the switch also provides a quick and simple means of demonstrating the effectiveness of the energizer.

Physically, the unit is only 5¾-inches in length (including mounting ears), 2⅞-inches in width, and 2⅛-inches in height (including terminals); small enough to be mounted almost anywhere. It will fit on the back of the speaker cabinet or it may be placed within the enclosure or the equipment cabinet. If it is to be switched in and out of the system, placement of the unit and the switch within the equipment cabinet will simplify wiring.

Although it cannot replace the perfect bass response of a carefully designed large speaker system, the Altec Bass Energizer can provide a healthy bass transfusion for any little bookshelf speaker.

AUDIO ETC

(*from page 14*)

into the home system? Plenty! Might cause a number of healthy explosions.

Integration

TV tape, as we see, will first of all "blend" right into the home tape recorder. Same tape, same deck, sharing audio electronics and drive mechanisms. Seems likely, anyhow. That's something! Maybe not all at once but, in the end, inevitably. Then you'll be able to record "off the air," on your tape deck, all the mono or stereo audio you want, plus any old video you may see on your "tuner." Live shows. And, of course (above the law?) all sorts of commercial movies—suddenly turned into repeatable home movies. (Get busy, you copyright lawyers.) Take down the Beethoven Ninth Symphony in stereo. Or the Beethoven Ninth in a TV spectacular. Button A or Button B. But is this the end? Far from it.

Along comes the TV camera (in home form), the video "mike" for your recorder. And presto—you have home "movies" on tape. You can play them back through your TV set. But, of course, they won't work on your movie projector. Too bad. That's a missing link.

It won't be for long. Somebody, natch, will develop a new gadget for you, a projection TV attachment for the home movie screen, out of your video recorder. Easy.

And, quick as a flash, the reverse as well! Maybe even part of the same package. An adaptor for your video "mike", (the camera) so you can "play" your film movies directly through the video circuits of your recorder and into your TV set. Nothing to it. They've been doing this for years in the TV studios.

Eraseable Home Movies?

Link after link, tie-in upon tie-in! How about portable TV recording? Well, that *is* a bit of a way off. But still—? Could it offer redundant competition with the home movie camera, pitting tape against film?

A TV camera, alas, has to be hitched to a TV recorder. And until we develop something weighing rather less than 95 pounds, there won't be any home TV-in-the-field. Not until, that is, we develop a micro-recorder that will reel magnetic TV tape inside the space now taken by a roll of film in a movie camera. Who knows? Could be! Just turn in your old obsolete film camera and get back a new one that looks the same, only its battery-pack runs tape, not film, and you can *erase* your pictures and start over again if you don't like them. Wow! Is *that* an idea! And you can see the pictures seconds after you make them, too. Better get the Poloroid people in on this one . . .

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Well, my imagination loves to soar, but let me conclude more soberly. You can see, with all this, that the presently launched $4000 Ampex V-303 fits rather precisely into the heirarchy of successive models at just the point where the old Ampex audio 400 came in, the first one-suitcase, semi-portable, semi-pro machine with the first intimations of eventual future home use. That 400 led directly to the 600, and so on.

Will the next Ampex video recorder be a "video-600?" I shouldn't wonder. And then the *next* generation? That one just might be the home audiovideo deck. Unless somebody beats Ampex to it. Æ

REVERSIBLE SOUND SYSTEMS

(*from page 32*)

the remaining body of the curve. This brings us to the crux of the matter. If just one sharp predominant peak of sensitivity exists (at the resonant frequency) then the transmitted signal will consist predominently of the band encompassing the resonant area almost to the exclusion of that part of the frequency band where the intelligence of the reply message exists. To make matters worse, this sensitivity so predominently peaked in the lower frequency bands *will be greatest to the room reverberant energy.* The result will be a great imbalance between unwanted pickup and message intelligibility content, the latter suffering severely.

Of great interest is the microphone response of the 8-in. co-ax system. It might be inferred before serious thought is given to the matter that the extended frequency response of this system would also make a better microphone out of it. However, the reverse is true! Not only is its response the most peaked of the three at its resonance of 100 cps and in the area of greatest room reverberation and ambient noise, but its upper frequency extension, despite its tweeter, is the most restricted of the three, falling off at 1500 cps. What actually happens in this case is that the high end of the loudspeaker consisting of a small tweeter diaphragm and small magnet structure compared to the woofer diaphragm and its heavy magnet, intercepts a very small portion of the sound wave hitting the loudspeaker as a whole. Its electrical output due to the combined influence of small sound wave intercept and small magnet compared to the large sound wave intercept and heavy magnet of the woofer, will be practically negligible. Of the three cones tested, then, the 8-in. co-ax will have the poorest response as a remote reply microphone, due to its excessively peaked response in the reverbrant frequency area, and its depressed and restricted response in the intelligibility area.

Fortunately these conditions causing deterioration of performance of a loudspeaker when used as a remote reply microphone may be alleviated considerably by the choice of a paging-talkback horn projector unit. The characteristics of horn units as *sound reproducers* are well known, and need hardly be mentioned here. For example, while the ordinary cone speaker has an efficiency of about 5 per cent the projector may be as efficient as 30 per cent for standard production units. The meaning for audio power conservation is self-evident. Furthermore, the ability to control projector directivity easily is a great boon in directing the paging message into the specific area that needs the greatest sound intensity. But now we come to the analysis of these projectors as talkback devices and we see that some of their attributes as good sound projectors carry over into providing desirable performance as remote reply microphones.

Figure 2 illustrates the performance of two paging talk-back projector speakers, one with a cut-off frequency of 350 cps, another with a cut-off frequency of 250 cps. As loudspeakers these two units have sharp cut-offs at their specified frequencies. The meaningful results of this characteristic is that a maximum efficiency as a *paging* unit is achieved over the intelligence-carrying part of the voice spectrum, and power is not lost at the low end that doesn't penetrate into the heavy noise areas. More germane to this discussion, however, is the fact that a horn is a reversible element: it is not only a projector, it is a receiver. The same cut-off characteristics govern it for both conditions; if it will not transmit below a certain frequency, it will not accept frequencies below that same frequency. Accordingly, as shown in *Fig.* 2, the low end response of these horn projectors as microphones, follows closely their output response as speakers. Moreover, since their low-frequency response is limited (by design), reverberant energy pickup is greatly attenuated, and the received sound signal consists, in the main, of the desired voice intelligibility frequencies, relatively unmarred by masking room noise and reverberation.

While there is a sloping-off characteristic of the higher frequency characteristic of these projectors as microphones, it is not nearly as severe as

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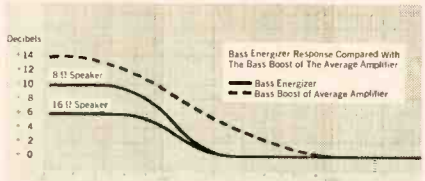

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the sudden drop-off of middle frequency section of the cone units. This may be due to the fact that even though the sound wave front impinges on the entire diaphragm, for the high frequencies the energy imparted to the outer areas of the cone never really reaches the voice coil because of physical absorption within the main body of the cone. This mechanism would be analogous to the performance of a cone as a loudspeaker where the high-frequency vibrations are mainly in the apex region, and diminish as they proceed out to the peripher areas of the cone. Similar discrimination against the transmission of the highs *inward* to the apex may exist when the microphone function is performed.

In the case of the projector, the sound wave intercepted by the mouth of the horn travels down the horn's length towards its narrow throat where the moving system of the small stiff diaphragm and its voice coil sees the entire wave front at once (even though the wave front is compressed to the horn throat dimension). The upper end roll-off that does show up in the microphone characteristics of these projector horns may be due to several conditions, but the most important one would arise from the front and rear cavities confronting diaphragms. In microphone designs, these cavities are made as small as possible consistent with the (small) excursion of the diaphragm with consequent minimum high-frequency acoustic capacitive shunting across the diaphragm. However, in light of the fact that the moving system of the horn driver must have adequate free area into which to move under applied electical power, these larger diaphragm acoustic shunting capacities do influence performance as a microphone.

In conclusion it might be said, depending upon the need for such bi-directional characteristic in a sound reenforcement system, that serious attention should be paid to the conditions under which replies will be required. If the replies are to be obtained from locations remote from the transducer, and where room resonance and reverberation are to be minimized, it would be far more desirable to use the high-efficiency horn-loaded paging speaker as a talk-back device. On the other hand if the reply is to be generated very close to the speaker itself where room resonances and reverberation and ambient noise is almost entirely negligible then the cone speaker may be used. However, even in this latter instance there will be a great reduction in the articulation area of speech due to the loss in high frequencies in the typical cone speaker structure and its peaked response at the low end. Æ

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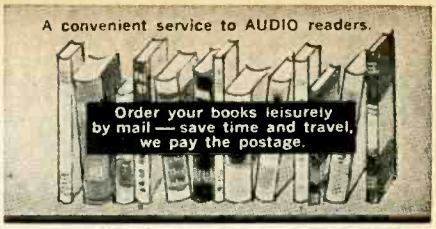

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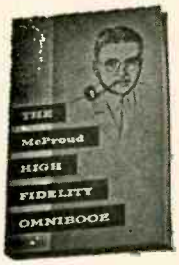

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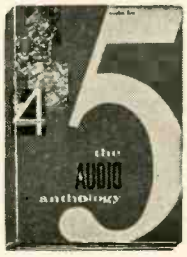

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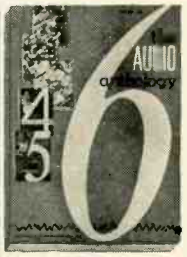

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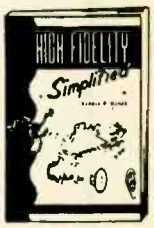

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AUDIOCLINIC

(*from page 4*)

speakers are causing the trouble. They produce sufficient sound energy at low power levels. This means that there is little voltage available at the speaker terminals to drive the meters. The only cure for this situation is to use some step-up transformers between the meters and the speakers. The transformers should have impedances of 200 ohms or so at the meter end and approximately equal the speakers' impedances at the other end. I would like to tell you to use transformers with 600-ohm secondary impedances, but these will be too good a match for the meters. Their rectifiers may reflect some distortion back out to the speakers. Therefore, I have chosen a compromise impedance of 200 ohms. This will give you a considerable increase in voltage appearing across the meters.

If you still require more voltage use the 600-ohm winding. Possibly there will be little increase in distortion. Because most transformers which have 200-ohm windings also have 600-ohm windings, you can make the changes easily.

INZIDE AUDIO

(*from page 47*)

• The Bogen Communications Division of Lear Siegler, Inc., recorded in 1964 the greatest yearly sales increase in its history, it was reported recently.

High fidelity sales for the year were 34 per cent above the previous year's mark nationally and public address system sales rose by 25 per cent in the same period, **Harold Goldsmith,** President of Bogen said.

Mr. Goldsmith was also named President of Olympic Radio & TV in addition to his present duties as President of the Bogen Division and a Vice President of Lear Siegler. Busy man ! !

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The display was also shown at the National Electronics Week trade show in New York City, March 31—April 4th.

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STEREO CONTROL

(*from page 28*)

We now express the separation ratio (S. R.), using our new symbolism, by combining *Eq. 3, 4,* and *5*:

$$\text{S. R.} = \frac{\text{Left} \oplus (-\text{Right})}{\text{Left} \oplus \text{Right}} = \frac{[L \oplus M_{(L)}] \oplus [(-R) \oplus (-M_{(R)})]}{[L \oplus M_{(L)}] \oplus [R \oplus M_{(R)}]}. \quad Eq.\ (10)$$

According to *Eq. 1, 2, 6,* and *7* we may deduce *Eq. 10* to be:

$$\text{S. R.} = \frac{[U \oplus M] \oplus [(-U) \oplus (-M)]}{[U \oplus M] \oplus [U \oplus M]}. \quad Eq.\ (11)$$

Since components of a root mean square sum may be combined in any order desired, provided they are not added before squaring, then:

$$\text{S. R.} = \frac{[U \oplus (-U)] \oplus [M \oplus (-M)]}{[U \oplus U] \oplus [M \oplus M]}. \quad Eq.\ (12)$$

Applying *Eq. 1, 2, 8* and *9*:

$$\text{S. R.} = \frac{[U \oplus (-U)] \oplus O}{[U \oplus U] \oplus 2M} = \frac{\sqrt{2}U}{\sqrt{2}U \oplus 2M} = \frac{\sqrt{2}U}{\sqrt{2U^2 + 4M^2}}. \quad Eq.\ (13)$$

Now if we solve for U/M, and let S. R. be called k, then k is the quantity whose values appear on the S. R. Calib. Control dial, and U/M defines the stereo signal characteristic necessary for a detector null at that dial position. We first square *Eq. 13*:

$$k^2 = \frac{2U^2}{2U^2 + 4M^2} = \frac{1}{1 + \frac{4M^2}{2U^2}} = \frac{1}{1 + 2\frac{M^2}{U^2}},$$

$$\frac{1}{k^2} = 1 + 2\frac{M^2}{U^2}, \quad \frac{M^2}{U^2} = \frac{\frac{1}{k^2} - 1}{2},$$

$$\frac{U^2}{M^2} = \frac{2}{\frac{1}{k^2} - 1}, \quad \frac{U^2}{M^2} = \frac{2k^2}{1 - k^2},$$

and finally,

$$\text{U/M} = \sqrt{\frac{2k^2}{1 - k^2}}. \quad Eq.\ (14)$$

Now if the coherent (monophonic) M component is reversed in phase in one channel, the difference signal becomes larger than the sum signal. Reversing the connections to one channel has the same effect. Showing the latter mathematically, assuming the right channel is reversed:

$$\text{S. R.} = k = \frac{\text{DIFF}}{\text{SUM}} = \frac{[L \oplus M_{(L)}] \oplus [-(-R) \oplus -(-M_{(R)})]}{[L \oplus M_{(L)}] \oplus [(-R) \oplus (-M_{(R)})]}. \quad Eq.\ (15)$$

Taking into account the balanced nature of the signal:

$$k = \frac{[U \oplus M] \oplus [U \oplus M]}{[U \oplus M] \oplus [-U \oplus -M]}. \quad Eq.\ (16)$$

Rearranging as before:

$$k = \frac{[U \oplus U] \oplus [M \oplus M]}{[U \oplus -U] \oplus [M \oplus -M]}. \quad Eq.\ (17)$$

Determining the rms sum of all components:

$$k = \frac{\sqrt{2}U \oplus 2M}{\sqrt{2}U \oplus O} = \frac{\sqrt{2U^2 + 4M^2}}{\sqrt{2}U} \quad Eq.\ (18)$$

Squaring both sides as before:

$$k^2 = \frac{2U^2 + 4M^2}{2U^2} = 1 + 2\frac{M^2}{U^2},$$

$$\frac{M^2}{U^2} = \frac{k^2 - 1}{2}, \qquad \frac{U^2}{M^2} = \frac{2}{k^2 - 1},$$

and finally,

$$\text{U/M} = \sqrt{\frac{2}{k^2 - 1}} \quad Eq.\ (19)$$

Equations 14 and *19* tell us what the correlation ratio, U/M, of a stereophonic signal must be to matrix to given values of separation ratio, k, the latter being capable of measurement by the separation ratio detector circuit. Although we cannot measure U/M, since the signal components, U and M have been mixed together even before reaching the microphones, we can calculate these ratios, using them to specify standard stereo test signals. A set of values for the correlation ratio necessary for test signals having representative separation ratio values are tabulated in Table I. It will

TABLE I

SEP. RATIO k	U/M	U/M db	R_M OHMS	
0.05	0.0708	-23.00	1,279	SEPARATION RATIO LESS THAN ONE, M IN PHASE TO BOTH CHANNELS. $U/M = \sqrt{\frac{2k^2}{1-k^2}}$
0.1	0.1421	-16.95	2,715	
0.2	0.2887	-10.79	5,669	
0.3	0.4447	-7.04	8,812	
0.4	0.6172	-4.19	12,287	
0.5	0.8165	-1.76	16,303	
0.6	1.0606	+0.51	21,203	
0.7	1.3862	+2.84	27,667	
0.8	1.8856	+5.51	37,581	
0.9	2.9200	+9.31	58,116	
0.95	4.3027	+12.67	85,566	
1.0	∞	+∞	∞	
1.1	3.0860	+9.79	61,411	SEPARATION RATIO GREATER THAN ONE, M OUTPHASED BETWEEN CHANNELS. $U/M = \sqrt{\frac{2}{k^2-1}}$
1.25	1.8856	+5.51	37,581	
$\sqrt{2}$	$\sqrt{2}$	+3.01	28,346	
$\sqrt{3}$	1.0000	0.00	20,000	
2.0	0.8165	-1.76	16,303	
5.0	0.2887	-10.79	5,669	
10.0	0.1421	-16.95	2,715	
20.0	0.0708	-23.00	1,279	

be noted that U/M is a double-valued function of k, in that *Eq. (14)* is used when $k<1$ and *Eq. (19)* is used when $k>1$. The next procedure is to assemble equipment to generate these standard signals and determine the circuit constants necessary to produce known values of U/M.

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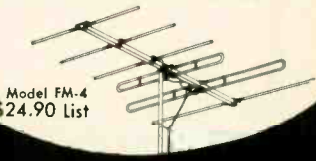

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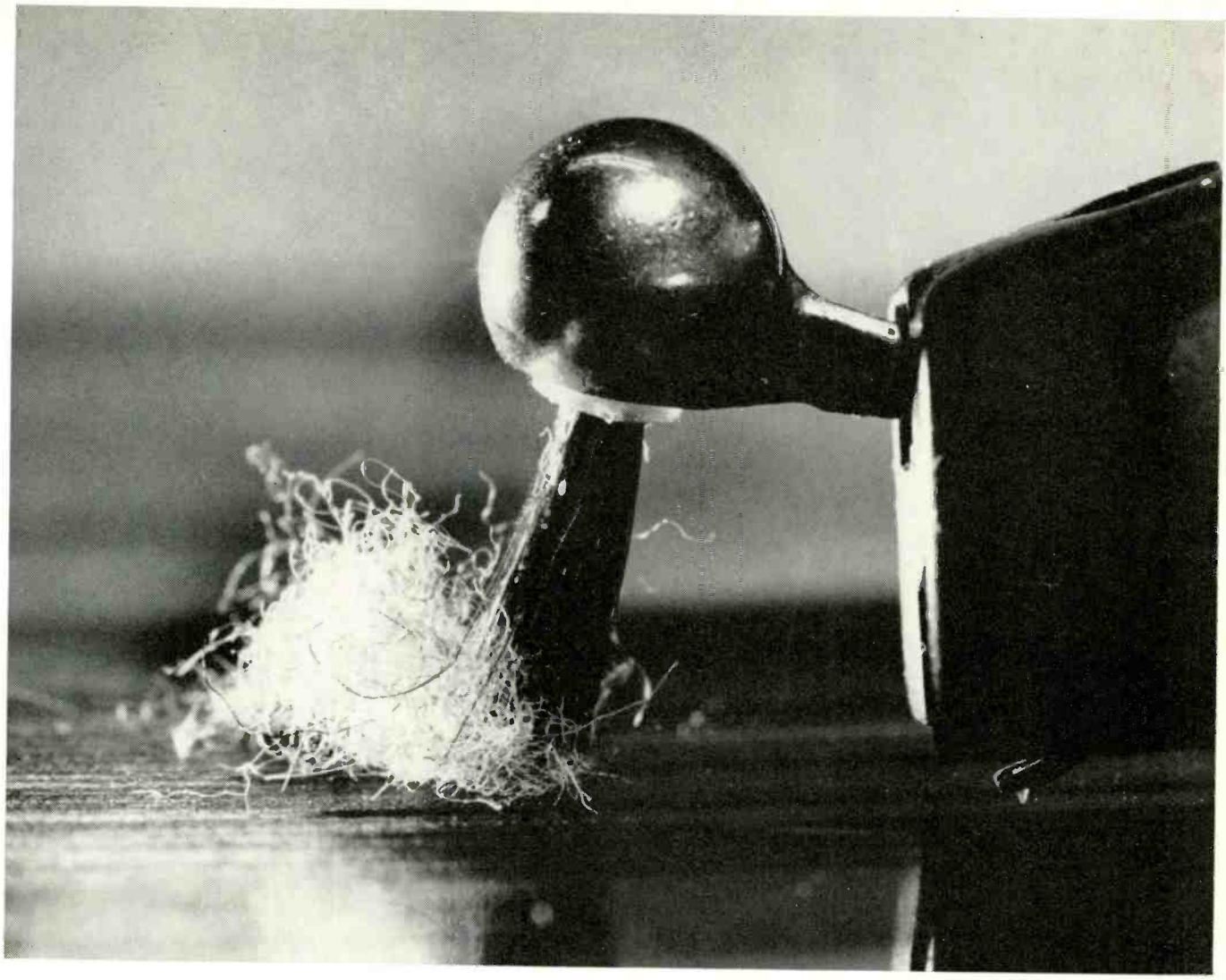

You are looking at the world's only true longhair cartridge.

In this unretouched photograph, the long, black hair of the brush built into the new Stanton 581 is shown in action on a rather dusty record. Note that all the loose lint, fuzz and dust are kept out of the groove and away from the stylus. That's why the Longhair is the ideal stereo cartridge for your Gesualdo madrigals and Frescobaldi toccatas. Its protective action is completely automatic, every time you play the record, without extra gadgets or accessories.

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