# AUDIO

MAY, 1958
50¢

*. . .the original magazine about high fidelity!*

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**Model DB212 Stereo Control Center and Dual Amplifier**

THIS is the new Bogen Stereophonic Dual Amplifier-Preamplifier. With this single unit you can precisely control all stereo sources (tapes, FM-AM radio broadcasts and the exciting new stereo discs!) and feed them through the self-contained dual 12-watt amplifiers to your stereo speakers. When you play monaural program sources, you have a total of 24 watts of power available for your speakers. Ask your Bogen dealer to tell you about the exclusive "Speaker Phasing Switch" which eliminates the "hole-in-the-middle" effect that sometimes occurs in stereo. See and hear the DB212 today . . . stereo hi fi by Bogen, the world's most experienced high fidelity manufacturer. Chassis price: $115.00. Pearl grey enclosure: $7.50.

**DB212: Output Power:** 24 watts (two 12-watt channels). **Peak Power:** 48 watts. **Harmonic Distortion:** 0.5% at rated output; less than 1% at 28 watts. **Frequency Response:** 20 to 20,000 cycles, ±1db. **Sensitivity:** tuner, aux, high tape – 0.25 v; mag, low tape – 8 mv. **Noise and Hum (referred to rated output):** tuner, aux, high tape – 80db; mag, low tape – 55db. **Output Impedances:** 4, 8 and 16 ohms. **Tone Controls:** Bass (60 c) – ±10db. Treble (10 kc) – ±8db. **Equalization:** Tape (Std NARTB), Phono (RIAA). **Controls:** Selector (four positions: tape, phono, radio, aux). Function (Monaural: Channel 1, Channel 2, Channels 1 & 2; Stereophonic: normal, inverted). Volume. Bass. Treble. Hi Filter (flat, 4 kc). Lo Filter (flat, 100 c). Speaker Phasing (2 positions). Power (on-off).

*David Bogen Co., Paramus, N. J. • A Division of The Siegler Corporation*

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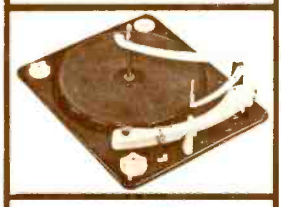
Professional 3-speed transcription turntable. Each speed variable and adjustable. Each player with its own inspection report.

■ **GARRARD**
*Model RC88*
World's finest record changer. Automatic and manual operation. True-turret drive . . . no belts. 4-pole motor. Foolproof pusher platform.

■ **GARRARD**
*Model RC98*
The Super Changer! All RC88 features PLUS continuous + or — variable control on each speed.



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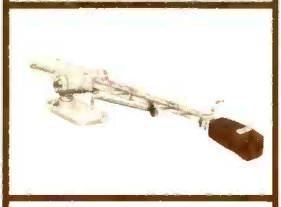

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Precision Transcription tone arm fully adjustable for length (12″ to 16″) and tracking angle; professional quality performance; beautifully styled; takes any cartridge.

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NEW! KT88 — high power, low distortion amplifying tetrode.

The Sounding Board

— cut along dotted line and save —

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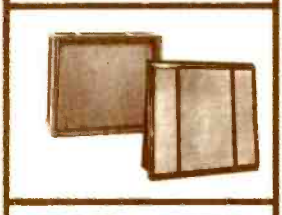

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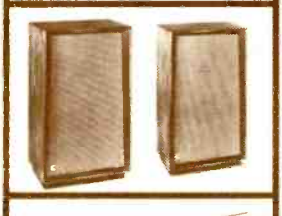

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**NEW! WHARFEDALE AF/10 x AF/12 ENCLOSURES**
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■
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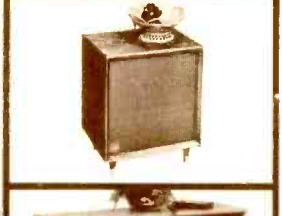
"Loudspeakers," "Sound Reproduction," "Pianos, Pianists and Sonics," and new book "High Fidelity, the Why and How for Amateurs."



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MAY, 1958 VOL. 42 No. 5

Successor to RADIO, Est. 1917.

# AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION



CONTENTS



COVER PHOTO: One influence of stereo on the modern living room. Shown is a pair of Electro-Voice speaker systems—at the right the phase-loaded "Carlton," whose woofer faces the rear of the cabinet and crosses over at 300 cps, making the sound radiated by the cone and its accompanying reflections from wall and floor very nearly in phase at all bass frequencies. At the left is E-V's new *Stereon*, which consists of mid-bass, treble, and tweeter sections in neat, narrow cabinet, which gives full stereo effect because very low frequencies contribute but little, and which conserves living-room space and is less costly than another complete system.

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# AUDIOCLINIC??

JOSEPH GIOVANELLI*

Note: More and more of you are placing your confidence in this column, with the result that sometimes there are slight delays in answering your interesting letters. Regardless of whether I find your letters suitable for use in the column, I write an answer to each. I answer even letters which will be used in the column, because there would otherwise be a delay of several months before such material would be printed, and because we want to give you ample time to specify if you do not wish your name to be used.

Several things you can do will help me in answering your letters more quickly. If, for some reason, you do not wish your name used, please indicate in your letter. Write so that your letter is clearly legible. Some letters could not be answered, because I could not determine what was wanted, or because the address could not be distinguished. Please enclose with your letter a stamped, self-addressed envelope, and direct your letter to me personally at the address shown at the bottom of this column, *not* to AUDIO Magazine in Mineola.

One final point: Please don't phone me for information. Always write. I can do a better job of serving your needs if you comply with these requests. Your cooperation in this matter will be greatly appreciated. Thank you very much.

This column is devoted entirely to one subject, enabling me to discuss it in much greater detail than would otherwise be possible. I invite your comments on this approach. You will also notice that I have more liberal use of diagrams than heretofore. Your comments on this matter would also be most welcome.

I edit another column for AUDIO, this one known as "Audio Techniques." Its success and continuance depend again on you. Many of you are experimenters. In working out your various projects you have undoubtedly evolved means for performing operations which are shortcuts or at least are different approaches from the standard means used to accomplish a given result. Some of the things which you may have uncovered may be warnings. In the June, 1958, installment, for example, we shall print some facts about the possibility of confusion which can come up with respect to reading the correct values of resistances. This column is a clearing house for those ideas. By this means we can share ideas and experiences, all of which disseminates knowledge and furthers the growth of the art of sound reproduction.

### Impedance Measurement

Q. *How may I determine the impedance of a device such as a phonograph pickup or microphone? Ira Jamieson, Rockville Centre, New York*

A. *Figure* 1 shows the normal wiring of such a device. $R_L$ is shown in parallel with the device, and its value is so chosen that it will be equal to the impedance of the device. In many cases, where the impedance is low, a transformer is substituted for the resistor. To determine the impedance of the device, feed a signal into it. In the case of a microphone, this is accomplished by placing it near a loudspeaker and feeding this speaker in turn with a tone whose frequency is approximately 400 cps. If the device is a phonograph cartridge, use a frequency record. Connect the output terminals of the device under test to the input terminals of an a.c. voltmeter whose impedance is at least ten times that of the device under study. A VTVM with an input impedance is a few megohms and a sensitivity of around 1 millivolt can work well with most devices. (If the unit being measured is a crystal microphone, its probable impedance is 5 megohms, so that a VTVM with an input impedance of at least 50 megohms would be needed and this is not usually available.) *Figure* 2

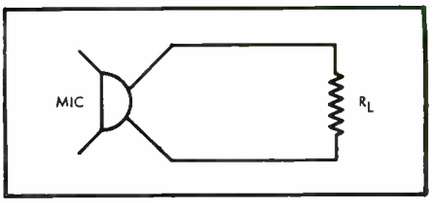


Fig. 1

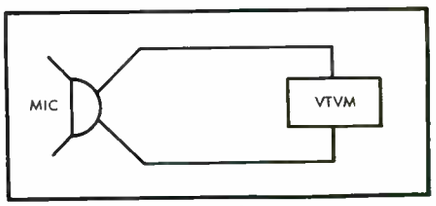


Fig. 2

shows the equipment under test wired to the measuring instrument. Note the voltage read under these conditions. Now connect a variable resistance across the device as shown in *Fig.* 3. Adjust this resistance until the output has dropped 6 db (which occurs when the voltage reading is half that of the original, or unloaded, voltage). If, regardless of the setting of the resistor, the voltage does not rise to this value, the maximum resistance is too small and a larger one must be substituted. If the adjustment is critical and falls close to the minimum resistance of the element, it would be better to substitute a smaller unit for the one originally used. At any rate, once you have arrived at the point where the voltage has been dropped 6 db, disconnect the resistor from the circuit

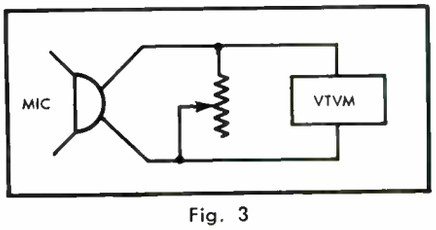


Fig. 3

* *3420 Newkirk Ave., Brooklyn 3, N. Y.*

He who is fortunate enough to own the Garrard 301 Transcription Turntable and the Garrard TPA/10 Tone Arm can enjoy the unique pleasure of knowing that *his* is the finest . . . the handsomest . . . record-playing combination in the entire high fidelity galaxy.

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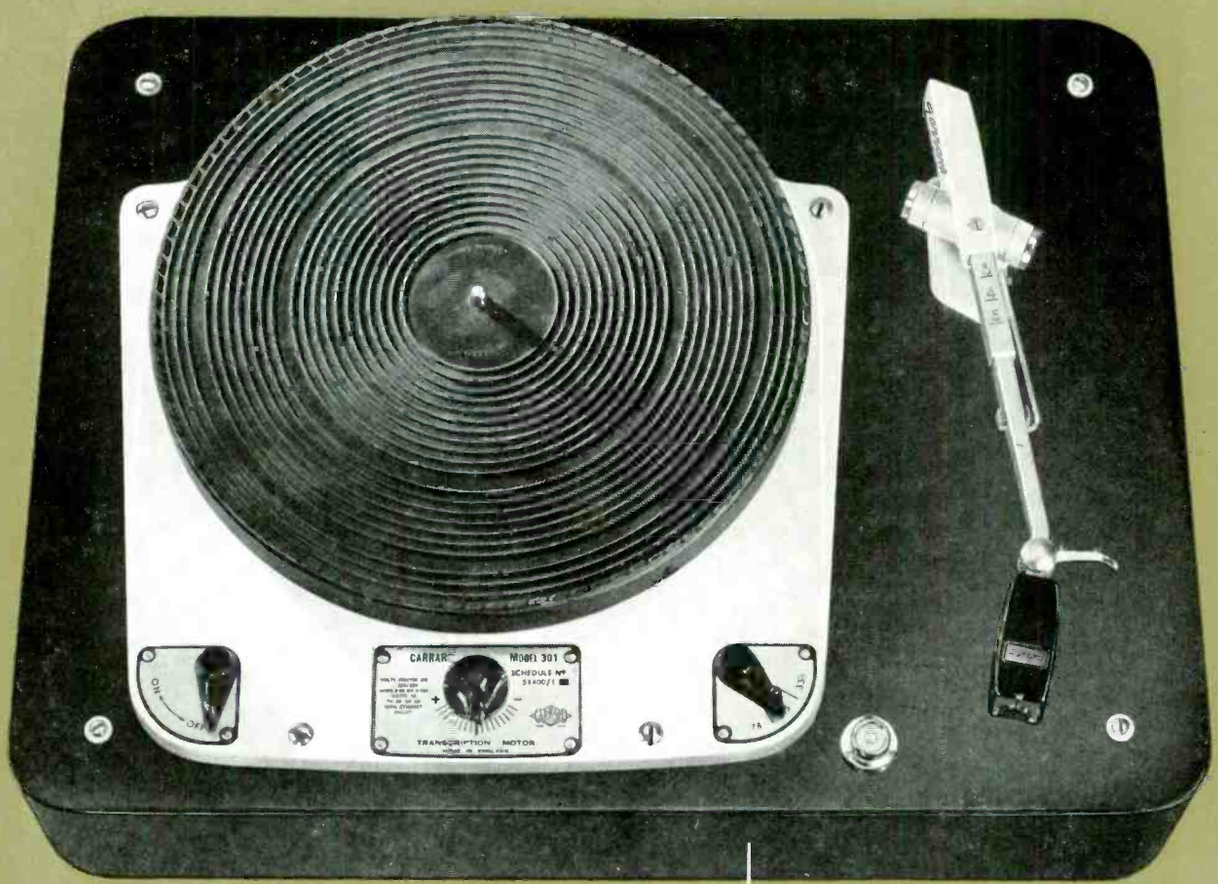


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- Heavy-duty 4-pole shaded motor is entirely Garrard-built
- Cast aluminum turntable is a full 6½ lb. . . . dynamically-balanced
- Motor and connected levers are completely isolated from unit by an exclusive damping system of tension-compression springs
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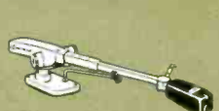
- Performance of each 301 is certified with a written individual test card

**$89.00**



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- Fits into more installations than any other professional tone arm, since it is adjustable in length and tracking angle . . . plays up to a full 16" record
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4-Speed Super Auto-Manual Changer
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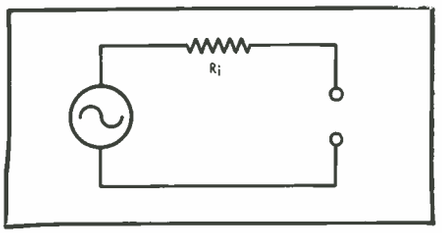



Fig. 4

and measure its value with an ohmmeter. The ohmic value of this resistor is equal to the impedance of the device being tested.

The impedance of amplifiers may be measured by similar means. A signal is fed into the amplifier and the unloaded secondary winding of the output transformer is connected to the indicating meter. This time, however, a vacuum-tube-voltmeter need not be used. The standard 20,000-ohms-per-volt movement will work very satisfactorily, as will an output meter whose impedance is as low as 100 ohms. Be sure that you do not apply too much signal to the input terminals of the amplifier because the voltage across the terminals of the output transformer will rise to a level which might be sufficient to cause arcing within, and this would probably ruin the transformer. The variable resistor is adjusted as before. The impedance read this time will be the source impedance of the amplifier. This is something quite different from the impedance into which the amplifier is designed to work. An amplifier might have a source impedance of 0.5 ohm, but the impedance into which it is intended to work is 8 ohms.

The question naturally arises as to why putting a resistor in parallel with a cartridge or amplifier can yield the impedance. You place almost any number of appliances in parallel across a 117-volt line without causing much drop across the line. All that is proved by this logic is that the impedance of the line is very low. Do not use the foregoing means to measure the line's impedance, for the least that can happen is that you will blow the house fuse in the attempt, and cause serious overheating of the wiring. The answer to this lies in our reconsidering the internal structure of the pickup. The resistor used to measure the impedance of the pickup is really in series with it and not in parallel with it. The pickup may be considered as being composed of a generator of zero resistance in series with the internal impedance of the pickup. This is shown in *Fig.* 4. When the load resistor, or test resistor, is placed across the pickup, we are actually placing it in series with the pickup's internal resistance or, more accurately, its internal impedance, $R_i$ in *Fig.* 4. *Figure* 5 shows that the generator, the pickup's

*(Continued on page 61)*

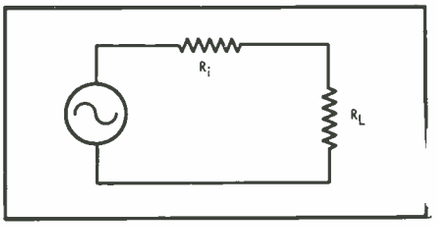
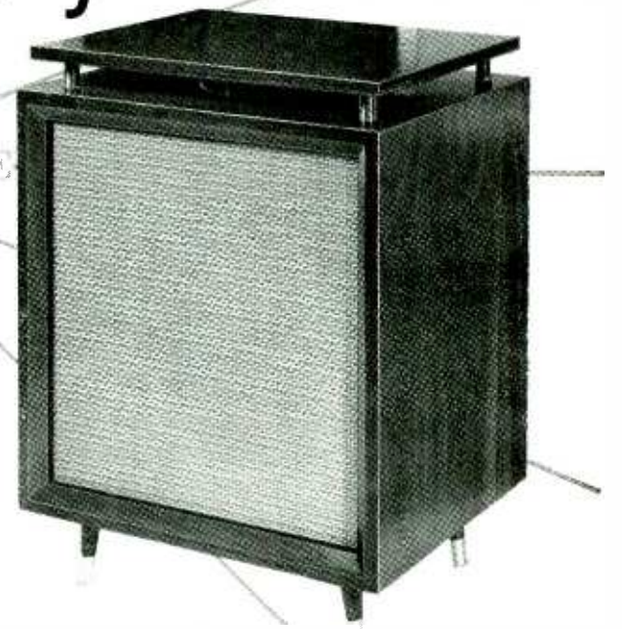



Fig. 5

**NOW! One Speaker System That Gives You**

# sound in every direction!



## COMPASS-1

with exclusive circular tweeter

and exclusive phasing switch

*. . . and the room shall be filled with music!* Because you're using Kingdom COMPASS-1, the new omni-directional speaker system that gives you sound in every direction! Brilliantly designed and engineered, COMPASS-1 combines a 12″ woofer, with exclusive circular tweeter, and front and back grilles . . . to gently envelop you in sound, eliminate "dead spots" and provide highest-fidelity reproduction anywhere in a room! Can be used, too, as an end table or room divider!

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COMPASS-1

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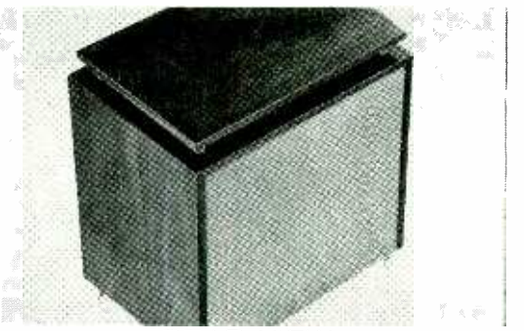
| *Mahogany* | **$149.50** |
| *Walnut* | **$154.50** |



REAR VIEW

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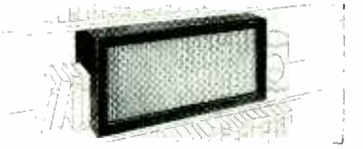

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# LETTERS

**Flannel and Foam**

SIR:

Your footnote to Mr. Briggs' letter in the February issue can be supplemented: the facts make an even better story than E.T.C.'s. Here they are:

On flannel, whether Mr. Canby or Mr. Briggs is right in the Wharfedale surround story, the first flannel surround on a commercially produced speaker was that of the original Hartley-Turner of the late 20's, and in the intervening 30 odd years no change whatever has been made to that surround, for time has shown it to be very nearly perfect. But it is fundamentally different from all others in that it is molded to a U section, so that at maximum displacement it rolls on itself with negligible friction. A tight surround, such as got with stretched textile, gives a high bass resonance and loss of sensitivity through friction, a fact that Mr. Briggs points out was happening with his speakers before he switched to foam.

As to the trouble involved in using even such a comparatively complicated surround as that on Hartley speakers, the time required to make and fit the surround is rather less than two minutes.

Now as to foam. The stuff Mr. Canby talked about and which various speaker manufacturers are using is shortly called polyurethane. For those who wish to experiment it can be bought at stores in various thicknesses at quite low prices. But I cannot understand why it is being used by speaker manufacturers at all.

As very little has been published on the manufacture and use of these "plastic" foams, what follows should be of interest. It is not new at all, for the chemistry behind it was well known in the U. S., Britain, and Germany in 1940 and even earlier. It is only mass production that is recent.

The first step in the manufacture is to combine an amine or amine salt with phosgene in the presence of an inert medium such as o-dichlorobenzene. Side reaction produces polyurea derivatives and the desired end product is an isocyanate. This chemical manipulation and the predetermined grade of the end product is beyond the resources of all but expert chemical manufacturers. Thereafter, the technique becomes available to anyone with the necessary mechanical resources.

The isocyanate can be considered in various ways. For example, diphenylmethane di-isocyanate is an adhesive of unusually useful properties (to which reference will be made later). But our immediate interest is the mixing of a suitable di-isocyanate with water and a hydroxyl-ended polyester ("synthetic resin" in ordinary parlance). This sets up a chemical reaction in which carbon dioxide is liberated and this blows up the mass into an elastic foam which, when the reaction is completed, is a slab of polyurethane foam enclosed in a non-porous skin. Suitable machinery is then used to remove the skin and slice the slab into sheets of whatever thickness is desired. It is also possible to cast the foam into long continuous sheets, but at all times a very close measure of control is needed, and specialised machinery is required.

Every cell of the foam is filled with $CO_2$, and the cells are non-communicating. The foam is normally used in compression, for upholstery, carpet underlay, and resilient packing, and the thousands of pneumatic cushions incorporated provide a most satis-

(*Continued on page 70*)


# stereo sound equipment . . . and here it is!

## stereo tape deck kit

HEATHKIT MODEL TR-1D $143.95

Enjoy the wonder of Stereophonic sound in your own home! Precision engineered for fine performance, this tape deck provides monaural-record/playback and stereo playback. Tape mechanism is supplied complete. You build only the preamplifier. Features include two printed circuit boards—low noise EF-86 tubes in input stages—mic and hi-level inputs—push-pull bias-erase oscillator for lowest noise level—two cathode follower outputs, one for each stereo channel—output switch for instantaneous monitoring from tape while recording. VU meter and pause control for editing. Tape speeds 3¾ and 7½ IPS. Frequency response ±2 db 40-12,000 CPS at 7½ IPS. Wow and flutter less than .3%. Signal-to-noise 55 db at less than 1% total harmonic distortion. NARTB playback equalization. Make your own high quality recordings for many pleasant listening hours.

## stereo equipment cabinet kit

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(Price to be announced soon)

Beautifully designed, this stereo equipment cabinet has ample room provided for an AM-FM tuner—tape deck — preamplifier — amplifiers — record changer — record storage and speakers. Constructed of ¾" solid-core Philippine mahogany or select birch plywood, beautifully grained. Top has shaped edge and sliding top panel. Sliding doors for front access. Mounting panels are supplied cut to fit Heathkit units with extra blank panels for mounting your own equipment. Easy-to-assemble, all parts are precut and predrilled. Includes all hardware, glue, legs, etc. and detailed instruction manual. Speaker wings and center unit can be purchased separately if desired. Overall dimensions with wings 82" W. x 37" H. x 20" D. Send for free details.

### DELUXE AM-FM TUNER KIT

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Here is a deluxe combination AM-FM tuner with all the advanced design features required by the critical listener. Ideal for stereo applications since AM and FM circuits are separate and individually tuned. The 16-tube tuner uses three circuit boards for easy assembly. Prewired and prealigned FM front end. AFC with on/off switch—flywheel tuning and tuning meter.

### STEREO PRE-AMPLIFIER KIT

HEATHKIT MODEL SP-1
(Price to be announced soon)

This unique two-channel control center provides all controls necessary in stereo applications. Building block design lets you buy basic single channel now and add second snap-in channel later for stereo without rewiring. 12 inputs each with level control—NARTB tape equalization —6 dual concentric controls including loudness controls—built-in power supply.

### 55 WATT HI-FI AMPLIFIER KIT

HEATHKIT MODEL W-7M $54.95

First time ever offered—a 55-watt basic hi-fi amplifier for $1 per watt. Features EL-34 push-pull output tubes. Frequency response 20 CPS to 20 KC with less than 2% harmonic distortion at full output throughout this range. Input level control and "on-off" switch provided on front panel. Unity or maximum damping factors for all 4, 8 or 16 ohm speakers.

### 12 WATT HI-FI AMPLIFIER KIT

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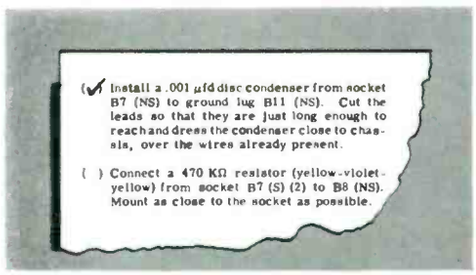


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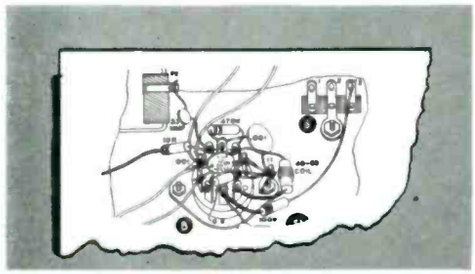

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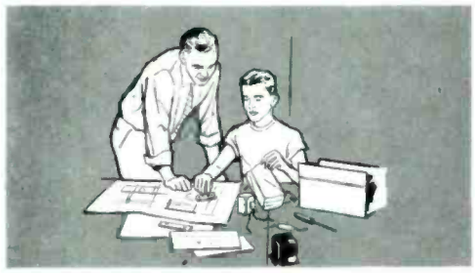

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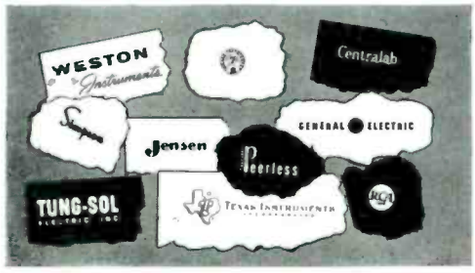


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CE-1C Mahogany
CE-1CB Birch
**CONTEMPORARY**

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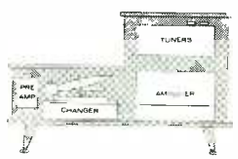

Be sure to specify model you prefer

**$43.95 each**

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**MODEL FM-3A $25.95 (with cabinet)**

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## broadband AM tuner kit

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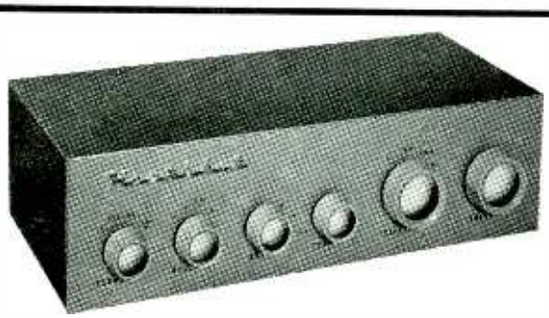
**MODEL BC-1A $25.95 (with cabinet)**



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## master control preamplifier kit

Designed as the "master control" for use with any of the Heathkit Williamson-type amplifiers, the WA-P2 provides the necessary compensation, tone, and volume controls to properly amplify and condition a signal before sending it to the amplifier. Extended frequency response of ± 1½ db from 15 to 35,000 CPS will do full justice to the finest program material. Features equalization for LP, RIAA, AES, and early 78 records. Five switch-selected inputs with separate level controls. Separate bass and treble controls, and volume control on front panel. Very attractively styled, and an exceptional dollar value. Shpg. Wt. 7 lbs.

**MODEL WA-P2 $19.75 (with cabinet)**

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**HEATHKIT 25-WATT**

MODEL W-5M

**$59.75**

# high fidelity amplifier kits

**HEATHKIT 70-WATT**

MODEL W-6M

**$109.95**

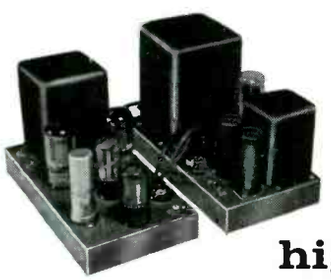
To provide you with an amplifier of top-flight performance, yet at the lowest possible cost, Heath has combined the latest design techniques with the highest quality materials to bring you the W-5M. As a critical listener you will thrill to the near-distortionless reproduction from one of the most outstanding high fidelity amplifiers available today. The high peak-power handling capabilities of the W-5M guarantee you faithful reproduction with any high fidelity system. The W-5M is a must if you desire quality plus economy! Note: Heathkit WA-P2 preamplifier recommended. Shpg. Wt. 31 lbs.

For an amplifier of increased power to keep pace with the growing capacities of your high fidelity system, Heath provides you with the Heathkit W-6M. Recognizing that as loud speaker systems improve and versatility in recordings approach a dynamic range close to the concert hall itself, Heath brings to you an amplifier capable of supplying plenty of reserve power without distortion. If you are looking for a high powered amplifier of outstanding quality, yet at a price well within your reach, the W-6M is for you! Note: Heathkit model WA-P2 preamplifier recommended. Shpg. Wt. 52 lbs.

**HEATHKIT DUAL-CHASSIS**

MODEL W3-AM

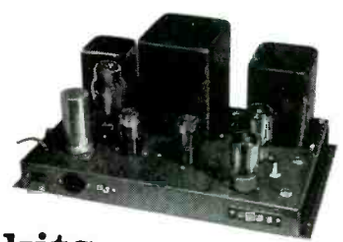
**$49.75**



**HEATHKIT SINGLE-CHASSIS**

MODEL W4-AM

**$39.75**



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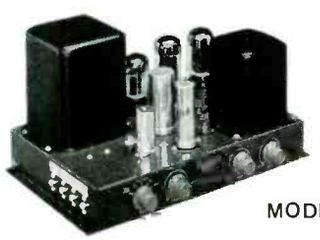
# high fidelity amplifier kits

One of the greatest developments in modern hi-fi reproduction was the advent of the Williamson amplifier circuit. Now Heath offers you a 20-watt amplifier incorporating all of the advantages of Williamson circuit simplicity with a quality of performance considered by many to surpass the original Williamson. Affording you flexibility in custom installations, the W3-AM power supply and amplifier stages are on separate chassis allowing them to be mounted side by side or one above the other as you desire. Here is a low cost amplifier of ideal versatility. Shpg. Wt. 29 lbs.

In his search for the "perfect" amplifier, Williamson brought to the world a now-famous circuit which, after eight years, still accounts for by far the largest percentage of power amplifiers in use today. Heath brings to you in the W4-AM a 20-watt amplifier incorporating all the improvements resulting from this unequalled background. Thousands of satisfied users of the Heathkit Williamson-type amplifiers are amazed by its outstanding performance. For many pleasure-filled hours of listening enjoyment this Heathkit is hard to beat. Shpg. Wt. 28 lbs.



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## high fidelity amplifier kit

MODEL A-9C **$35.50**

For maximum performance and versatility at the lowest possible cost the Heathkit model A-9C 20-watt audio amplifier offers you a tremendous hi-fi value. Whether for your home installation or public address requirements this power-packed kit answers every need and contains many features unusual in instruments of this price range. The preamplifier, main amplifier and power supply are all on one chassis providing a very compact and economical package. A very inexpensive way to start you on the road to true hi-fi enjoyment. Shpg. Wt. 23 lbs.

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## electronic crossover kit

MODEL XO-1 **$18.95**

One of the most exciting improvements you can make in your hi-fi system is the addition of this Heathkit Crossover model XO-1. This unique kit separates high and low frequencies and feeds them through two amplifiers into separate speakers. Because of its location ahead of the main amplifiers, IM distortion and matching problems are virtually eliminated. Crossover frequencies for each channel are 100, 200, 400, 700, 1200, 2000 and 3500 CPS. Amazing versatility at a moderate cost. Note: Not for use with Heathkit Legato Speaker System. Shpg. Wt. 6 lbs.

HEATHKIT "LEGATO"

# high fidelity speaker system kit

Wrap yourself in a blanket of high fidelity music in its true form. Thrill to sparkling treble tones, rich, resonant bass chords or the spine-tingling clash of percussion instruments in this masterpiece of sound reproduction. In the creation of the Legato no stone has been left unturned to bring you near-perfection in performance and sheer beauty of style. The secret of the Legato's phenomenal success is its unique balance of sound. The careful phasing of high and low frequency drivers takes you on a melodic toboggan ride from the heights of 20,000 CPS into the low 20's without the slightest bump or fade along the way. The elegant simplicity of style will complement your furnishings in any part of the home. No electronic know-how, no woodworking experience required for construction. Just follow clearly illustrated step-by-step instructions. We are proud to present the Legato—we know you will be proud to own it! Shpg. Wt. 195 lbs.

MODEL HH-1-C
(imported white birch)
MODEL HH-1-CM
(African mahogany)
**$325.00** each

HEATHKIT
BASIC RANGE

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RANGE EXTENDING

## high fidelity speaker system kits

MODEL SS-1 **$39.95**

A truly outstanding performer for its size, the Heathkit model SS-1 provides you with an excellent basic high fidelity speaker system. The use of an 8" mid-range woofer and a high frequency speaker with flared horn enclosed in an especially designed cabinet allows you to enjoy a quality instrument at a very low cost. Can be used with the Heathkit "range extending" (SS-1B) speaker system. Easily assembled cabinet is made of veneer-surfaced furniture-grade ½" plywood. Impedance 16 ohms. Shpg. Wt. 25 lbs.

MODEL SS-1B **$99.95**

Designed to supply very high and very low frequencies to fill out the response of the basic (SS-1) speaker, this speaker system extends the range of your listening pleasure to practically the entire range of the audio scale. Giving the appearance of a single piece of furniture the two speakers together provide a superbly integrated four speaker system. Impedance 16 ohms. Shpg. Wt. 80 lbs.

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# AUDIO ETC.

## Edward Tatnall Canby

## CBS Stereo—A Layman's Look

I'M ADDING some last minute words here, written after the compatibility issue in stereo discs had been resolved by Columbia's decision to begin with a non-compatible disc, minus the full ASRA modification of the difference-signal as described below and in the article on page 26.

An expensive and futile propaganda war of words was thus avoided—but as I see it, the principle of some modification of the vertical cut difference-signal (below) in the 45/45 disc is surely bound to be applied to all coming stereo records. Maybe it will be unheralded and probably it won't be drastic enough—as with ASRA—to make the records playable on most standard monaural pickups. But it'll be there, for good engineering reasons, if I understand the situation.

I suggest that a year from now you put meters, vertical versus lateral, on a batch of stereo records, any old brands, and see what you get in output. Dollars to doughnuts. . . .

Since writing the rest of this piece I have heard ASRA personally on extensive AB comparisons. It works. In most of the comparisons I could not spot any difference—I guessed wrong again and again. In some places, loud transient die-away echos for instance, I could reliably hear a stereo difference; but a barely audible decrease in input level (ASRA is a dynamic device) removed it.

ASRA must be used carefully, of course, and adjusted to suit each recorded sound. But as a recording tool I'd call ot at least as practical as a limiter—and less of a distortion.

This new CBS project has a number of intellectual booby traps in it for the unwary, both layman and engineer. A lot of people are already floundering around in considerable confusion, I've discovered. The first thing to know about it, for instance, is that—in spite of the title "Columbia compatible stereophonic record," the development announced at the end of March isn't a record at all, but a compatible system for *cutting* a stereo record—more specifically, a system for preparing the final pair of signals that is fed to the stereo disc cutter.

The intent is compatibility—as between a stereo disc and a standard LP. The idea was to produce a record that would play with "full stereo effect," to use the CBS phrase, and yet also play safely via any standard monaural pickup, for full monaural effect. This is not the case with the present 45/45 record, its two stereo signals unaltered. Thanks to the vertical modulation, many monaural pickups—most—will have trouble tracing the 45/45 grooves and many of them, lacking enough vertical compliance, will ride them roughshod, so to speak, doing serious damage. That's the incompatibility that CBS was out to lick.

As Dr. Peter Goldmark, who launched the LP itself ten years ago, said at the CBS press conference, the new CBS system produces a stereo disc that is even compatible with the incompatible disc—the now-standard 45/45. The CBS disc, for that matter, *is* in practice a 45/45 record (though it could be a lateral-vertical if desired), with the crucial and tricky alterations introduced into the vertical component of the groove, reducing the vertical "bumps" to the point where they can be negotiated safely by monaural pickups. The stereo record itself can conform physically to already accepted standards. Only the amplitude of the vertical component is involved.

Thus any stereo pickup will play a CBS-cut disc. All 45/45 pickups will do it, without any special circuit arrangements whatsoever. (Any lateral-vertical pickup, too, if the signals are shifted about by a phasing circuit to equal the 45/45. This is, of course, also true with any other 45/45 disc; it can be played by a lateral-vertical pickup with appropriate circuit changes.)

Similarly, any orthogonal stereo cutter (i.e. a cutter with two cutting motions 90 deg. apart, whether 45/45 or lateral-vertical or otherwise), will cut a CBS stereo disc; you just insert a special CBS modifying amplifier between the cutter head and the two stereo signal sources to feed the L-V cutter; an additional "matrixing" circuit (more about which later) is necessary to feed a 45/45 cutter.

The alteration, again, is confined exclusively to the vertical component of the signals. Thus the central feature of the whole arrangement is that, according to CBS, though the vertical component is radically reduced in power—the stereo effectiveness of the whole is virtually unchanged. With the groove mostly a lateral one, plus only a small vertical component, it is to all intents and purposes a standard LP—and yet it is also a stereo. Have your cake and eat it.

The purpose of all this is a canny one, you see. With an almost fully interchangeable disc, compatible every which way, there can be a much needed "smooth transition" from normal LP recording to full stereo LP, with practically no dislocation in the record business itself. The changes can be concentrated in the equipment side of the market. This is usefully important if stereo disc is to move in smoothly. This is a cake that could well be worth having and eating, too.

### Sums, Differences, and Matrixes

There's no use trying to understand the CBS stereo system until the concept of sum and difference signals is digested; for the whole business, as we'll see, depends on the combining of the two stereo signals—call them *L* and *R*—into two compound signals, one the sum of the two and the other the difference. Sum-and-difference, of course, is nothing unusual, nor in any way new to a well trained engineer. The principle applies to plenty else in stereo, and to any area where two signals are involved. (It's related, after all, to such matters as intermodulation distortion, where two frequencies generate extra spurious frequencies by combination.) But I'll confess that to many non-engineers, including, I am sure, a good many of our readers, this is not an easy concept to grasp. An understanding of sum-and-difference is an absolute requirement if you are to fathom the CBS stereo system and, for that matter, the whole subject of stereo disc. The algebra involved is ultra-simple; just addition and subtraction. But to "visualize" (or should I say, auralize) what actually happens when two stereo signals are added together, or subtracted one from the other, requires an exercise of the imagination that can bring sweat to the fevered brow.

It did to mine. I'd already torn out hair trying to understand the M-S stereo microphone, the one that has two mikes mounted together at a single point over the central portion of an orchestra and yet gives a spread-out stereo effect. Just as I got that subject partway under my belt, including the sum-and-difference circuits that make it possible, along comes CBS. I took a couple of days off to do homework at that point before I could emerge and say that I'd figured CBS out, after a fashion. It was all about sum-and-difference.

Let me look at this aspect of dual-signal sound before touching on the CBS application of it to stereo disc. A new word has sprung up—new, at least, in this connection—out of the CBS presentation. It is matrixing, and it comes, I gather, from color TV. The old and familiar term for it was a phasing circuit; CBS calls this a matrixing circuit or a matrix. I'd say that the derivation is slightly doubtful but I'll admit that it's a handy term and likely to get into general use. So matrix it is, in place of phasing circuit.

If the trained engineers will skip forward at this point, I'll get down to business with sum-and-difference. If you are to have stereo sound, two sound-signals of the same music, slightly unlike, containing some elements that are identical and some that are different in phase and quality, (with all degrees and shades of difference between) you can quickly assume that these relationships can be treated in terms of like and unlike—or better in degrees of like and unlike. That gives us an oppositeness *vs.* a sameness, two contrasting elements in the

total relations between the two stereo signals.

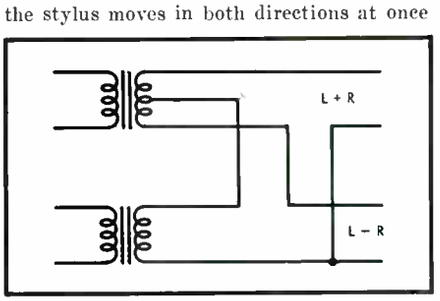
Some elements are the same; some are literally opposite (180 deg. out of phase) and many are different by varying degrees. If you take these opposing factors as, so to speak, your criterion of comparison, you may analyze two given stereo track *L* and *R* into two factors; the degree of sameness between them and the degree of differentness. Feed tracks *L* and *R* into the simplest of simple "analyzers"—the matrix—and you get two signals coming out, each *combining L* and *R*, but from opposite points of view; one represents the sameness-elements in the combined signal; the other represents the unlikeness-elements, each in the degree of sameness or unlikeness that exists at any moment, of any of the millions of sound patterns in a musical or other dual stereo sound signal.

Why make it so complicated? Only because, here, I have put a simple arithmetical or geometrical idea into semi-verbalized listening terms. As to circuitry, all you do is to feed tracks *L* and *R* into a "matrix" and extract (a) the sum of the two, and (b) the difference between the two. $L+R$ and $L-R$. It can be done via various circuit elements, as the editor points out to me, but the classic "matrix" involves transformers plus center taps. Feed in *L* and *R*, feed out a Sum signal and a Difference signal. (Nope, this is *not* merely reversing the phase of one track, but almost. Both outputs are combinations of *L and R*, but combined in opposing ways.)

Again, though electrically this idea is ultra-simple, the implications in terms of loudspeakers and stereo sound are not too easy to grasp, so to speak, in three dimensions.

### Sum-and-Difference Geometry

Next, comes the crucial element for stereo grooving, the relationship between these nice sum and difference signals and the combination of two simultaneous signals that goes into all stereo disc groovings. For those who are still somewhat doubtful as to how a single stylus can produce two signals, take the simplest system—lateral-vertical. Lateral motions of the stylus account for one track, vertical motions for the other. One track feeds to each speaker; the stylus moves in both directions at once



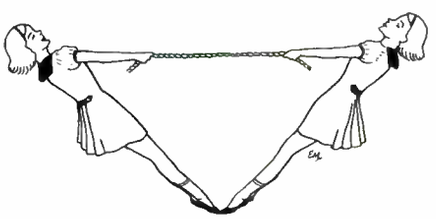

A simple matrixing circuit

but its two internal receiving mechanisms are fixed to respond only to the vertical or horizontal elements in the motion. Wiggle your needle sidewise and one signal goes squawk, the other is silent. Wiggle the needle vertically and the other element gives out with a blat, the first is silent. *Wiggle the needle both ways at once—i.e. diagonally—and both signals are generated.*

Ha! Now we approach the 45/45. The Westrex and similar 45/45 systems merely tilt the driving mechanisms, or responding mechanisms, an eighth-turn around, so that each is diagonal to the record surface, making a V at 90 deg. Feed track *L* to one side of such a groove cutter and track *R* to the other, and you have a 45/45 recording in which each track obviously is cut diagonally, one aiming to the right, the other to the left; *and in each signal the groove motion is part lateral, part vertical.* That's what we mean by diagonal, in layman's language.

Thus 45/45 cutters tend to look like sawed-off V-8 auto engines, two "pistons" driving a stylus between them. When both push equally, the stylus moves up and down, but if one pulls while the other pushes, the needle sways laterally. Get it? All combinations of the two motions are possible—and hence all angles of cutting from lateral to vertical. The stereo cartridge can reproduce the same motions and the same signals in its two diagonal responsive elements, opposed to each other in the same way, at 90 deg. or the square.

So, vertical-lateral is replaced by half-and-half, at one diagonal, and half-and-half, at the opposite diagonal. The great advantage is that a stereo disc cut this way has two tracks that are identical in physical characteristics, though opposite in their "right and left" diagonal direction. Your two simultaneous recordings can thus be treated with the same equipment, curves, etc., and will wear, sound, and function in all respects like identical twins, right-handed and left-handed.



The 45/45 groove system is now officially accepted by RIAA, together with standards for dimensions, cutting, etc., and so all coming stereo discs will no doubt have this characteristic groove configuration.

But what of the Sum and the Difference? Oddly enough, the 45-deg. groove cuts *are*, in terms of lateral and vertical, a sum and a difference. Each track, in the groove, is part vertical and part lateral, since again, this is what diagonal motion actually amounts to. Equal but opposite combinations of vertical and lateral motion. Therefore we have a marvelously useful relationship. We can think of—and use—the sum and difference signals, as well as the plain track *L* and track *R* signals, in terms of the lateral and vertical elements in stereo recording.

A lovely rule is seen gracefully to emerge from all this. Each time you convert a pair of signals from track *L* and track *R* to a sum signal and a difference signal, *or* vice versa, you in effect move the two 90-deg.-apart groove elements an eighth-circle around. Each time you rotate your actual groove cuttings you in effect change the played electrical signals from one of these forms to the other.

*(Continued on page 61)*

# EDITOR'S REVIEW

## STEREO BOXSCORE

WE ARE AT LAST getting somewhere in the stereo disc picture, with the official acceptance of the Westrex 45/45 system being announced by the Record Industry Association of America. During the Institute of Radio Engineers' Convention in March, several papers were presented on the subject, one of which is reproduced in full in this issue. CBS Laboratories has developed a compatible stereo record which can be played with monaural pickups with a minimum of damage and with satisfactory—and possibly even comparable—LP quality. The development was by CBS Labs, and the presentation of the paper did not imply that Columbia Records was intending to release records cut with this method. As a matter of fact, Columbia Records has since announced that they would release standard 45/45 records, even though the discs were incompatible. However, we consider the system of sufficient interest to reprint the paper in full, and in addition, to carry Mr. Canby's comments on the device. As might be expected, the CBS Labs' announcement inaugurated a series of publicity blasts which implied that the stereo effect was being compromised to produce a compatible record, and that the originators of the blasts would never compromise stereo in order to make a compatible record, all of which sounds suspiciously like sour grapes. We well remember 1948 when some of the companies stated that they would not produce LP's, but the memory of the public is short, and no one commented when these companies finally came forth with LP releases. In any case, we agree with Mr. Canby that some modification of the recording process will be employed by all manufacturers before many months have passed. How much simpler life would be if publicity and press statements were as distinguished for their veracity as they are for their loguacity.

One of the advantages of the CBS Labs' system has not been stressed so far in the various presentations of the past month. By its very nature, the lateral component of the recorded signal is of considerably greater amplitude than the vertical one, which makes it possible to use a conventional high-power amplifier for the lateral channel and one of somewhat less power for the vertical channel, with matrixing in the output circuit to restore the right and left signals of the 45/45 system. Carrying this one step further, by simplexing the amplifier so that it functions in the usual push-pull manner on the lateral (or sum) signal and as a parallel single-ended amplifier on the vertical (or difference) signal, a complete stereo amplifier system can be had from a single set of tubes. In the June issue we will present this plan in constructional form and we believe it will result in a fairly simple and relatively inexpensive unit. From the standpoint of low priced "hi-fi" stereo systems which are likely to flood the market in coming months, this type of simplification is certain to be employed.

Pye Records, Ltd., in England, is the first to announce that they will be releasing stereo discs in the near future. In the U.S.A., Vox and Urania have so far announced their intensions to produce stereo records, and RCA Victor puts a date of "June or July" for their entry into the field. One company—Paramount Enterprizes, Inc.—has already held a press showing of packaged "hi-fi" sets and a library of six classical and thirteen popular stereo discs.

So Sidney Frey's Audio Fidelity records, which undoubtedly "jumped the gun" with four commercial releases well in advance of the official acceptance of the 45/45 system, have established themselves with another first—in addition to providing sample recordings for pickup manufacturers to practice with.

## HI FI SHOWS

With none in the immediate offing—the next one is the Houston (Texas) High Fidelity Show scheduled for June 6–8 at the Shamrock Hilton Hotel—it seems like a good time to take a look at the scheduling of the major shows by the larger show-producing organizations. Obviously, the major shows—New York and Los Angeles—are of greatest importance to the industry as a whole, and the Institute of High Fidelity Manufacturers has good reasons for choosing the dates of these events. The time of the year is important, and availability of show space comes second in determining the exact dates. Rigo Enterprises is a large operation, too, and it and the IHFM co-operate in setting dates.

Any organization planning an independent show should first check with IHFM and Rigo to make sure there will be no conflict, for manufacturers can scarcely arrange for two sets of show staffs at the same time—one is often enough of a chore. And, as a reminder, the IHFM show in New York is scheduled for September 30 to October 4 in the New York Trade Show Building.

## BIGGEST PRESS EVENT OF MONTH

Midst a number of press "parties" this spring, the opening celebration for ORRadio Industries' new plant in Opelika, Alabama, on March 29 was probably the largest. Some 300 townspeople and representatives of the press and radio were on hand for the ceremonies at which Alabama's Senator Sparkman made the principal address, while J. Herbert Orr and George Long —presidents of Orradio and Ampex Corporation respectively—outlined the history, progress, and aims of the company. After which everyone repaired to a park for a real Southern barbeque luncheon.

Congratulations to Orradio and a small wish for more opening celebrations, even if we do get sunburned again.

# For a greater measure

PHOTOGRAPH BY ROBERT W MITCHELL

# of listening pleasure...


*Important Quality Features, so necessary for high fidelity reproduction from records.

## play your records with the incomparable Fluxvalve®

PICKERING'S *truly* miniature FLUXVALVE magnetic phonograph cartridge represents the *newest* concept in high fidelity cartridge design since PICKERING introduced the *first* really lightweight high fidelity pickup more than a decade ago.

You get a *full measure of listening pleasure* . . . because the FLUXVALVE has a full range response, flat within 2 db, from 10 to 30,000 cycles. Hermetically sealed, the FLUXVALVE is impervious to any and all of the elements . . . heat, cold, humidity, etc. Moreover, the FLUXVALVE has the exclusive PICKERING *hum rejection* circuit built-in, assuring hum-free performance.

PICKERING'S "T-GUARD," the newest and safest idea in a stylus assembly, is incorporated in all FLUXVALVE models. Change of stylus is done quickly and easily with the comfortable grip of the "T" shaped assembly . . . *no precarious fingernail fumbling* . . . you are always sure the stylus is correctly seated. *The most flexible cartridge in the world,* the FLUXVALVE is the *only* cartridge with the *amazing* ½ mil stylus, and it can be used with *five* interchangeable styli to play any record, at any speed.

Only the FLUXVALVE has 100% IQF*, and it may interest you to know that because of its ability to make *precise* and *reproducible* record measurements, the FLUXVALVE is used for calibrating recording channels and record masters.

**BUILD UP THE QUALITY OF YOUR HI-FI SYSTEM WITH A PICKERING FLUXVALVE**

**FLUXVALVE TWIN SERIES 350**—A turnover cartridge providing a rapid change of stylus point radius. Available in 12 models featuring many combinations of styli, prices start at a modest $24.

**FLUXVALVE SINGLE SERIES 370**—A miniature high quality cartridge for use in any type of auto-changer or manual player arm. Available in 5 models, prices start at a low $17.85.

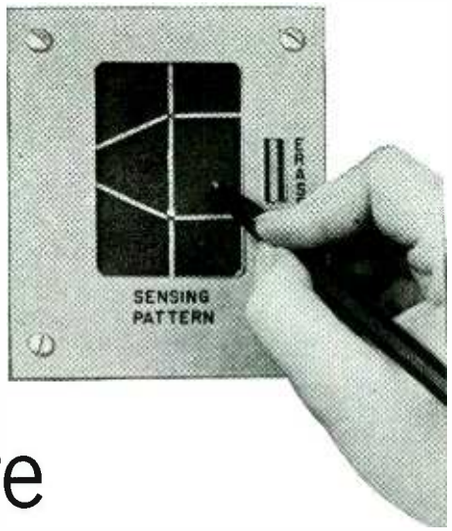
**Model 194D UNIPOISE Pickup Arm**—This new . . . lightweight . . . integrated arm and cartridge assembly containing the FLUXVALVE with exclusive "T-Guard" stylus—is only a fraction of the weight of conventional tone arms. High compliance and single friction-free pivot bearing assure distortionless tracking of microgroove and standard groove recordings. Available with the ½, 1 or 2.7 mil diamond stylus. Prices from $59.85.

*"For those who can hear the difference"* **FINE QUALITY HIGH FIDELITY PRODUCTS BY**

**PICKERING & COMPANY, INC., Plainview, N. Y.**

Enjoy the quality of a **FLUXVALVE** at your favorite Hi-Fi shop today . . . you can hear the difference.
For the dealer nearest you or for complete literature write to Dept. A-58

# Write a numeral here

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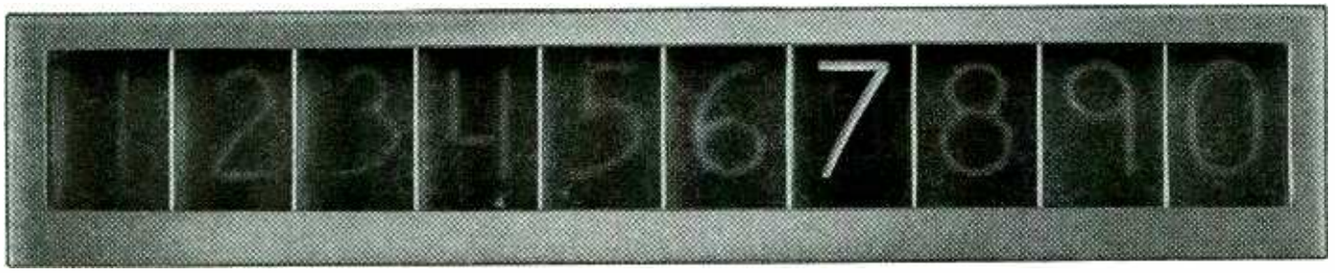
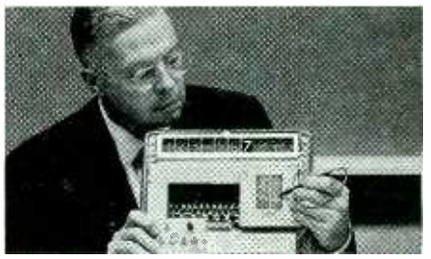



# on new Bell Labs machine

A new device invented at Bell Laboratories "reads" a numeral while it is being written and instantly converts it into distinctive electric signals. The signals may be employed to make a numeral light up in a display panel, as above, or they may be sent to a computer or to a magnetic "memory" for storage.

The writing is done with a metal stylus on a specially prepared surface. Two dots, one above the other, are used as reference points. Seven sensitized lines extend radially from the dots. Transistorized logic circuits recognize numerals according to which lines are crossed.

The concept of a number-reader has interesting possibilities as a new means of communication from humans to machines. For example, in an adjunct to a telephone, it might provide inexpensive means of converting handwritten data into signals which machines can read. The signals could be transmitted through the regular telephone network to a teletypewriter or computer at a distant point. In this way, a salesman might quickly and easily furnish sales data to headquarters, or a merchant might order goods from a warehouse.



Tom Dimond, a B.S. in E.E. from the University of Iowa, demonstrates an experimental model of his number-reading invention. A similar device can also be made to read alphabetical characters. Small size and low power requirements result from transistor circuitry.

Modern communication involves many more fields of inquiry than the transmission and reception of sound. The experimental number-reader is but one example of Bell Telephone Laboratories work to improve communications service.

**BELL TELEPHONE LABORATORIES**
World Center of Communications Research and Development

# The Use of Twin-T Networks

**The author presents a thorough analysis of Twin-T circuits and explains how to choose the elements to secure a desired result in various applications.**

NORMAN H. CROWHURST*

IN RECENT YEARS the twin-T type of circuit, which has the useful property of providing a perfect single-frequency rejection characteristic, has become increasingly popular in different types of audio circuits. It can be adapted in a variety of ways and the approach to its use may be theoretical or experimental—most often the latter. As some discussions on the subject of its use seem to betray lack of understanding on the manner in which this circuit achieves its objective, the author set to work to analyze critically the various properties of this circuit, which analysis follows.

The most frequently used circuit is the twin-T arrangement shown at *Fig.* 1. But, for some purposes in analysis, it may be helpful to look at the dual equivalent shown at *Fig.* 2, which has the same properties, but is essentially a four terminal network. This has the practical disadvantage that, if one side of the input is grounded, then both sides of the output must be isolated from ground. For this reason the circuit at *Fig.* 2 is rarely used, while the circuit of *Fig.* 1 will be found in quite a variety of places.

The schematics for both these circuits give the values in resistance or reactance at the critical frequency, which may or may not be a null point, according to the precise relationship between the values chosen. In the case of *Fig.* 1, each T of the twin will be seen to consist of one each of the values *a*, *b*, and *c*. The difference is that, in the upper group, *c* is a reactance while *a* and *b* are resistances, while in the lower group, *a* and *b* are reactances while *c* is a resistance.

Symmetry is assumed in the sense

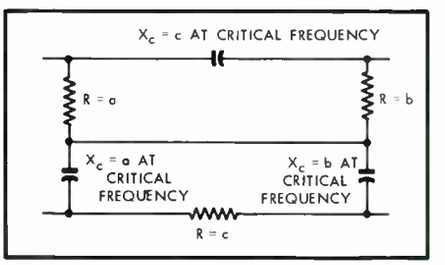



Fig. 2. This twin-π network is the dual of Fig. 1. The values shown here are used through this article with reference to this circuit.

that, at the critical frequency, the reactance with is value is marked as *a* has the same value as the resistance so designated. Beyond this basic symmetry, the values *a*, *b* and *c* can take up any combination desired and part of the purpose of this article is to investigate the effect of different combinations in these values.

The classic twin-T circuit uses values *a* and *b* which are exactly twice that of *c* in a configuration of *Fig.* 1. In the dual equivalent of *Fig.* 2, and still referring in resistance or reactance values, *a* and *b* would each be half that of *c*.

To help visualize what happens in this circuit the vector diagram of (A) in *Fig.* 3, which is based on the classical relationship of values, shows the condition on tune. Vector OA is the input voltage. On the left side vectors OB and BA represent the division of voltage between resistor *c* and capacitor *a* in the lower T network, assuming that capacitor *b* is not connected to this junction for the moment.

Similarly the vectors OC and CA represent the division of voltage between capacitor *c* and resistor *a* in the upper T network, with resistor *b* regarded as disconnected.

When the series combination of resistor and capacitor *b* is connected between these tapping points across the output, this has the effect of loading the voltage at the two T junctions; from B to D and C to E. Then the resistor and capacitor elements *b* produce the voltage-divider action represented by DO and OE. Thus it is seen that the output junction point corresponds with the zero or origin.

(B) in *Fig.* 3 shows an alternative way of viewing this twin-T, that may be helpful in consolidating the visualization of its behavior. The approach we just used considered first the condition with components *b* removed, and then added them, to find the over-all performance. Alternatively we could assume the output at the critical frequency *is* zero and start on the somewhat hypothetical basis of removing components *c* from the network. This is hypothetical, of course, because the output's being zero is actually dependent on the presence of components *c*.

### Voltage-Divider Effect

As the output point is at zero or ground potential, both the resistance elements *a* and *b* and the capacitance elements *a* and *b* act as voltage dividers and, without considering the effect of connecting components *c* at the tapping point, we could regard these tapping points as being sources whose voltage is the input voltage divided by the ratio between *a* and *b* in each instance, and whose effective source impedance is the parallel combination value of *a* and *b*. In the case of the resistances *a* and *b*

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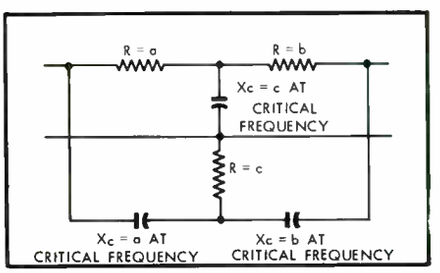


Fig. 1. Basic circuit of twin-T network, with value references used throughout this article.

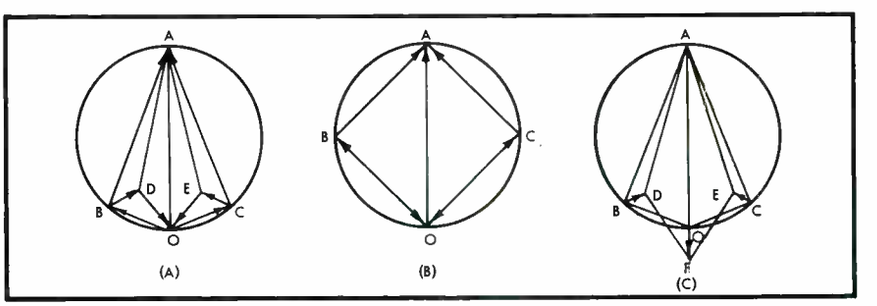


Fig. 3. Vector diagrams relating to operation of the twin-T circuit (Fig. 1) at critical frequency (see text).

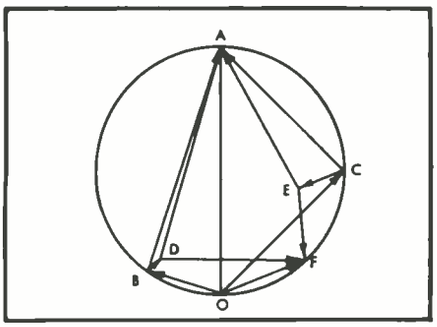


Fig. 4. Vector diagram for twin-T circuit at an off-null frequency.

this will be an effective resistance value, while in the case of capacitances *a* and *b* the effective reactance is the same value. This is based on Thevenin's theorem.

This gives rise to the vector diagram of (B) in *Fig.* 3. There the vector OA is this purely hypothetical open circuit voltage at the T junction points before the elements *c* are connected rather than the input voltage (with which it will be in phase, however).

When the elements *c* are "connected," the voltage at one T junction moves from A to B and at the other T junction from A to C, due to the loading in each case: of the resistance with a correspondingly equal reactance, and the reactance with a correspondingly equal resistance. Then the voltage division between the output elements *b* which are equal but at 90 deg. will bring the output voltage to the fourth corner of the square, at the zero point O once again.

From this approach, it is comparatively easy to see why any combination of values in this circuit such that *c* is equal to the effective parallel value of *a* and *b* will produce the necessary null at the output. These are the only values that result in the perfect square.

The disadvantage of the vector diagram of (B) in *Fig.* 3 is that it only shows the relationship at the null or critical point, having been based on the assumption that the output voltage is zero. On the other hand, the complete vector diagram of (A) in *Fig.* 3 can be redrawn for positions off tune, a sample of which is shown at *Fig.* 4.

This again is for the classical twin-T, where at null values *a* and *b* are each twice that of *c*. The particular frequency shown is where the reactive elements are just twice the value at the null point. The significance of the lettered vectors in the diagram is exactly the same as at (A) in *Fig.* 3 and the output voltage, instead of being zero, is now the final vector OF.

From the vector diagram of (B) in *Fig.* 3 we would probably jump to the conclusion that the locus of the output voltage vector is a circle. It so happens it is, but this is not so obvious from the diagrams of (A) in *Fig.* 3 and *Fig.* 4. The circle which forms this locus has been drawn in each case as an aid to visualizing the variation of the diagram, but it is not obvious from the configuration of the figure that point F has to fall *on* this circle. This fact can be rigorously deduced from the derivation of Eq. (*23*) in the appendix.

Operation of the circuit dual of *Fig.* 2 can be visualized by the vector diagram of *Figs.* 5 and 6. The input voltage vector as before is OA. At the null point, if we consider only elements *a* as being connected first, vectors OB and BA represent the voltage division.

When elements *b* and *c* are connected in shunt with element *a*, this loads down the circuit at this point, so the voltage across the input pair (values *a*), becomes OC and CA (instead of OB and BA). Now the voltage division across these input elements *a* by elements *b* and *c* is such that in each case the voltage across element *b* is represented by vector CD and the voltages across

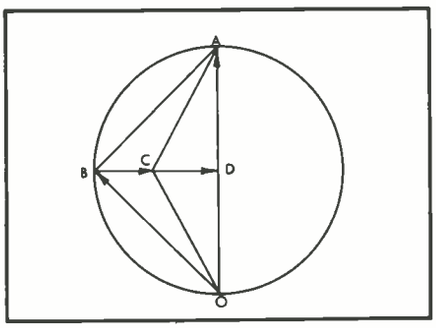


Fig. 5. Vector diagram for twin-π circuit at null frequency.

element *c* are represented by vectors AD and OD respectively. Thus the potential at both output terminals is represented by point D and, as these coincide, there is no difference of potential and hence zero output.

*Figure* 6 shows how this condition deviates off the null frequency. As before, the vectors OB and BA are the voltages across elements *a* when elements *b* and *c* are not connected. Connection of the latter elements results in the voltage across elements *a* and represented by vectors OC and CA as before, but in the different position indicated at *Fig.* 6. In this instance, vector OB represents the voltage across reactance *a* while BA represents the voltage across resistance *a*. Reactance *a* at this point has become half its null value.

Loading with the remaining values *b* and *c* brings this junction to point C. The division across the resistance element, by resistance *b* and reactance *c* is represented by vectors CE and EA respectively, while the division across reactance *a*, by reactance *b* and resistance *c* is represented by vectors CD and DO respectively. This leaves the output voltage as DE.

This obviously cannot be plotted as a locus as in the case of *Figs.* 3 and 4, but it can fairly easily be visualized from these diagrams. From the zero point D in *Fig.* 5 the deviation starts to produce a very short horizontal line, corresponding to DE near the center of the circle. This gradually swings around to the position shown at *Fig.* 6 and by further deviation eventually coincides with the input vector OA. This is equally true whether we move the frequency down to zero or up to infinity.

### Effect of Different Values

Having gone over the vector arrangement to visualize circuit operation we can proceed to see what effect use of different values will have. This is given mathematically by the expressions Eqs. (*1*) through (*4*) in the appendix for two cases in each circuit configuration.

One case is the hypothetical condition when an input voltage is applied at the left side of the circuit from a zero-impedance source, while the output is fed to an infinite resistance load.

The other case for each circuit is when an infinite-impedance current source is applied at the input and the output is fed into a short circuit.

The condition for null given by Eqs. (*5*) and (*6*) in the appendix is independent of the source or load resistance used, provided the values are correct for the null. However, if the critical frequency does not produce a null, the output voltage or current actually achieved is given by Eqs. (*1*) through (*4*) for the different circuit configurations respectively.

Substitution of a variety of values for reactances and resistances *a*, *b*, and *c* into the formula will show that the residual output at the critical frequency, where this does not produce a null, can either be in phase with the input, represented by a positive solution, or out of phase, represented by a negative solution.

The possibility of phase reversal can be explained in terms of the vector diagrams by assuming that the first pair of vectors produces a division lower down on the circle. Then the second pair of vectors represented by the division in the output network (values *b*) produces a reduced loading on the circuit, with the

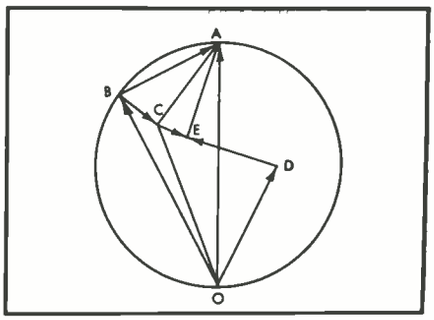


Fig. 6. Vector diagram for twin-π circuit at an off-null frequency.

result that the output vector at the critical point is in the opposite direction from OA. This possibility is represented at (C) in *Fig.* 3.

The case for values *a* and *b* being identical is represented by Eqs. (*7*) and (*8*) in the appendix for the circuit configurations of *Figs.* 1 and 2 respectively. The significance of these expressions is interpreted by *Fig.* 7 which shows how the value of output voltage or current varies with the ratio of *a/c*, or *c/a*, according to whether we use *Fig.* 1 or *Fig.* 2 and assuming that components *b* are identical with *a*.

Where *a* and *b* are both exactly twice the value of *c* in *Fig.* 1 a null occurs, and where *a* and *b* are both exactly half the value of *c* in *Fig.* 2 also a null occurs. But for other values a null does not occur.

In the case of *Fig.* 1 with *a* and *b* being less than twice, or in *Fig.* 2 more than half the value of *c*, there is a residual output in phase with the input voltage the relationship of which is given in *Fig.* 7 in db.

For values of *a/c* in *Fig.* 1, or *c/a* in *Fig.* 2 greater than 2 the output residual is out of phase with the input and the attenuation between input and output is also given for these values in *Fig.* 7. Increasing this ratio results in progressively greater residual out-of-phase output, up to a certain point. Beyond this the residual falls again, or the attenuation is greater.

### Maximum Out-of-Phase Output

If the maximum possible out-of-phase output is required for any particular reason, this condition is achieved when the ratio, *a/c* or *c/a* as the case may be, is given by Eqs. (*9*) or (*10*) in the appendix. For approximate purposes this is achieved by using values in a ratio of 5 to 1. As this is in the part of the curve where change in attenuation with the value of ratio variation is comparatively small, this makes a convenient approximation so that standard values can be used. If preferred value components are to be used in a fixed circuit, the useful relationship of 4.7 to 1 also produces a close approximation and results in a point on the characteristic where 5- or 10-per cent tolerance will not seriously invalidate the result.

In each case the attenuation theoretically is slightly more than 20 db. Slight deviation may result in an actual attenuation rather greater still. The value represented by the ratio of Eq. (*11*) is a maximum, using ideal termination, so termining impedances may modify this result as detailed later.

An ever bigger reversed-phase output can be obtained by using different values for *a* and *b*. In the circuit of *Fig.* 1, progressively higher values of *b*, using a constant-voltage input source and an open-circuit output, make possible progressively greater phase-reversed output. Using constant-current input and short-circuit output with the twin-T arrangement, progressively higher values of components *a* will achieve the same result.

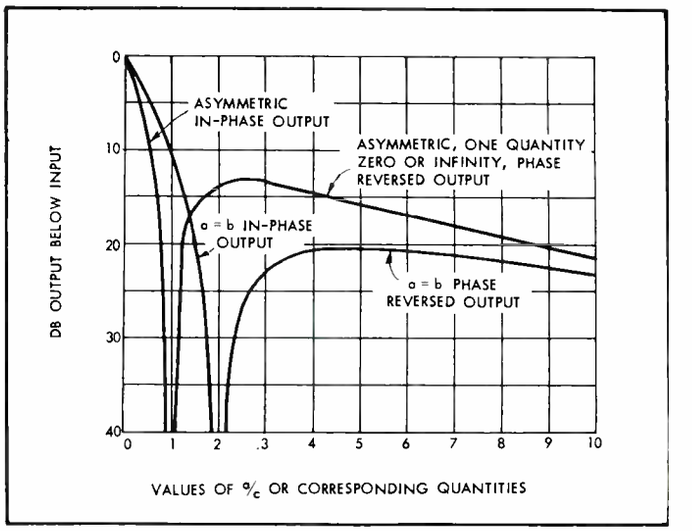


Fig. 7. Curves showing variation in output at the critical frequency, with variation of quantities involved, for two conditions: (i) when **a = b**; (ii) when one of these quantities is zero or infinity (see text).

In the circuit of *Fig.* 2 progressively smaller values of *a*, working with constant-voltage input and open-circuit output, or smaller values of *b* for constant-current input and short-circuit output, will achieve the same general trend.

For any chosen value relationship of the grouping just discussed, there is an optimum choice for the remaining value to get the maximum phase reversal. To avoid going through the whole sequence of conditions again, we will discuss just the case of constant-voltage input with open-circuit output in the configuration of *Fig.* 1. The other conditions are represented in the appendix to correspond.

In this case progressively higher values of *b* result in greater possible maximum phase reversal. But choosing a specific value of *b* relative to *c*, the maximum phase reversal is given by choosing a value of *a/c* in the ratio of Eq. (*12*). Substituting these values in Eq. (*1*) will give the appropriate value of residual voltage for this particular combination, and which is a maximum-phase-reversed voltage for the chosen relationship between *b* and *c*.

These conditions for the various configurations are represented graphically in *Fig.* 8. This does not show the possibilities up to infinite or zero value of the controlling component (in the common case, *b*) which is the limit for this particular element. These values, of course, do not have any practical significance, but their use will give an ultimate possibility and this produces an optimum relationship for the remaining value given by Eqs. (*20*) or (*21*).

This brings up the available reversed

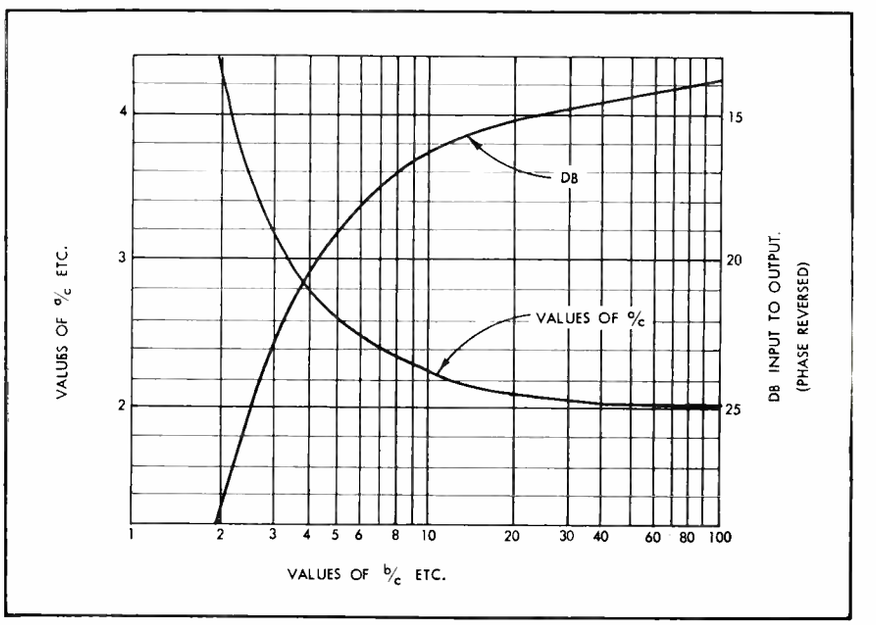


Fig. 8. Variation in phase-reversed output when different, but optimized, values of **a** and **b** are used.

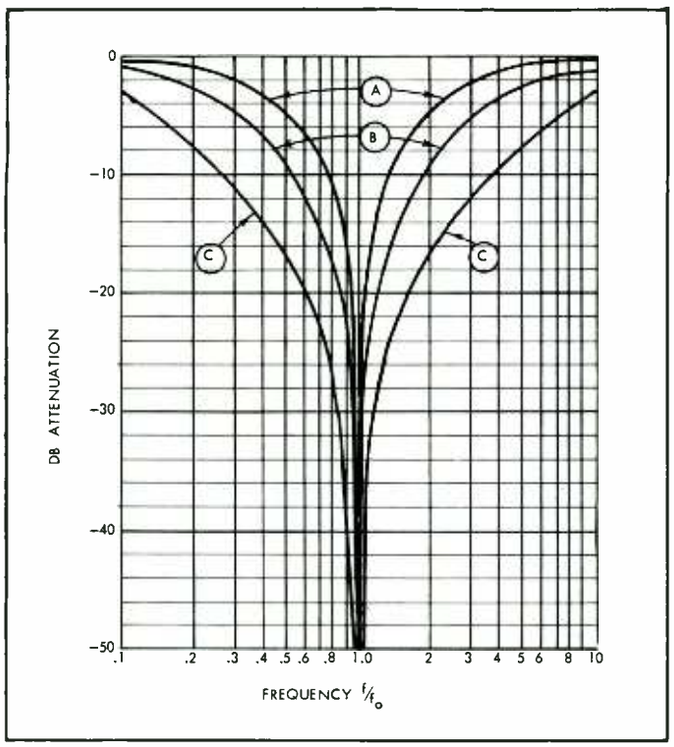


Fig. 9. Variation in amplitude response for networks producing a null (see text).

phase output to a little less than 14 db down on the input. In practice 14 db is about the working limit. Suitable value combinations can be worked out with the assistance of the graphs given.

For example, using $b/c$ of 6, $a/c$ should be 2.5, when the phase-reversed output will be about 18 db below input.

Changing relative values of $a$ and $b$ compared to $c$ not only affects the residual output in its phase relationship and magnitude, or whether a null is achieved, but it also affects the sharpness of the response on the side. This information is summarized in Eqs. (*23*) through (*25*) of the appendix and *Figs.* 9 and 10 show possible variations for response curves in magnitude and phase with practical values.

Curves (A) are for a hypothetical condition, using, in the circuit of *Fig.* 1, with constant-voltage input and open-circuit output, $a/c = 1 \times b/c = \infty$. This is a hypothetical maximum sharpness. Curves (B) are for the classical case $a = b = 2c$ for *Fig.* 1 or $2a = 2b = c$ for *Fig.* 2. Curves (C) represent a broader case, in particular for $a/c = 5$, $b/c = 1.25$ (or equivalent for other configurations). As these curves are all for null operation, there is a unique relationship between $a$, $b$ and $c$ such that, for *Fig.* 1, the parallel combination of $a$ and $b$ is always equal to $c$.

### Curve Plotting

To facilitate plotting other curves with practical values in circuits that produce a definite null, the abac of *Fig.* 11 has been prepared to enable complete calculation of an entire frequency response to be made for any combination of $a$, $b$, and $c$. As shown, values of $a/c$ and $b/c$ are for constant-voltage input open-circuit output. For configuration of *Fig.* 2 use left reference line by finding corresponding reading on adjacent line.

For example, if the values of $b/c$ and $a/c$ for the circuit of *Fig.* 2 are, respectively 0.4 and 0.6, the corresponding values of $a/c$ and $b/c$ on the left reference line (representing equivalent *Fig.* 1) are 2.5 and 1.67 respectively.

If either circuit is to be operated constant-current input and short-circuited output, the use of $a/c$ and $b/c$ scales should just be interchanged, when the same chart may be used.

All of these results are based on the hypothesis of either constant-voltage input and open-circuit output or alternatively, with the noted change in value relationship, for constant-current input with short-circuit output. Use of finite terminating impedances will modify the response to an extent impossible to predict in detail by means of charts of this nature. However the general effect will be discussed later on in this article.

An important point to note here, however, is the the terminating impedances, whether purely resistive or also containing reactances, do not affect the null condition or frequency of the twin-T or twin-$\pi$ network. The condition for null for *Fig.* 1 is given by Eq. (*5*) which indicates that the parallel combination of $a$ and $b$ must be equal to $c$ correspondingly for the twin-$\pi$ network of *Fig.* 2, the series combination of $a$ and $b$ should be equal to $c$. These relationships are true, whether the input is constant-voltage and the output open-circuit, the input constant-current and the output short-circuit, or whether any finite values of terminating impedance are used. What the use of different values effects is the shape of the characteristic away from null.

We will assume first that the source impedance is a finite resistance. By working with the input impedance given in Eqs. (*26*) or (*27*), the insertion loss and phase-transfer angle at null frequency can be obtained. This will not be

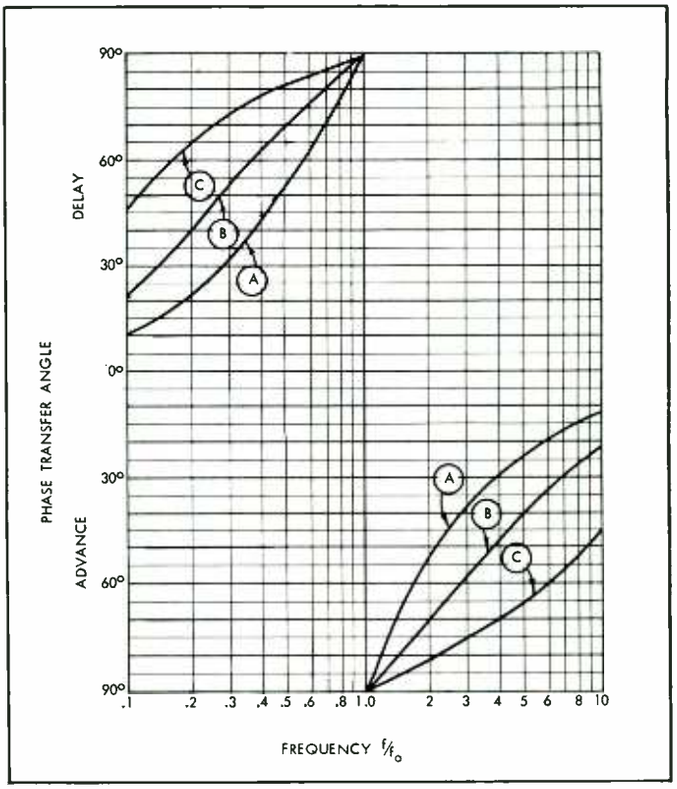


Fig. 10. Variation in phase response for networks producing a null.

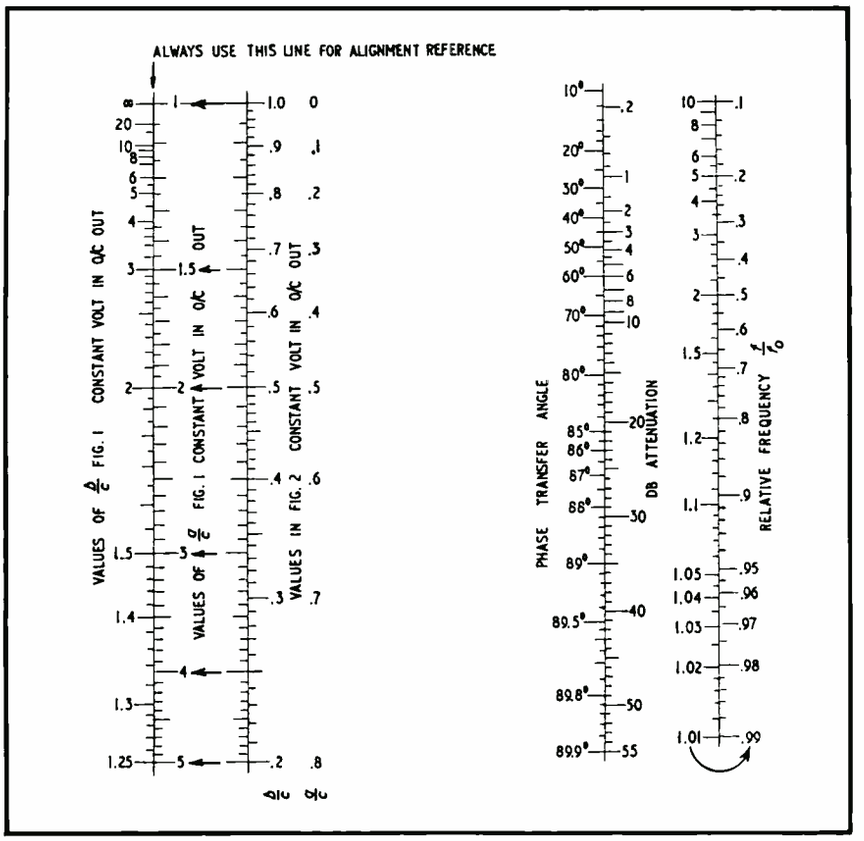


Fig. 11. Nomogram for calculating amplitude and phase response of any network producing a null.

identical at frequencies away from null but will be quite close to it for a small region, because the magnitude of input impedance does not change very rapidly while the phase of the input impedance is almost constant in the region of null.

The maximum possible phase transfer angle that can occur is 45 deg. Actually it can never be this much in practice because it would require an infinite-impedance input with open-circuit output. In other words we would be considering a current input with voltage output relationship or some such arrangement. In all practical circuits the phase shift at the input will be something less than 45 deg.

If the source impedance is resistive the transfer vector diagram is illustrated at (A) in *Fig.* 12. The effect of such an addition to the transfer characteristic on the locus of the output voltage is illustrated at (B) in *Fig.* 12.

The effect of loading an arrangement intended for open circuit operation with a finite value of resistance is precisely similar, but of opposite phase. The shift is in the opposite direction, as at (C) in *Fig.* 12.

### Effect of Source and Load Values

If finite values are to be used the ideal combination would be such that the operating impedance of the twin-T network is a geometric mean between the source and load resistances. If, for example, the impedance as given by Eqs. (*26*) and (*28*) both figure out to 1000 ohms, then operation between a source resistance of 20 ohms and a load resistance of 50,000 ohms would result in zero ultimate phase displacement of the vector locus circle *in the vicinity of its null point.*

The effect on transfer at frequencies widely divergent from the null point can be computed by considering the additional effect of these resistances to the relevant section of T operating in that frequency range.

Below null frequency the section of T comprising resistance for *a* and *b* and capacitance for *c* is the operative section. Above null frequency the T consisting of capacitances for *a* and *b* and resistance for *c* is the operative section.

In general, use of widely divergent values of source and load resistance, of the general order of ratio just discussed, will insure that the calculated results are quite closely approximated.

We shall further briefly discuss four possible ways of using this circuit. The first is as a simple rejector circuit. For this purpose any combination of values that produces a null can be used and phase shift is usually unimportant. The only thing that can invalidate the calculated response is the insertion loss produced by the T elements themselves in combination with the source or load resistances actually used. The null frequency and the response *in the immediate vicinity of null* is not materially affected by either the magnitude or phase relationship with source or load impedance.

The remaining three applications employ feedback circuits. In the first case the twin-T may be applied in the feedback of a straight amplifier, to produce what behaves as a single frequency tuned amplifier. The twin-T provides 100 per cent feedback over the majority of the frequency range but rejects completely the frequency to which it nulls. This means the amplifier has zero gain over the majority of the range but at the null frequency it has the full gain of which the amplifier is capable.

By designing an amplifier, for example, with 60 db gain, this can be sharply tuned to the null point of the twin-T network. It is in this kind of application where magnitude error and phase relationships can become important. The expressions from (*31*) to the end of the appendix indicate the relative importance of magnitude error.

In the case where *a* and *b* are both twice the value of *c*, a 1-per-cent error in the value of *a* will only produce a ⅛ of 1 per cent residual output voltage. This is if both values of *a* are off by 1 per cent in the same direction. If one only is off by this much a readjustment of the circuit would result in an error of 1/16 of 1 per cent. Similarly with

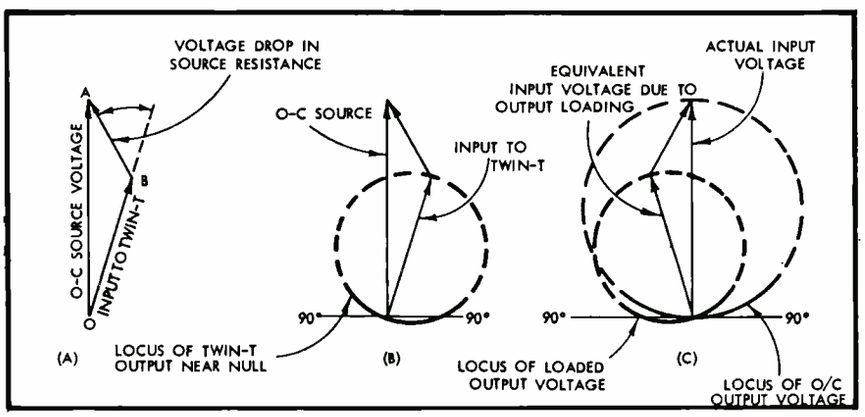


Fig. 12. Vector diagrams showing effect of terminating impedances (see text).

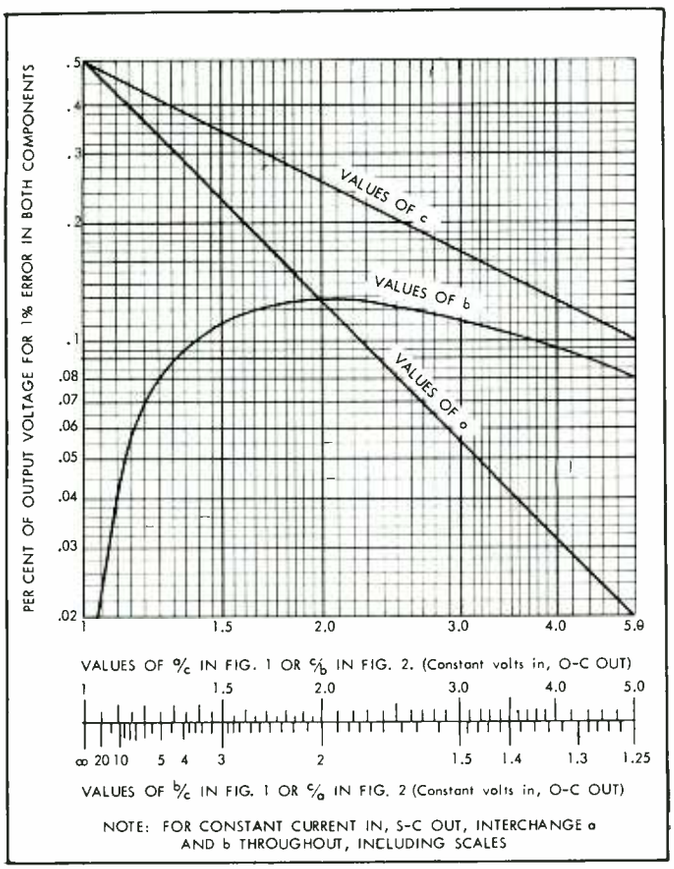


Fig. 13. Graph showing effect of value relationship on the importance of value tolerances.

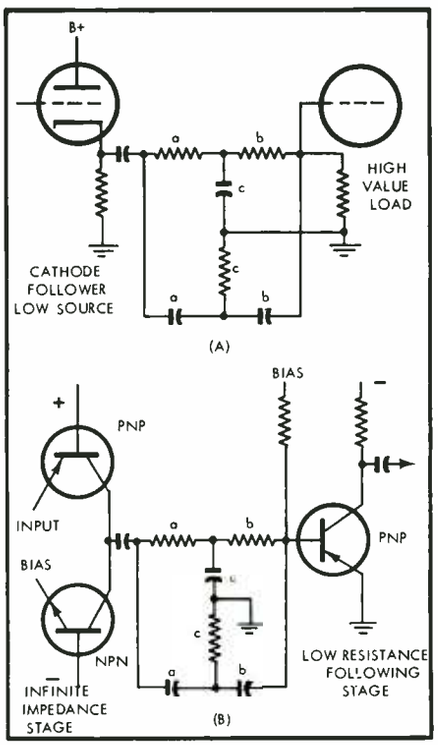


Fig. 14. Showing (A) the ideal arrangement for terminating a twin-T in tube circuits, and (B) in transistor circuits.

value $b$ this will also be $\frac{1}{8}$ of 1 per cent, while value $c$ will give a deviation of 0.25 per cent for 1 per cent error in both values of $c$. Either one correspondingly will result in an error of $\frac{1}{8}$ of the error in the individual components.

This applies to the classic values of 2, 2, and 1 for $a$, $b$ and $c$. For other values Eqs. (*31*), (*33*), and (*35*) will evaluate the relative error produced. It will be seen in this circuit configuration that using constant-voltage input and open-circuit output the error voltage is principally dependent upon the ratio of value $a$ to other components.

Use of a larger value for $a$ reduces the relative error dependency. In the case of $a$ itself the reduction is by the square of its relative value. In the case of $b$ large values of $a$ reduce dependency on $b$ approximately in direct proportion to $a$. In the case of $c$, similarly. These relations are shown in *Fig.* 13.

This means in effect that it may be profitable to utilize an amplifier with considerably less amplification and employ the phase-reversal condition to produce controlled boost in gain at the critical frequency. This controlled boost becomes very little dependent on small tolerance variation in the T network component, if $b$ is made large relative to $c$ and $a$ uses the optimum value given by *Fig.* 8. This graph also indicates the db loss resulting in the twin-T network and from this a suitable positive feedback combination can be calculated.

### Use of Transistorized Circuits

It should be noted, as shown in *Fig.* 14, that these circuits, with a corresponding adjustment in configuration, represented by changing from the sequence of expressions based on Eq. (*1*) of the appendix to those based on Eq. (*2*), can be operated from a virtual constant-current source into a virtual short circuit. This is convenient for transistorized amplifiers.

A grounded-base output using some form of complementary-symmetry circuit can produce almost-infinite-impedance source to feed the twin-T. Naturally

(*Continued on page 56*)

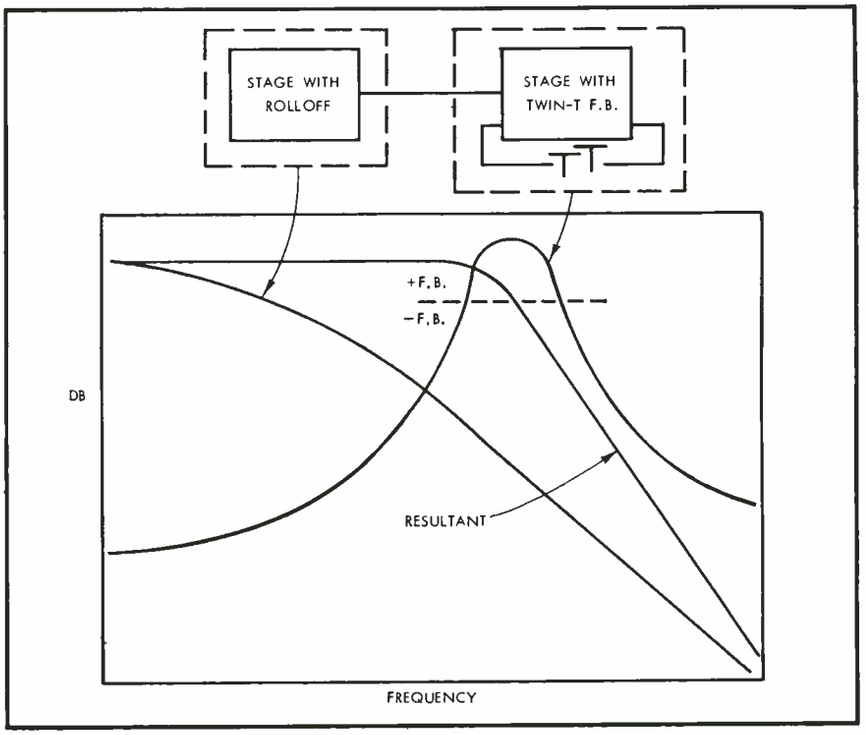


Fig. 15. How a modified twin-T can be used to produce accentuated sharpness in a rolloff characteristic.


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# The Compatible Stereophonic Record*

PETER C. GOLDMARK,[1] BENJAMIN B. BAUER,[2] and WILLIAM S. BACHMAN[3]

**Stereo records can be cut so as to be playable with conventional monaural pickups and with the same playing time as present LP records. As shown by the authors, this results in some improvement in wear and in a reduction of distortion.**

Our research on the stereophonic record was a natural extension of the development of the LP record and the 16⅔ rpm 7″ extra-fine groove records. The objective was to provide stereophonic sound equal to that of the best stereophonic tapes. The stereophonic LP record had to be compatible so that it could be played on any existing monaural phonograph as satisfactorily as today's standard LP record. This meant having the same sound level and quality in terms of frequency response, distortion and signal-to-noise ratio. The playing time would have to be the same too. It was felt that only in this way could a smooth transition take place between the current LP record and the new stereophonic LP record.

In order to understand more fully the theory underlying the development of the new record it is necessary to discuss briefly the problems of compatibility. This in turn requires an understanding of certain properties of monaural records and pickups.

### Compatibility Problems

In a laterally modulated record the groove and stylus motions are mainly in the plane of the record. However there is also a stylus motion normal to the record surface owing to what is known as the "pinch effect." The origin of the pinch effect is illustrated in *Fig.* 1. The groove width and depth remain constant when measured along the radius of the disc, however at the points where modulation occurs the cross-section of the groove is narrowed down. Thus at $P'$ the radial width $W$ is the same as at the point $P$, but the cross-section width $W'$ at $P'$ is diminished or pinched by the factor

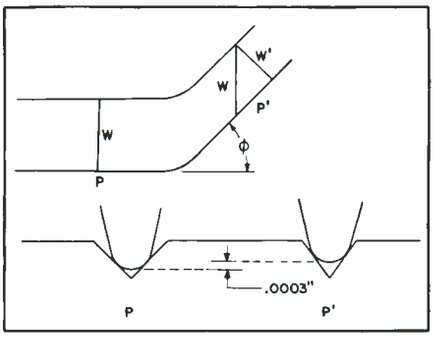


Fig. 1. Deviation of a lateral groove from its normal spiral path results in an effective narrowing of the groove as seen by a spherical stylus, resulting in "pinch effect."

$\cos \phi$, where $\phi$ is the modulation angle. Due to the narrowing of the groove angle, the profiles of the groove and stylus require the stylus to rise at $P'$ to accommodate this pinching of the groove. The amount of the resulting vertical motion can be 0.3-mil or more depending upon the recording level and groove velocity (or modulation angle) and stylus radius. If the stylus were unduly stiff in the vertical mode and thus not adapted to follow this up-and-down motion, gouging of the groove would occur resulting in distorted and noisy reproduction. Another annoying effect caused by undue vertical stylus stiffness is objectionable chatter radiated from the record and the tone arm. Designers of pickups have for many years recognized the importance of vertical freedom of motion by providing lateral pickups with an adequate amount of vertical compliance which in most instances is about one- to two-thirds of the lateral compliance. Thus most lateral pickups already have a built-in-capability of handling at least 0.3-mil vertical displacement, which then would be available to carry the added information required by stereophony.

The elasticity of the record material is another factor, which, though smaller, is nevertheless important. With a 6-gram pickup the 1-mil stylus penetrates about 2 microns into the groove wall of a Vinylite record and this corresponds to about a 0.1-mil motion in the vertical direction. Therefore the total vertical displacement which any record can impose on practically all monaural pickups, without causing mistracking, is roughly 0.4-mil, or +0.2-mil from the position of equilibrium.

Another aspect of compatibility is concerned with the manner in which stereophonic information is recorded on the disc. Since stereophony involves at least two channels, the groove must be modulated in two orthogonal directions so that one channel will not interfere with the other. Some systems of disc stereophony carry one channel as horizontal modulation and the other as vertical modulation. This resulted in an incompatible record because monaural pickups would only reproduce the information from the one channel which is recorded laterally.

In the new stereophonic record to be described, the left and right channels are converted into a sum signal $S = L + R$ and into a difference signal $D = L - R$. The sum signal is recorded as lateral modulation and the difference signal as vertical modulation. The sum signal contains all the significant information which is presently contained on the standard LP record. The difference signal however carries the spatial information essential for stereophony.

To clarify the role of this difference signal in stereophonic reproduction let us take the case of two identical channels being reproduced over two separate loudspeakers. The resulting sound will appear to emerge from a single source located midway between the two loudspeakers. This in effect would be monaural sound. Only when the left and the right channels differ from each other are spatial effects produced. Therefore it is the *difference* between the left and right channels when combined properly with the sum signal which produces stereophony.

A record with the $L + R$ channel re-

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* Text of a paper delivered at the I. R. E. Convention on March 25, 1958, in the Sert Room of the Waldorf Astoria Hotel.

1 *President and Director of Research, CBS Laboratories.*

2 *Head of Audio and Acoustics Section, CBS Laboratories.*

3 *Director of Engineering and Research, Columbia Records.*


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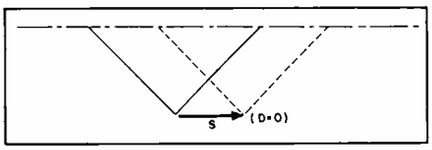


Fig. 2. When the "sum" signal is recorded, the resulting modulation is lateral in stereophonic recording.

corded as lateral modulation and the $L-R$ channel as vertical modulation will be reproduced on a monaural phonograph as a conventional LP record provided however that the previously mentioned restrictions as to vertical modulation limits are observed. The same record will play as a stereophonic record when reproduced with stereophonic reproducers.

### Stereophonic Record

Let us first examine the type of modulation obtained when the sum signal only is recorded. The profile of such a groove is shown in *Fig.* 2 where the initial position of the groove is indicated in solid line (the bottom radius being omitted for simplicity). When the sum signal $S$ is applied to the groove as lateral modulation the groove moves to the new position shown in dashed lines. In this particular case the difference information is not recorded ($D=0$), so that the apex of the groove remains in a plane parallel to the surface of the

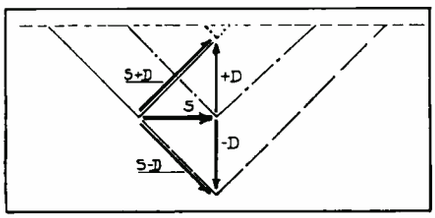


Fig. 3. When the "difference" signal equals the "sum" signal, the resulting modulation is vertical.

record. This, of course, leads to a standard LP record which will contain all the information of both channels except for stereophony. Referring next to *Fig.* 3, here in addition to the sum or $S$ signal, the difference signal has also been recorded and the effect of this $D$ signal on compatibility will now be examined.

Let us assume that an extreme stereophonic signal is recorded with the information arriving over the left channel only, the signal from the right channel being equal to zero. In this case the sum signal will be : $S=L$, and the difference signal: $D=L$; thus $S$ and $D$ are numerically equal as represented by the vectors $S$ and $+D$ in *Fig.* 3. The motion of the groove apex will follow the vector $S+D$ slanting at $+45$ deg. The profile of the displaced groove is shown by the small dotted triangle and it is seen that what remains of it could not guide a pickup stylus. Assuming now that the stereophonic signal is contained in the $R$ channel only, the $L$ channel being equal to zero, then $S=R$ and $D=-R$; therefore $D$ is again numerically equal to $S$, but directed downward. The motion of the groove apex is portrayed by the vector $S-D$ slanting downward at $-45$ deg., and the new profile of the groove is shown in dashed lines. Note that the space occupied by this new profile is substantially greater than the space occupied by the usual monaural groove. Therefore the playing time of

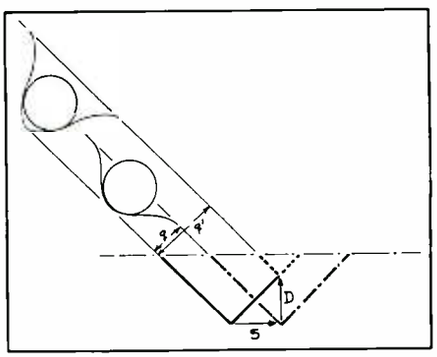


Fig. 4. When the "difference" signal is equal to the "sum" signal, the stylus may have difficulty in tracing the groove.

this record would be appreciably less than that of the LP record.

Additionally it should be noted that the system just described contains as much vertical as lateral modulation at all levels when $L$ or $R$ are zero. If it is attempted to inscribe on it as much lateral modulation as currently found on LP records, the corresponding vertical modulation will exceed the tracking capability of the current monaural pickups. It will be remembered that for compatibility the maximum vertical modulation should not exceed about $\pm 0.2$ mil, yet it is not uncommon to find LP lateral modulation amplitude peaks to reach values in excess of $\pm 1.0$ mil. Thus to achieve compatibility the record just described would have to be recorded at a level of about 14 db lower than the standard LP level, resulting in a corresponding decrease of signal-to-noise ratio.

There exists yet another reason why this record is incompatible. Referring to *Fig.* 4 the sum signal alone is represented by the arrow $S$ and the extreme positions of the groove wall modulated by $S$ correspond to the sidewall motion $q$ in the normal direction. If the signal is sinusoidal, then at high modulation velocities the 1-mil radius stylus may just be able to trace this modulation. If, however, a signal $D$ is added then the sidewall motion becomes $q'$ which could be as much as twice $q$. The 1-mil stylus would no longer be able to trace this modulation as is shown by the diagram at the upper left hand side, and therefore a considerable amount of distortion would be generated.

Because of the 45-deg. inclination of the $S+D$ and $S-D$ vectors with respect to the horizontal, the method just described is equivalent to the so-called 45/45 system. This latter poses a dilemma: either the over-all recording level of both lateral and vertical modulation has to be appreciably reduced to permit tracking with the existing monaural pickups or, if the level were maintained as in existing LP records, the majority of existing pickups would not track it. Additional serious problems would be the generation of distortion and the reduction of the program length. Therefore neither choice would yield a satisfactory compatible record.

### The New Compatible Record

It was the writers' objective during the many years of research on stereophonic records to develop a system which would be completely compatible with existing phonographs yet which would convey the required stereophonic impression to the listener. The new record system which meets these requirements is based on the following principles.

Since it was desired to produce a stereophonic record with the same sound level as the LP record and which can also be tracked with existing monaural pickups, the answer seemed to lie in a stereophonic record with full lateral

(*Continued on page 66*)

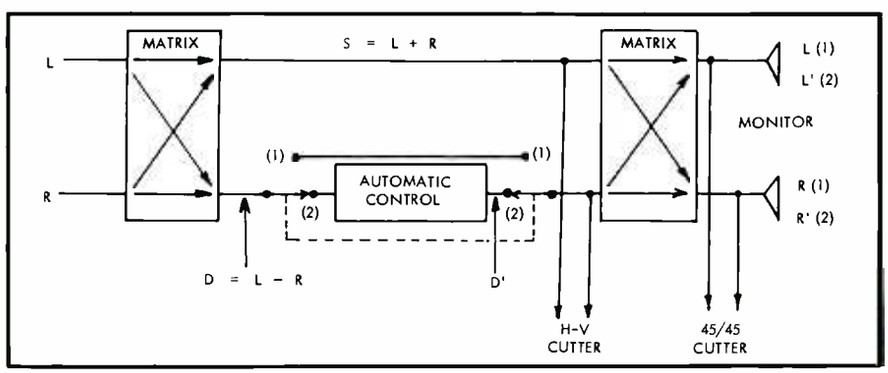


Fig. 5. Block schematic of compatible recording system. Left and right signals enter at the left, are matrixed before feeding a horizontal-vertical cutter. Matrixing again permits feeding a 45/45 cutter as well as left and right monitoring circuits.


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FISHER STEREO

# Simple Transistor Tester

RICHARD S. BURWEN*

**Transistor experimenters will find good use for this simple instrument which is easy to construct and calibrate, and which gives reliable information about both transistor types.**

TRANSISTORS are so easily damaged by momentary overloads that it is a necessity to be able to make a quick check on their operating characteristics. A tester designed for this purpose is shown in *Fig.* 1. It measures two of the most important transistor characteristics: d.c. current gain β and amplified leakage current $\beta I_{co}$.

While there are numerous parameters specified for a transistor, measurement of only β and $\beta I_{co}$ is sufficient for a great deal of transistor work. Precise measurement of all the characteristics involves many hundreds or even thousands of dollars worth of complex equipment which takes considerable time to operate.

In contrast with this complex equipment the tester shown in *Fig.* 1 uses only a d.c. milliameter, switch, resistors, and batteries. A complete test takes only a few seconds. It checks any low-power PNP or NPN transistor.

Such a tester is particularly useful to the circuit designer who finds that his new circuit amplifies nicely but burns out a transistor every time power is applied abruptly. Transistors are too easily damaged by a momentary current surge through a coupling or bypass capacitor —or by one slip of the test prod. The tester may be used in detecting transistors that have been damaged in this way. It is equally useful in servicing modern portable radios.

Simple as it is, the tester presents a good picture of a transistor's performance. The d.c. current gain β as measured is the ratio of d.c. collector current to d.c. base current when the transistor is connected as a grounded-emitter amplifier. Leakage current $\beta I_{co}$ is the collector-to-emitter current that flows when the base circuit is opened.

Note that β is the d.c. or large-signal current gain. This quantity differs only slightly from the dynamic or small signal β usually specified by transistor manufacturers and which requires much more elaborate equipment to measure accurately.

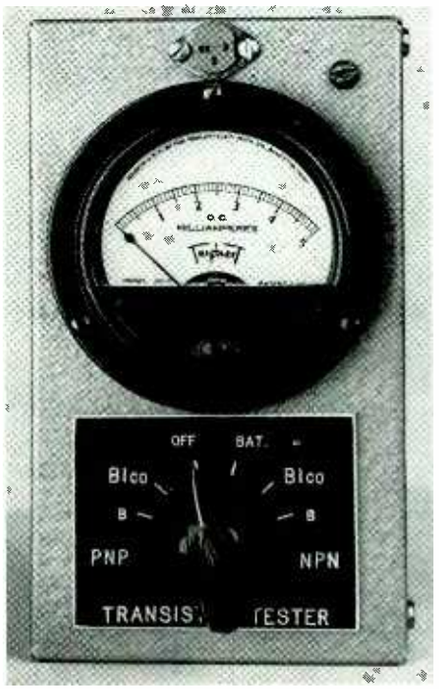



Fig. 1. External view of simple transistor tester.

The amplified leakage current $\beta I_{co}$ is a measure of how much the transistor's collector current will drift with temperature. This current results from the transistor's amplifying by a factor of β its own collector-base junction leakage current $I_{co}$ (measured with the emitter open).

In germanium transistor circuits with no temperature stabilization this leakage causes collector-current operating-point drift that may be tremendous. The leakage component of the collector current, $\beta I_{co}$ [more accurately $(1+\beta)I_{co}$] which may be a substantial fraction of the total, approximately doubles with every 9°-Centigrade rise in temperature. In circuits that incorporate d.c. emitter degeneration to reduce this drift the increase in collector current is reduced to somewhere between $I_{co}$ and $\beta I_{co}$.

### Use

To measure β and $\beta I_{co}$ the tester uses the simple reliable circuit shown in *Fig.* 3. A 6-position selector switch permits measurement of β and $\beta I_{co}$ for either PNP or NPN transistors. In addition it permits a check of its own battery's voltage and provides an "off" position. Neither the transistor nor the meter can be damaged by short circuits or overloads because the current is limited to 12 milliamperes by a resistor in series with the meter. Battery life should be at least 300 operating hours, which in

(*Continued on page 69*)

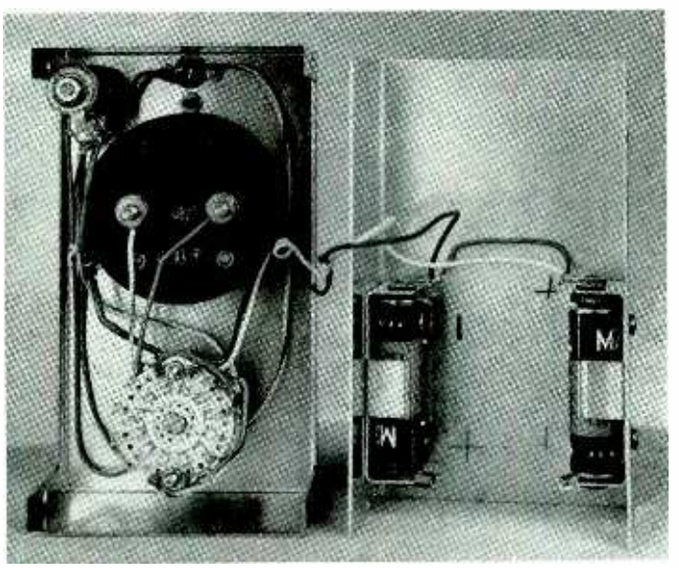
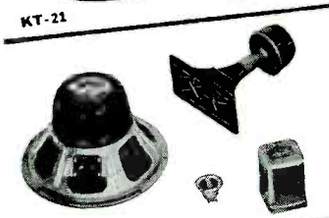


Fig. 2. Internal view of the tester.

* *Minneapolis-Honeywell, Boston, Division, 1400 Soldiers Field Road, Boston 35, Mass.*


KT-21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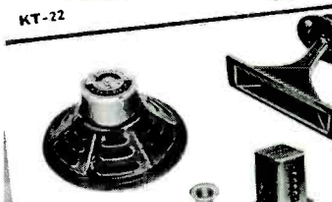
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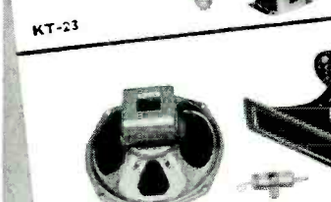
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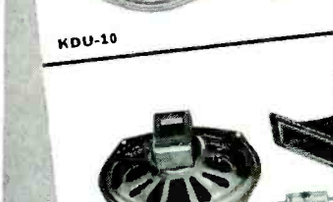
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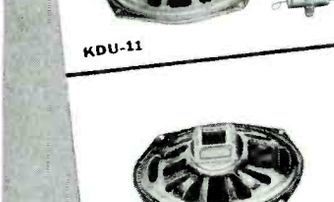
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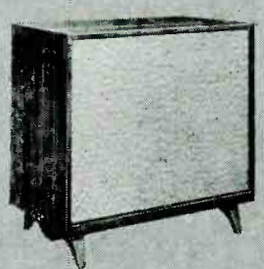

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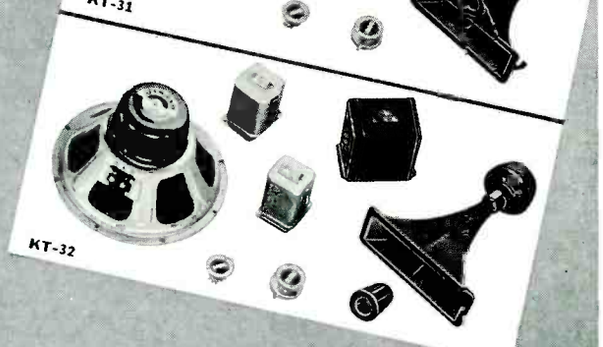
KT-31


KT-32

**36 PAGE JENSEN MANUAL 1060**

This is your guide to kit selection and enclosure construction. Complete data and instructions for all Jensen Speaker Kits from the famous 3-way "Imperial" system to the budget cost 2-way "Duette" system. Describes Bass-Ultraflex and Back-loading Folded Horn enclosures in complete detail with exploded views and simplified wiring instructions.

**JENSEN MANUAL 1060** — Net Each ..... **50c**


| Model | KT-31†† | KT-32†† | KT-21 | KT-22 | KT-23 | KDU-10 | KDU-11 | KDU-12 |
|---|---|---|---|---|---|---|---|---|
| Type | 3-way Imperial | 3-way Tri-plex | 2-way Concerto-15 | 2-way Concerto-12 | 2-way Contemporary | 2-way Duette or Contemporary | 2-way Automobile or Duette Table | |
| Frequency Range††† | 25-UHL | 30-UHL | 30-15,000 | 30-15,000 | 40-15,000 | 50-15,000 | 50-15,000 | 55-13,000 |
| Power Rating (Watts) | 35 | 35 | 30 | 25 | 20 | 20 | 20 | 15 |
| Impedance (Ohms) | 16 | 16 | 16 | 16 | 16 | 8 | 4 | 4 |
| Components: | | | | | | | | |
| L-F ("Woofer") | P15-LL* | P15-LL | P15-LL | F12-NL | P12-RL | P8-RL | P69-RL† | 69J10† |
| M-F (Mid-Range) | RP-201 | RP-201 | | | | | | |
| H-F ("Tweeter" or "Supertweeter") | RP-302 | RP-302 | RP-102 | RP-102 | RP-103 | RP-103 | RP-103 | P35-VH |
| Networks | A-61; A-402 | A-61; A-402 | A-204 | A-204 | A-204 | Capacitor | Capacitor | Capacitor |
| Controls | ** | ST-917; ST-901 | ST-901 | ST-901 | ST-901 | | | |
| Shipping Wt. (Lbs.) | 43 | 43 | 29 | 19 | 15 | 7 | 6¾ | 3¾ |
| Net Price | $184.50 | $169.50 | $99.50 | $73.00 | $42.75 | $24.75 | $23.75 | $10.50 |

*Special "woofer" for "Imperial" Back-Loading folded horn—not available separately. †6 x 9 Oval—not available separately. ††Includes M-1131 Intrarange equalizer—not available separately. **Special M-F and H-F Controls—not available separately. †††L-F response depends on enclosure. (UHL—Upper Hearing Limit).

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# Rewire Your Garrard for Stereo Cartridges

**A few simple steps are all that are required to adapt any of the Garrard changers or record players for stereo discs.**

"TWENTY EIGHT minutes and twenty eight cents" or "one hour and one dollar"—depending on your proficiency and shopping habits—and your Garrard is as up to date as tomorrow's newspaper, all ready for stereo. The operation is fairly simple, and while newly arriving models are already wired for stereo, one doesn't junk a satisfactory unit if he can modify it readily.

You will need about 18 in. of phono arm cable, such as Belden 8431; five feet of shielded interconnecting cable (and this can be had with a phono plug already installed on one end); a phono plug, unless you get the prepared cable; and some solder.

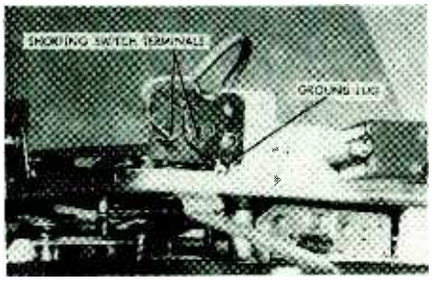


Fig. 1. Appearance of shorting switch terminal board under chassis before any modifications.

While the photos refer to the RC-88, the same principles apply to the other types as well, since all have the same head and arm, and all have similar connecting blocks.

1. Turn the changer over and disconnect both shields from the grounded terminal of the pickup shorting switch (*Fig.* 1). This will free the terminal from the ground connection to the lug on the chassis. Then reconnect both shields to the ground lug but do not solder.
2. Connect the shields of both the external connecting cable and the short length of pickup arm lead to the ground terminal and solder. Connect the center leads of both to the shorting-switch terminal from which the shields were originally removed (*Fig.* 2).
3. On the opposite side of the terminal strip, bent up the lug which held the original external cable so as to free the cable. Place the new external cable alongside the first and bend the lug down again to secure both.
4. Free the original arm lead from its present position, loosen the clamping lug under the arm pivot, and pull the lead up into the arm so as to make a loop.
5. Dress the new arm lead up into the arm over the horizontal pivot.
6. Loosen the set screw under the end of the arm to free the head connector (clear plastic). It may be necessary to loosen the rear binding head screw slightly, but do not loosen the screw at the front (*Fig.* 3). Slide the connector out of the end of the head.
7. Cut the new arm lead to the same length as the original one, and remove outer insulation and the shield for one-half inch. Clip the shield wires off carefully against the insulation. Strip the end of the lead and connect to the connector terminal which has no wires on it. Do not attempt to connect the shield. (*Fig.* 4).
8. Slide the connector back into the arm, plug in the head to position the connector, and tighten the screws so as to hold the connector firmly in place.
9. Dress the two arm leads up into the arm, pulling the slack down under the chassis. Clamp both leads together under the arm pivot, and dress the leads as they were originally.
10. Cartridge head already has two leads connected—one black and one red. The black lead is the grounded connection. Connect another lead to bottom pin inside head, using some color other than black. Connect proper terminal connectors for pickup to be used onto each of the three leads.
11. Mount cartridge and connect the leads to the terminals, with the black lead on the ground terminal of the pickup cartridge. This completes the conversion.

With magnetic cartridges, it should not be necessary to shield the leads inside the head. With ceramic or crystal cartridges, shielding is necessary to prevent hum pickup when the user's hand is near the head. The three leads may be fed through a short piece of shielding braid which is connected to the ground terminal (black wire) as in *Fig.* 5, or short lengths of shielded wire may be used for the leads, with both shields grounded.

With this method the pickup is not shorted during the change cycle. By replacing the phenolic washers which actuate the shorting switch with brass washers the switch can be made to operate to silence the pickup during the change cycle, but the adjustment is fairly critical for consistent operation.

Connecting the leads in this fashion leaves the normal pair connected to one channel of the stereo system so that other heads in which monaural pickups have already been installed will function normally without the need for changing the connections. Æ

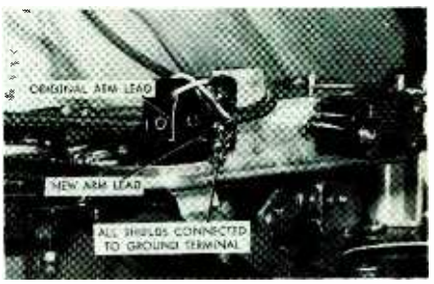


Fig. 2. Shields of two external cables and two arm leads are all connected to the grounding lug. "Hot" leads of external cables are connected on the other side of the switch.

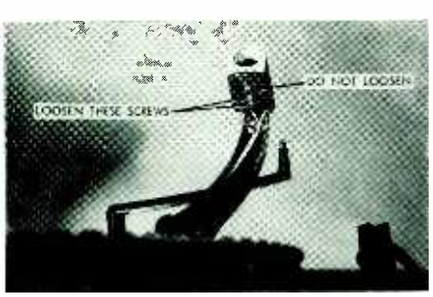


Fig. 3. Underside of pickup arm showing the three screws which control detent and hold connector receptacle.


Fig. 4. Connector receptacle is pushed forward out of arm to make connections.

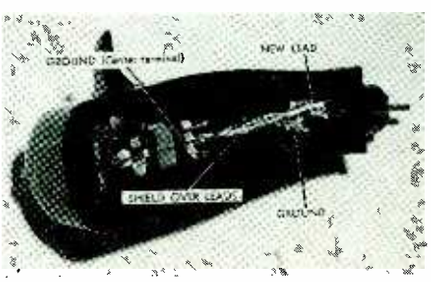


Fig. 5. Electro-Voice stereo cartridge installed in Garrard head. Leads are shielded with short piece of grounded braid to reduce hum pickup from proximity of hand.

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# A New System of Sound Recording*

## FROM THE ARCHIVES OF BELL TELEPHONE LABORATORIES

H. C. HARRISON

**Because of the current interest in stereophonic recording which involves some of the principles used in vertical or "hill-and-dale" records, a review of this material may enable the reader to understand current recording techniques better.**

WHEN THE SCIENTISTS of Bell Laboratories first became interested in the recording of sound, shortly after World War I, they brought into the art an electrical technique based on long experience with telephone systems. Instead of cutting the record with only the very small energy of the sound waves, they were prepared to convert the sound to corresponding electrical waves of much greater energy content, and to employ electromagnetic forces for the actual cutting. The lateral-cut system, most commonlly used at the time, was the type of recording chosen because an analysis of fundamentals showed that with the types of structures then available, the inherent advantages of the vertical type would be more than offset by difficulties in making the needle follow the groove contour at all frequencies. As a result of the contributions of the Laboratories, the orthophonic phonograph was brought out, and later, the sound picture.

Although the recording and reproduction in both of these systems was far better than anything that had been attained before, the Laboratories' engineers realized that much improvement was still possible. During the last few years, therefore, the complete subject of sound recording and reproducing has been reinvestigated. Methods have been developed by which it is possible to reproduce with markedly improved quality. This has required both that a wider band of frequencies be recorded, and that more of the extraneous frequencies, either in the form of surface noise or of distortion, be excluded. Such a twofold gain was made possible only by a coordinated development along three lines: the design of apparatus that would record and reproduce a wider band of frequencies, the production of a record with considerably less surface noise, and the securing of decreased distortion arising from improper tracking of the reproducing needle. These improvements were obtained by an improved design of recorder and reproducer, by a new method of processing the records, and by a different manner of cutting the groove.

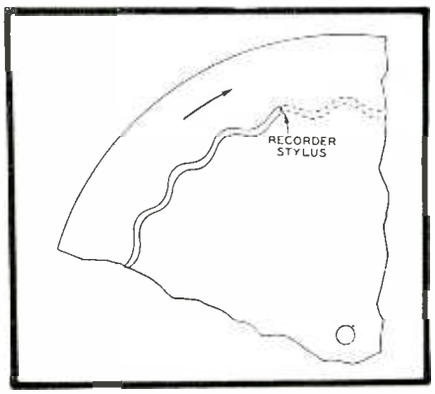


Fig. 1. In the lateral system of recording, the cutting stylus is moved radially in response to the sound to cut a wavy groove on the disc.

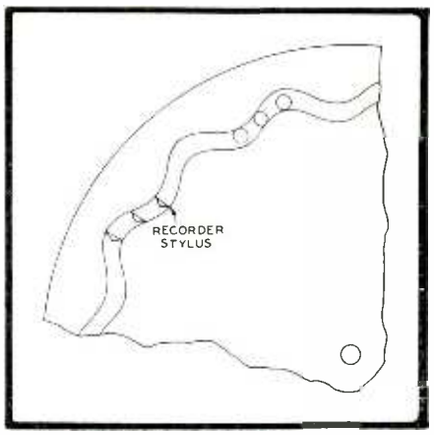


Fig. 2. The width of the groove measured radially is constant since it is equal to that of the cutting stylus. The width of the groove perpendicular to the sides, however, is not constant because of its undulating character.

In the studies of sound recording and reproducing that followed the orthophonic phonograph and the sound picture, careful measurements soon showed that a certain amount of distortion introduced in the reproduction was to a large extent inherent in the method of cutting then employed. With that method, known as lateral cut, the depth of the cut remains constant. The cutting stylus is moved radially in correspondence with the actuating sound to chisel a wavy groove on the rotating disk, as shown in *Fig.* 1. This groove is of the same width along the radius of the disk at all points. Since it is a wavy one, however, winding toward and away from the center of the record with the variations of sound pressure, the distance across the groove—perpendicular to its sides—is not constant.[1] It is widest at top and bottom of the waves and narrowest on the slopes as shown in *Fig.* 2. The reproducing needle, on the other hand, is round, and its diameter cannot be greater than the distance across the groove at its point of greatest steepness. Along these sloping sections of the groove the needle is guided by both sides and follows the actual form of the groove with fair precision. Along the tops and bottoms of the sweeps of the groove, however, it is in contact with only one side of the groove at a time, and may skid from side to side, thus introducing distorting frequencies.

### "Hill-and-Dale" Recording

Another method of recording on wax is known as vertical cutting. With this method the stylus is moved up and down and thus leaves a groove of which the

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[1] Commonly referred to today as the "pinch effect."

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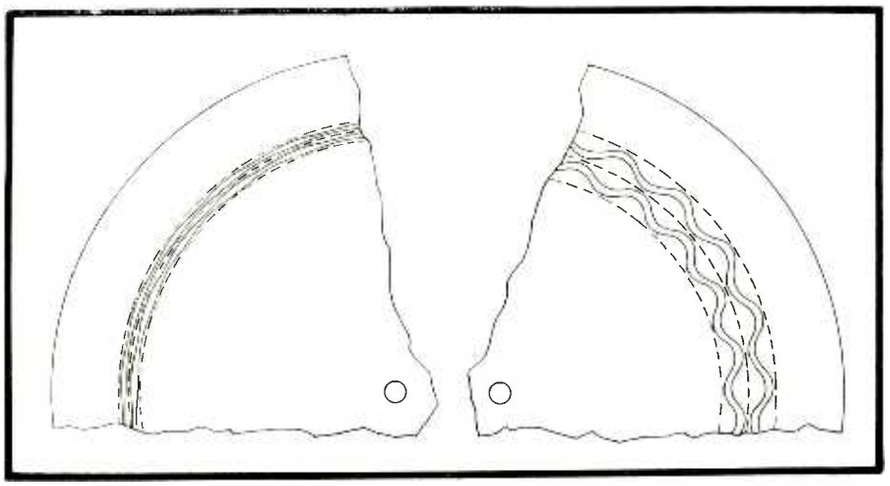

Fig. 3. The waves cut by the new method are in a vertical rather than a horizontal plane.

depth varies according to the sound. It gives a series of hills and valleys along the groove, and the method, for this reason, is often referred to as "hill and dale." It is illustrated in *Fig.* 3. In reproducing from this type of record the needle is held to the bottom of the groove by an unbalanced portion of the weight of the reproducer head. Although the actual pressure on the disc is small, it is sufficient—in conjunction with a light spring by which the needle is fastened to the reproducing head—to force the light stylus to follow the exact undulations at all times. There is no skipping, so the distorting frequencies that sometimes occur with side-cut records are absent with the vertical.

Although vertical recording has been employed by others before, the greater part of the development of the past has been in connection with lateral-cut records. Because of the inherent reduction in distortion that analysis and preliminary studies indicated could be obtained with vertically cut records, however, vertical cutting was taken by the Laboratories as the basis of the new method. It has another advantage over the lateral-cut record in making possible a longer playing time. With lateral-cut records the radial distance between adjacent grooves must be great enough to allow the maximum displacement of both grooves from mean position—corresponding to the greatest volume of sound—without danger of cutting through from groove to groove. The actual annular space allowed for a groove must be the width of the cutting stylus, plus twice the maximum displacement of the groove, plus a small remainder to ensure that adjacent grooves remain separate. With vertically cut records, on the other hand, very little allowance need be made in the spacing of adjacent grooves for the displacement of the groove. Due to the tapered sides of the cutting stylus there is a widening of the groove as the depth increases, but it is of minor importance compared to the full displacement of the groove that must be allowed for with lateral-cut records. Because of this fact it is possible to cut vertical records with a pitch of from 150 to 200 grooves per inch—thus giving standard twelve-inch records that will play from 15 to 20 minutes on one side, or ten-inch records that will fit in the cover of a 1000-foot film can and play for from ten to twelve

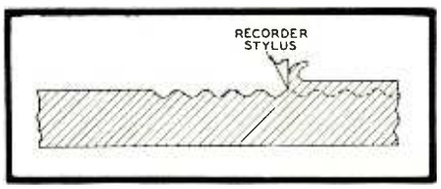


Fig. 4. A schematic indication, not to scale, of the difference between lateral and vertical records.

minutes. The difference between the two types of record is shown in Fig. 4.

### Frequency Response

Although the adoption of the vertical method laid the foundation for better sound reproduction, the major development work was still to be done. Perfection in recording requires not only that distortion—in the form of false frequencies or sounds—be eliminated but that all the frequency components in the sound be present in their correct volume ratios. Although the ear recognizes as sound all periodic pressure variations in air occurring at frequencies from about 30 to some 16,000 cycles per second, all sections of this range are not equally important. Recent investigations have shown that the quality of orchestral music improves materially up to about 8000 cps but that the reproduction of only a few pieces, such as the percussion instruments, is noticeably bettered by the inclusion of frequencies above 10,000 cps. The ear also recognizes as sound, vibrations over a pressure range of about a million to one, or 120 db. The best phonograph and sound-picture practice included comparatively small amounts of frequencies above 5000 cps for a range of loudness corresponding to a pressure range of but 50 db.

Vertical cutting makes it much easier to increase the loudness range because, as already pointed out, an increased depth of cut does not necessitate a corresponding increase in the spacing of the cutting groove as it does with the lateral-cut record. Moreover a small amount of overlapping of the grooves is of no great matter with the vertical system since the reproducing needle follows the bottom of the groove, and is not affected by the sides provided they are smooth. The adoption of vertical cutting thus made it possible not only to eliminate the distortion arising from improper tracking but to increase the loudness range as well. To include a wider band of frequencies, however, an improved recorder and reproducer were required.

### Surface Noise

This widening of both frequency band and loudness brought in still further difficulties. In the ordinary record there is a certain amount of surface noise, caused by lack of smoothness of the record, which is ordinarily made unobjectionable by recording at a displacement that is high compared to the irregularities in the surface. To record at a wider range of loudness while maintaining the same magnitude of surface irregularities and the same ratio between cutting displacement and surface irregularities, would require too deep a cut. If, on the other hand, this ratio were decreased without decreasing the surface irregularities, the result would be very noisy records, and the good effect of the inclusion of the higher frequencies would be largely lost because of masking by the surface noise. It seemed necessary, therefore, besides a new recorder and reproducer, to develop a smoother record surface.

Here, also, certain methods which had been tried and rejected by others in the past seemed to offer great possibilities if a technic of manufacture could be provided which would avoid the earlier causes of failure. A large amount of work has been required over a number of years. The several lines of development had to be coordinated and carried on simultaneously. The result, however, has been eminently successful. A method is now available which results in the

ability to record and to reproduce frequencies up to 8000 cps—about 3000 cps higher than has been commercial sound-picture practice. It results also in so improved a surface that the usually prevalent needle scratch in the best recordings is nearly inaudible: a necessary requirement if full advantage is to be taken of the presence of the higher frequencies. The over-all result is a much greater naturalness: voices and instruments are more readily identified and the finer shades of tone are better brought out. The ultimate objective of reproduction—complete illusion of the actual presence of the orchestra or voice—is nearly attained.

Not the least of the advantages of the new system is that the method of processing the records is as simple and inexpensive as the present method. The various steps require neither highly skilled operators nor delicately controlled processes. The record is cut on a thin layer of wax flowed onto a metal disk, and after being cut is given a thin plating of gold by a method called sputtering. This surface is then heavily plated with copper to strengthen it, and records are made, by a hot pressing process, of a very smooth and practically unbreakable material. The reproducing stylus is not a replaceable steel needle but a permanent sapphire. Because of the light pressure of the reproducing stylus, records will last for several thousand playings with no noticeable deterioration.

Bell Laboratories, by its recent developments, has thus made available a greatly improved system of sound reproduction, which should have many commercial uses in the future. In addition to a variety of miscellaneous uses, there is, of course, the possibility of greatly improved sound pictures but the usefulness of the system is not limited to this field. A new form of phonograph employing the improved records and electrical reproduction seems an attractive possibility since 15- or 20-minute records of music almost indistinguishable from the original would be invaluable. One of the fields of immediate usefulness is that of the production of high-quality records for broadcasting purposes. The frequency range of these records is so much wider than the broadcast bands that the radio listener cannot distinguish between an electrical transcription made with this type of record and an original production. Whatever use is made of the new system, however, it is now possible because of this development to reproduce music and speech with such fidelity and so free from disturbing scratch that almost perfect naturalness is obtained. AE

# Equipment Review

## KLH Research and Development Corporation loudspeaker line—H. H. Scott Model 135 Stereo-Daptor control unit

WITH EACH NEW loudspeaker system that is introduced on the market, we seem to become more and more convinced that the last word in speaker design has not yet been reached. After many years of listening to practically all of the speakers and enclosures that have ever appeared, we have learned at least one thing—one cannot judge a speaker and/or enclosure in just a few minutes of listening. One must live with a speaker long enough to give it a very wide range of program material to be able to make a valid judgment. Because of this, it would seem that some enterprising dealers would make a "sale" of a loudspeaker—type and brand name unspecified—and then allow the customer to try out three or four of them at home (all in the price range selected by the customer himself) before being finally commited to a particular choice.

We have had the privilege of "living with" the largest unit in the relatively new KLH line of loudspeakers and we have heard the latest model compared directly to the big one. Then we made a trip to Cambridge to see something of the way the units are built. By this time we feel that we are competent to judge them intelligently.

Model One combined with Model Five—KLH uses spelled-out model numbers—is by no means an inexpensive loudspeaker, falling rather into the top price bracket. But with extended listening, one can only come up with the description that this system is a "loudspeaker that does not sound like a loudspeaker." The cabinet, shown in *Fig.* 1, is 38 in. high, 25 in. wide, and 16 in. deep. It consists of two 12 in. speaker mechanisms enclosed in separate air-tight 2.25 cu. ft. enclosures in the lower part, and a space 7½ in. high by 23½ in. wide and 14½ in. deep at the top to accommodate a high-frequency speaker. When supplied as "Model One and Model Five," the space is occupied by the KLH high-frequency speaker system—the Model Five part of the name—but the space is adequate to accommodate a JansZen electrostatic high-frequency speaker if desired. As Model One alone, the upper portion is open in the furniture cabinets—mahogany, birch, or walnut finishes being normally available. The Utility model is finished in dull black and is 27½ in. high over-all—no space is provided to the high-frequency speakers.

Model Five consists of a box in which are mounted three small direct-radiator cone speakers—the one in the center covering the mid range, while the two outside ones, splayed out slightly, cover the high range. Switches on the back allow for operating the two sections separately at normal, below normal, or above normal settings, which gives the user flexibility in adjustment for specific acoustic conditions in his listening room.

Extended listening to this One/Five combination gives the impression of listening to the original performance rather than to a loudspeaker. Listening without looking—a desirable practice when comparing speakers—one feels that he is hearing a direct performance. The effect is almost uncanny, because everyone is conditioned to previous experience somewhat, even though aural memory is not actually very long. This combination of speakers sounds exceptionally smooth, and no coloration seems to be apparent. Of course, this was the main objective of the manufacturers, but they have achieved this objective quite well.

In direct listening comparison to the "Standard" speaker, we would be inclined to believe that the KLH had less bass—even though it has good output without doubling down to about 27 cps while the Standard goes to about 24. There is some accentuation of the very low frequencies in the Standard system, which makes it extremely listenable at low levels, but this almost seems too much after listening for a half hour or so to the One/Five. At its price, however, it *should* be a good loudspeaker.

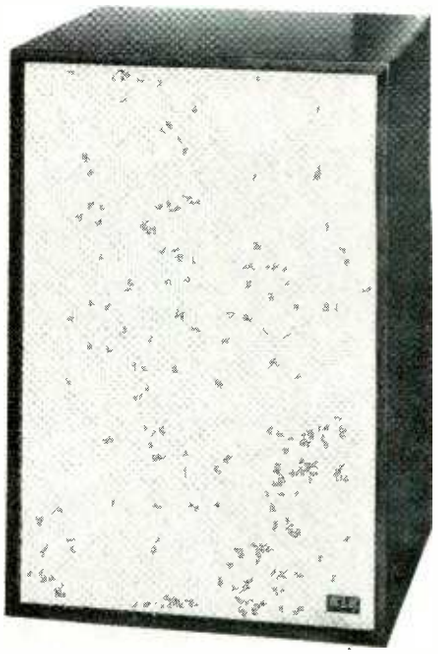

Fig. 1. KLH Model One low-frequency speaker which provides room inside at top to accommodate high-frequency units such as the KLH Model Five.

Fig. 2. The new Model Six is only 23½ in. high but sounds much bigger.

### The New Model Six

In March, the new Model Six was introduced to the press and trade. It is considerably smaller than the One, being only 23½ in. high by 12¼ in. wide and 12⅝ in. deep. By itself it is capable of a performance which we have come to think of as unbelievable for so small a cabinet. Two in a stereo pair are excellent.

On the Cambridge trip, we asked to hear the Six in direct comparison to the One/Five—a rugged demonstration any way you look at it, for the Six costs only about one-fourth as much as the One/Five. We came out of that test with the comment that we should hate to have to convince the better half that we should spend four times as much for the bigger model. There was a difference, to be sure, but it was not as apparent as one would expect and on some material, in fact, the unit that was 1½ db louder sounded best, regardless of which one it was. (We were unable to match levels exactly—the Six could be varied by 3 db, and it was either above or below the One/Five.)

The reasons for this similarity in sound quality may well be in the construction of the Six. The entire frame, baffle, and magnet-supporting structure are bonded together forever in a fiberglass-epoxy compound, making the speaker and baffle essentially one single unit. The high-frequency unit is similarly set into the baffle, although it is almost entirely self-supporting in the magnet structure, and is fitted into the baffle in that manner to make sure of air-tight construction. The board itself is sealed in the cabinet, with the volume practically filled up with rock wool "blocks."

KLH is one of the very few U. S. manufacturers to make their own cones—Bozak is the only other one we know of. We have

Fig. 3. H. H. Scott Model 135 Stereo-Daptor—a passive device designed to provide a control center for stereo systems.

seen evidence of much experimentation in the "junk box" where several hundred tried-and-discarded cone types have accumulated, in both woofer and tweeter types. The cone for the woofer is relatively heavy, and—because of its tar content—might be likened to a piece of roofing paper. It is also quite stiff, and is not likely to break up over the range in which it works. The tweeter cone is light and hard, much like a parchment bond paper. On the whole, the KLH line shows the results which can be obtained by intelligent and persistent research.

One demonstration we saw was of particular interest because it showed how smooth the tweeter is. Using machine-run curves and a calibrated Western Electric 640AA condenser microphone, several different types of tweeters were compared. The effects of diffraction around various baffles were readily noticed, and the curve of the small unit used in the Six was considerably smoother than we have come to expect from cone tweeters, with response extending out to well over 15,000 cps. We still prefer the One/Five, naturally, but we would be quite well satisfied with the Six—particularly if we needed two of them for a stereo pair. E-23

## H. H. SCOTT MODEL 135 STEREO-DAPTOR

Practically every user of component high fidelity equipment will soon be faced with the need for conversion to stereo, if he has not already made the change. Many audiofans lack the desire to rebuild all their equipment, and there are many preamplifiers which do not lend themselves readily to reconstruction to accommodate a second channel. In many instances, during the transition period the user will employ two separate hi-fi amplifiers and arrange to

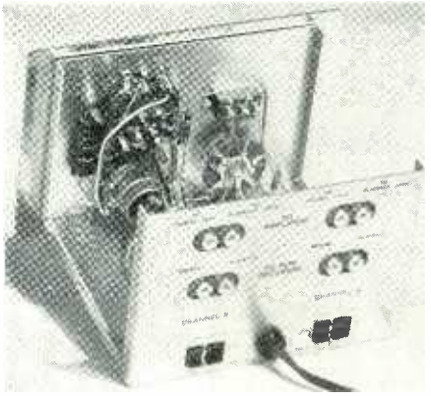

Fig. 4. Rear and inside view of Scott Stereo-Daptor. Both audio and power circuits are controlled.

couple them together in some fashion so that audio and power circuits can be switched with a minimum of inconvenience and the level can be adjusted on both channels simultaneously.

The first device that we have seen for this purpose is a simple unit that is small, neat in appearance, and inexpensive. Designed originally to permit users of Scott amplifiers to establish a control center for stereo, there is nothing to prevent other types of amplifiers being connected to the Stereo-Daptor in similar fashion.

Briefly, the Stereo-Daptor, shown in front view in *Fig.* 3 and from the back in *Fig.* 4, with the cover removed, consists of a selector switch, a volume or loudness control, a volume-loudness switch, and a record-playback switch. A power switch is coupled to the volume control. In use the power cord of the unit is plugged into a wall receptacle and the cords from the two amplifiers are plugged into the Stereo-Daptor. The outputs from two preamps are plugged into the rear of the unit, as are the inputs to two power amplifiers. With amplifiers like the Scott 99 Series, for example, which combine pre- and power amplifiers, modifications may be made to provide jacks at these points in the circuit. Then with the Stereo-Daptor volume control at maximum, the two channels are balanced for equal outputs. Thereafter the Stereo-Daptor is used for controlling the volume of both channels and for such switching as may be necessary.

The unit may be used with amplifiers in any of four groups, according to the instructions. These groups are: (1) Scott 99A, B, C, and D; 120A, B, and CP; 210B, C, and F. (2) Scott 121A, B, and C; 210D and E. (3) Any systems using separate preamplifiers and power amplifiers having input impedances to the power amplifier greater than 100,000 ohms; (4) Two identical complete amplifiers equipped with tape monitoring input and output jacks. Use with widely differing types of equipment is not recommended because of the difference in levels between the two channels. That is, one pre/power combination might operate with a signal level of 1/10 volt at the junction, whereas another might operate at 1 volt. When reversing channels, there would be a great difference between levels.

The record-playback switch on the front panel allows usual operation with a tape recorder where separate input and output circuits are provided.

The selector switch has five positions: (1) MONAURAL RECORDS, which connects both preamp outputs together and feeds them to both power amplifiers for use when it is desired to play monaural records with a stereo pickup; (2) STEREO, which connects the channel A preamp to the channel A power amplifier and connects the two channel B units together; (3) REVERSE STEREO, which connects A to B and B to A, thus reversing the position of the channels; (4) CHANNEL A, which connects the output of channel A preamp to both power amplifiers; and (5) CHANNEL B, which connects the output of channel B preamp to both power amplifiers. This provides just about all the switching that should be necessary except for phasing of one channel—but this would be practically impossible in a simple unit. However, we are glad to note that the manufacturer has called the user's attention to the need for proper phasing, not only for monaural use but also for stereo. Much more need be said on this subject until everything is standardized and we can forget about it once the equipment is set up.

Fig. 5. Scott Stereo-Daptor unit matches other Scott units in height and appearance.

This is an attractive and simple device which will do much to alleviate the inconvenience that is sure to be encountered when a second channel is added in making a conversion to stereo. There is nothing complicated about the Stereo-Daptor, and it should last forever. There are no tubes to burn out or deteriorate in performance, and the only possible wear points would be mechanical ones—and switches and volume controls rarely seem to wear out.

The provision of the loudness control is likely to be considered desirable by those who do not have them already in their equipment, but for those who do not like loudness controls, the switch permits the compensation to be cut out of the circuit. *Figure* 5 shows how the unit matches other H. H. Scott amplifiers in height and external appearance. This should be a very useful device particularly for those who do not regularly construct their own equipment. E-24

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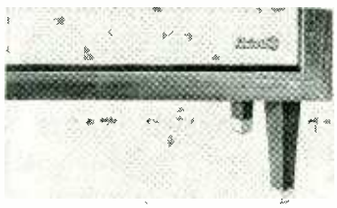
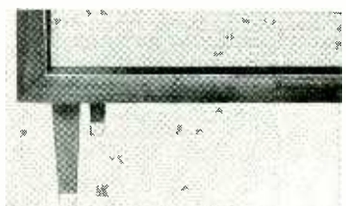


**MODERN** decor is accommodated by adjustment of the legs to this triangular position.



**TRADITIONAL** decor is accommodated when the legs are set "flat" in this position.

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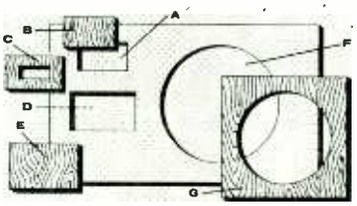


**EN-1215 BAFFLE BOARD AND ADAPTERS**

**A**—Hole for tweeter Model HF-206 or 4401.
**B**—Adapter blank to close hole A when tweeter not used.
**C**—Adapter for Model UXT-5 tweeter.
**D**—Hole for mid-range (Model H-600 horn).
**E**—Adapter blank to close hole D when mid-range unit not used.
**F**—Hole for Diffaxial Models 315-C, 6303, Diffusicone-15; woofer Models C-15W, C-63W.
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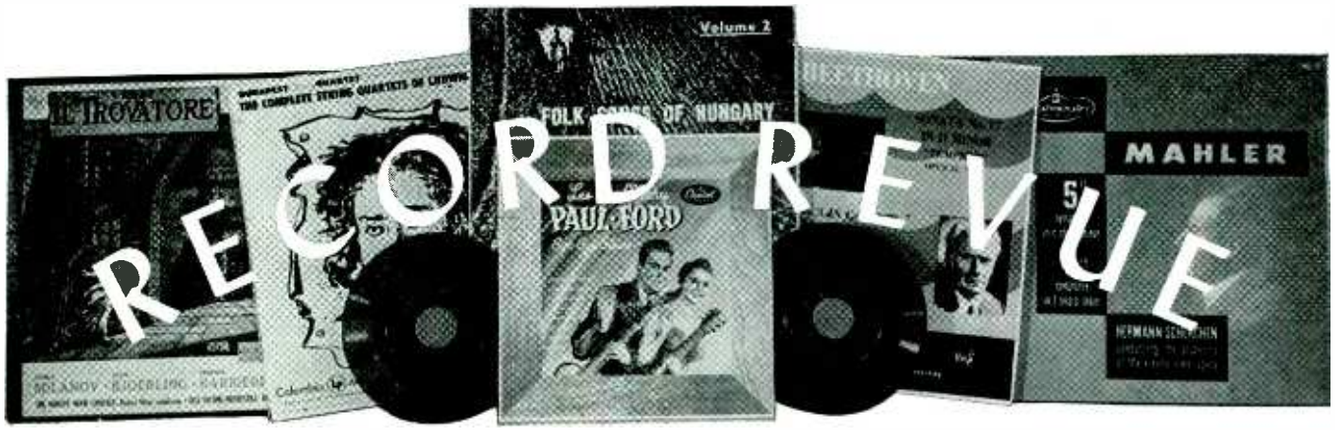


## EDWARD TATNALL CANBY*

### 1. STEREO CORNER (TAPE)

**Beethoven: Symphony #7.** Pittsburgh Symphony, Steinberg.
**Capitol ZF-22 (ST)**[1]

Capitol's classical stereo is a whiz. Though I haven't had time to absorb nearly what I'd like of the mammoth stereo output of the company so far, I toss this one at you as typical of the best, and one of the finest musical-stereo combinations to date.

Steinberg's Beethoven Seventh is a modern man's dream, not *the* definitive Seventh (there is no such thing) but a marvellously revealing look into the symphony as heard by a progressive, forward-moving conductor. Things move fast here, the texture is light and airy—really that "apotheosis of the dance" that was Wagner's heavyweight description of the symphony. We're getting away from the concept of Beethoven as massive and monumentally brutal; Steinberg shows what can be done in the new way and, as I say, it's a revelation of fine musicianship.

The stereo effect, like others in this series, is absolutely first rate for the music, a wide, big-hall feeling, the orchestra at a conservative, unexaggerated distance without gross "hi-fi" distortions, yet with all the presence and life you could want. If you want to find what stereo can do, given top music and top recording, here you are.

**Beethoven: Piano Concerto #5.** Rubinstein; Symphony of the Air, Krips.
**RCA Victor FCS-61 (ST)**

One of a series that includes all the piano concerti (also in disc form, in an album or separately), this is just what could be expected, a polished, professional, effective performance that—for my ear, anyhow—has a lack of spontaneity, as of the nine thousandth performance of the same old stuff, and a certain coarseness in many places that comes similarly from too many playings.

As I say, what more can you expect? Crack artists like Rubinstein are expected to play the same music again and again, year in and year out, indefinitely; the time when the interpretation reaches its peak of maturity and expressiveness is bound to pass, sooner or later. What follows thereafter is a constantly more sure-fire rendition, and a gradual lowering of the essential standards for high expression. Can't be helped.

And so I found myself again bored by this same old concerto. Not a thing "wrong" with it here—the show is much too well polished for that. But there are a million and one little indications of that tired feeling, which is pushed aside by means of a million and one slight exaggerations, hardnesses of tone, overplayings, the false smile trying to hide the wandering inspiration.

Now very possibly Mr. Rubinstein himself would deny all this, as might the orchestral players. All I can say is, I hear it. Try for yourself. This is a seasoned, road-tested, wrapped-up performance, but the music isn't that kind of music and never was.

Don't know whether this is RCA three-track or not, but the piano has been very suitably enlarged, according to standard conventions of concerto recording, and placed nicely in the indefinite middleground. The job is well done, because in this case the soloist doesn't seem to be floating in space out in front of the orchestra. He's just present, in no very spatial way, neither on the stage nor off it. Unless you prefer to locate your solo specifically down with the orchestra (*and* at the proper orchestral volume) this is much the best solution to the stereo concerto problem, it seems to me. It parallels the standard monaural treatment.

**Bartok: Violin Concerto** (1939). Menuhin: Minneapolis Symphony, Dorati.
**Mercury MFS5-10 (ST)**

*"The present recording was made in Carnegie Hall . . . between the hours of midnight and five o'clock, following the all-Bartok concert. . . ."*—thus do we treat our musicians, these days, to get records as well as live performances out of them! Well, if Menuhin sounds a bit wobbly here in his pitch, I don't really think it was the lateness of the hour. Musicians can and do rise to such challenges, a full-length special New York concert followed by an all-night recording session—an exhausting affair in its own right even after a day's rest.

Three-track recording here does what it is supposed to do. The orchestra is closer than most in stereo recording, with a typical sharp edge to it, yet the over-all spread of sound is not disturbed, between the two speakers. Good enough, though frankly, I like my stereo a trace more distant, as in the Columbia or Capitol-Pittsburgh tapes below.

The violin is a tough solo for stereo. Its thin, wiry tone demands exact placement, and yet for soloistic purposes you must blow it up, in the recording of a concerto. Here the Menuhin violin is less blown up than in other violin concertos I've heard, the effect is more as of the actual stage, close-up. At first he seemed to flit from place to place, perhaps because my stereo-sensing facilities were trying too hard to locate him; but after awhile he settled down in a safe position that seemed vaguely right of center stage, and from there on all was well. You can hear him breathing—he's that close.

This is late-Bartok, a work not unlike the well-known Concerto for Orchestra and a good follow-up for listeners who have fallen for that noble piece—which means a lot of us. Menuhin once had an RCA recording of the concerto, as I remember. The performance is good but not to my mind ideal here; Menuhin has a "soft" approach to this kind of music, a leftover of the old romantic Kreislerish way of playing; Dorati, on the other hand, is of the hard-as-nails school and shows his typical stuff here, to much good I'll admit. But a better integration of the two aspects could be made. Bartok responds wonderfully to a bit of sentiment—but also to a tough modern approach, and the ideal is a combination of both.

Maybe a Milstein-Steinberg recording would do the perfect job on this, for Capitol. No such thing, as of now.

**Villa Lobos and Stravinsky.** Phyllis Curtin and cellos, Willis Page.
**Cook 1062 (ST)**

Cook is back—with his full line of disc records in microfusion pressing (vinyl powder) and with, at last, a stereo tape line derived from the stereo masters that once were pressed into his dual-band, twin-pickup "binaural" discs, now discontinued. (Cook's plant was mostly destroyed by a fire last fall.)

The above title is exactly as inscribed on this excellent stereo tape. If your copy has the insert leaflet in it (mine didn't), you'll find out what is being played—the Villa Lobos Bachianas Brasileiras #5 for soprano and cellos (eight, as I remember) and a lovely string concerto of Stravinsky, from 1946. This line of classical numbers in the otherwise nonclassical Cook catalogue is well worth investigating even if you don't go for the zanier Cookisms on other tapes and discs. (I do go for them.) The Villa Lobos is a persuasively seductive bit of brilliant banality, a sort of Bach-Stokowski crooning on the soprano's part, with words here and there, Latin-American, plus a very male-sounding support from the many cellos. Like so much of Villa Lobos' work, its very brilliance of execution keeps it from real banality—and it will appeal both to highbrows in music and those who like a good tune. As for Stravinsky, this is one of his most ingratiating short later works, rather gentle, the rhythmic fragmentation always hinting at (and actually achieving) an eloquent melodiousness. Nice stuff.

Stereo? I'm not happy about the eight cellos, which seem to cluster tightly about the right speaker, like proverbial angels on the head of a pin, not blending with the excellent Miss Curtin, who is a semi-point-source in the left speaker. Not enough surrounding space for proper musical integration, in this rather dead recording situation. The Stravinsky, for a larger string body, is recorded in a live hall (perhaps Symphony Hall) and the stereo effect is excellent, tasteful, helpful to the music. Couldn't be better. Audio quality is, as might be expected, very high. Cook does his stereo copying at slower-than-usual speeds, for maximum fidelity. The originals were good and are still tops.

(Like other Cook recordings, this is also available on LP disc and—what'll you bet? is likely soon to appear on stereo 45/45 disc.)

**Stravinsky: Firebird Suite.** N. Y. Philharmonic, Bernstein. **Columbia IMB-3 (ST)**

Don't be fooled by Columbia's obviously spare contributions to stereo tape, so far. Only a handful of numbers have been released, but the company has been booming along in stereo behind the scenes, and the tapes so far on hand are of extraordinarily fine quality and excellent stereo effect.

Bernstein's "Firebird" is oddly conventional, making the piece rather old-fashioned, if entirely expressive and well tailored. This is what most people want, but it is odd that somebody like old Monteux, in his eighties,

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[1] ST = Stereo tape, in-line.


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can make the Stravinsky scores of this sort sound startlingly modern and "hi-fi." The explanation is easy, I think. Monteux was in on the premieres of these early Stravinsky works, when they were, indeed, violent novelties; he still hears them with that original fire and can bring out those qualities today, in terms of our own recording techniques. Bernstein, on the other hand, is a younger man to whom these scores are rightly of an earlier day and more the tail-end of Romanticism than the bursting-out of modernity.

So—enjoy the Firebird here for all its lushness, in wonderfully natural stereo, as juicy as you please.

**A Strauss-Offenbach Bouquet. Strauss in Stereo.** Vienna State Opera Orch., Drexler. **Livingston 722, 721 BN (ST)**

**The Vienna Strings Play Johann Strauss.** Vienna Str. Symphony, Rapf. **Livingston 717 BN (ST)**

Livingston has a corner on Viennese, it seems. (There's lots of Johann Strauss in stereo but much of it is the U. S. product and quite unlike the Viennese variety.) The first two, above, are by no less than the lordly Vienna Philharmonic, if the State Opera Orchestra is as usual its alternative title. Big sound, in the original scores, but played with a certain understandable lack of sparkle; the poor guys turn out this stuff by the eveningful decade after decade. Rightly styled, at least, except for some odd eccentricities of tempo on the part of Herr Drexler. But tired.

The Vienna Strings tape is frankly in the salon league, a small group in a small place with a spritely piano filling in the stuffing, the fiddles of that slightly squeaky sort you used to hear in hotel lobbies. Excellent of its sort, though, and very well taken down in stereo. I like it better than the Philharmonic tapes.

**Brahms: A German Requiem.** Terese Stitch-Randall, James Pease; North German Philh. Chorus and Orch., Bamberger. **Concert Hall RX-45 (2) (ST)**

The first choral piece I ever sang in—as a thirteen-year-old alto—was the Brahms Requiem. This superb recording brought the tears to my eyes more than once, I'll readily admit.

By monaural standards it's zany in a way, with the sopranos of the chorus off in the background, the tenors and basses close up front and the orchestra close-up with them. But stereo makes virtues out of effects that otherwise might seem faults. The sense of being inside a church here is extraordinary. The tenors and basses are ever so clearly off to your right, in front, and I mentally sang every note with them, knowing the parts more or less by heart. The sopranos, angelic and beautifully blended, are back in the rear to the left, and somehow the contrast between all these elements (yes, there are altos too) seems only to emphasize the warm humanity of this lovely early-Brahms choral piece, the amateurs' favorite.

The performance hits just the right balance between professional polish and amateur enthusiasm. I have seldom heard it more honestly and sincerely projected. Even the occasional minor goofs of the chorus, the familiar ones that always get made, are part of the scene and add a human touch that is made real by the stereo sense of immediacy. The orchestra is excellent, the soloists beautiful and at one with the whole concept.

From a technician's viewpoint this probably isn't the finest hi-fi stereo ever issued, but again, if you want to know what stereo can do to enhance a fine musical effect, this is your tape. Two reels and a lot of cash—but it's worth it. (Unless you want to wait a year or so until the same—maybe—comes out on stereo disc.)

**Brahms: Alto Rhapsody; Tragic Overture.** Grace Hoffman, alto; North Ger. Philh. Cho. & Orch., Bamberger. **Concert Hall HX-39 (ST)**

This is a supplement to the above major recording of the Requiem, with the same forces. The Alto Rhapsody, always a difficult piece to project, is excellent—as good as the

Requiem. Dark-toned alto solo and men's chorus. The Tragic Overture, orchestra only, seems to suffer from grievous lack of rehearsal—the orchestra just doesn't play the notes very well. But you won't find a better version of the Alto Rhapsody and the tape is good just for that.

## 2. POSITIVE—AND NEGATIVE

**Music for the Harp.** Marcel Grandjany. **Capitol PAO 8240**

The second in a series, this has Grandjany, the harp genius, playing a number of his own works plus, on side two, music by such differing moderns as Fauré, Prokofieff and Hindemith. This man is surely the world's greatest musician on the harp—I put it that way on purpose—and so don't expect merely the usual sweet harp sounds! His own works, on the verbose side, are wonderfully styled exhibition pieces, very musical—one of them, variations on a Haydn theme in the style of the Beethoven period (or, more properly, the time of Napoleon) even somehow manages to evoke the actual sound of an old piano, of the early Nineteenth century. Amazing. Oddly, I found Grandjany's own stuff more entertaining than the somewhat heavier-handed music by the Big Names.

**Piano Music of Debussy and Ravel.** Friedrich Gulda. **London LL 1785**

An interesting disc, by the young Austrian pianist who, starting off with some superb Beethoven recordings, went on to become a quite famous night club jazz pianist—a fact that London does not mention in its little box biography on the record case here!

As might be expected, I think, this playing of a set of major pieces by the two French composers relates more closely to jazz than to Beethoven. By which I mean simply that the piano effects of Debussy and Ravel and, in particular the harmonies of Ravel, are to this day so tremendously influential in night club style popular music (jazz or not) that any pianist who plays his own night club arrangements is bound to be very much at home in the Ravel and Debussy idiom. Gulda's Ravel is lush, expressive, perfectly assimilated as to the harmonic intentions—which is more than can be said of many playings; Ravel writes some pretty complicated stuff.

There is, too, a certain rather grandiose inattention to the details of phrasing and color, as compared to many another pianistic specialist in this colorful music. That, too, I think, goes along with the modern popular approach to pianism, which has lost most of the subtleties of piano technique, that belonged to the more classical school of piano. Ravel may be one of the fathers of today's entertainment music, but his piano writing was definitely of the older school in the need for consummate delicacy and perfection of detail.

**John McCormack Sings Irish Songs.** **RCA Camden CAL 407**

This one, bedecked in green, was issued for the Saint Patrick's Day market, but we trust it's still on hand—maybe for next year. This particular re-exploring of the enormous Victor archives interests me largely in the beauty of this voice and the way in which it is controlled.

In common with others of his day, McCormack could turn out the slushiest slush with the greatest of enthusiasm. Musically, this record is Irish spaghetti, if you see what I mean. But if you will play the earliest and latest recordings—1911 and 1930—you'll hear how a really well managed voice, in the real, genuine Italian *bel canto* tradition, is so effortlessly used that it scarcely changes in effect over almost a quarter century, in spite of thousands and thousands of recitals and recordings.

As the notes say, between John McCormack and those "likeable lads," the later claimants to his vocal throne, there is a world of difference.

By the way, what ever happened to Christopher Lynch?

**Gilbert and Sullivan: The Gondoliers.** Pro Arte Orch., Glyndebourne Festival Chorus, Sargent **Angel 3570 B/L (2)**

Funny—I can't find anything wrong with this non-D'Oyle-Carte recording, but I also can't help feeling that something is missing. G & S, as of today, is so very much a matter of precise style that even a slight and indefinable deviation from the True Path will hurt every dedicated Savoyardian soul.

The best I can say is that this is an oddly cool performance. It is highly professional, beautifully tailored, impeccably sung with the proper British accents; but it gives an odd impression of being more or less like *other* kinds of opera—which, presumably, the famous Glyndebourne people know all about.

Now anybody knows that G & S music is a continuous satire on all sorts of opera, from Carmen to William Tell and Wagner and back, not to mention all sorts of music in general, from the madrigal to the pseudo-oriental ditty. (After all, who got there first, "The Mikado" or "Butterfly"?) But by its very nature, this lovely satire must never, never sound *like* the stuff it satirizes. It must always, always, sound like Gilbert and Sullivan—as though nothing else in the wide world could possibly exist. Only in this fine fashion can the true G & S satire and the essence of its delight be projected.

The D'Oyly Cartes have always done it, since the Beginning. Thousands of amateur troupes have caught the spirit, be they ever so out of tune. But the fabulous Glyndebourne troupe just barely misses the G & S boat.

Nope, I really don't like this recording, though I could never say why. Not any better than this, anyhow.

**Sitwell-Walton: Facade.**
**Bowles: Music for a Farce.** Dame Edith Sitwell; Chamber Orch., Prausnitz. **Columbia ML 5241**

One side of this has the inimitable old recording of this amusing piece with the author herself reeling off the high-speed text, to the snazzy music of the early Twenties. (Unless I'm crazy, this is the old Columbia recording, modernized and re-cut.) This time, the complete text is provided in a booklet—and you'll need it, to keep up with the lady. She moves fast, and so does the music, and the two of them meet head-on throughout—for this was well before the days of broadcast "background music" and the easy fade, as now so familiar. The very idea of it hadn't yet been thought up. Interesting.

There's another and later Sitwell version of this, on London, in which she is aided in the very fastest numbers by a man with an even quicker tongue, the singer Peter Pears. He reads twice as fast as the fastest Gilbert and Sullivan patter-singer. She does pretty well herself.

I didn't have time to get to the second side of the Columbia disc, by press time. It was commissioned for an Orson Welles farce, in 1938, but the great man changed his mind and dropped the whole project, leaving the music orphan. Here it is.

**Meantone Temperament in Theory and Practice.** J. Murray Barbour, Fritz A. Kuttner. Robert Conant, harpsichord and organ. **Musurgia A-2**

Oof! OK, you mathematicians and figure-minded musicians, get out your cash and prepare yourselves to learn all about Meantone Temperament. The Theory is here presented in a large 31-page booklet that, for all I know, says the last scholarly word on the subject, in detail and with bibliography, not to mention printed tables and musical examples. The "Practice" is encompassed in the recording which, as a change from the first of this series (Theory of Classical Greek Music), is devoted largely to musical examples, played on the harpsichord or organ.

Well, Dr. Kuttner is sure I'll be happy with this one because it meets my objections to the earlier volume that it was all theory and no music. I fear I'm still in the wrong camp. I tried, but the best I can do is to hear a lot of music played without any very great inspiration—probably not Mr. Conant's fault—

on the same old harpsichord or organ, variously out of tune by small degrees.

Frankly, I can't listen to the tuning and hear the music, too. Maybe you can. Yes, theories of tuning are vital to music history and so are examples of actual systems as used in the past and their practical limitations, as illustrated in these selected pieces. The best I can say, to defend my own utterly blank reaction to these, is—

1) Though some instrumental music, keyboard music in particular, must be played via rigid tuning, applied ahead of time, by far the greatest part of music is free in tuning, adjustments being made dynamically as the music moves along. That includes a large part of the music we hear, of all periods.

2) Beyond this, it is a simple fact that we "infer" tuning, pitches, by mental rationalization. Otherwise, how could be recognize music played on a badly out-of-tune piano? We can and do. Moreover, we similarly "recognize" the implied pitch of a wobbly singer who misses many notes and oscillates on those she does hit. She can be a great singer, too, like Lotte Lehmann.

3) Thus, what really counts in active music-making in any period is first, the *implied sense* of the pitch and, second, the actual quality of pitch adjustment, which can be extremely precise.

If you want to hear what a fixed-pitch tuning system that is no longer used can do to your ears, and if you like figures and systems, try this album.

There are six more huge studies under way. I warn you.

**Brahms: Double Concerto for Violin and Cello.** M. Mischakoff, Frank Miller; NBC Symphony, Toscanini. (1948).
**RCA Victor LM 2178**

Well, we've come a long way in just ten years. That's what RCA unblushingly admits, on behalf of its corporate partner, NBC, in this new Toscanini release, taken from the broadcast of November 13, ten years ago.

It is honestly hard to believe that a recording technically as bad as this (presumably after RCA has done its best to refurbish the sound) could have been taken down off the air in the holy of holies at NBC, the main New York studio—of an event that NBC publicity was trumpeting with all the impressiveness it could muster (plenty) as one of the great moments in all musical history. In the present-day phrase, somebody goofed. Goofed on a really collossal scale. It's doubly unfortunate, I think, that these recordings must now be released on the regular RCA label, as though they were the latest in hi-fi sound. But this is probably a matter of sales policy, the gold-seal LCT label having evidently proved to be commercial poison for the records of past times that were once released upon it.

The interesting thing is that the goofing was by no means limited to matters of distortion and frequency response, though they constitute the obvious troubles. There is also that incredibly thin, dead sound (RCA can't do much about it in this extreme form) which I suppose still came from the famous studio 8H at NBC, so long used for these broadcasts. 8H or no, the sound is of the well-remembered sort here and it is poison to Brahms even more than to other composers.

And—I might as well say it—there is also the perfectly matched late-Toscanini Brahms playing which, for my ears, is grotesquely out of style, the pace incredibly fast and hurried, the tension all in the wrong places, the Brahms lyric quality often lost in the excitement. That is of course very much a matter of opinion; it could be said that this particular late Brahms is pretty heavy on its own and can stand some lightening-up in the Italian manner. Perhaps—but (opinion) not *this* much. It gives me the willies.

Since the Toscanini performances are so much a matter of differing evaluation, I suggest that those who feel otherwise can put aside the last part of the above dicsussion or take it in terms of their own interest. But the sound quality of the record is somewhat more an objective matter and there I stand on my statement, as above.

*(Continued on page 61)*


## CHARLES A. ROBERTSON*

**Dukes Of Dixieland:** Marching Along
**Audio Fidelity Stereodisc ASFD 1851**

With this release the stereo disc sweepstakes are open in earnest and anyone can play. Just as the first stereo cartridges began to trickle into the shops and disappear with greater rapidity than the last snows of winter, the stereo version of Volume Three by the Dukes reached the shelves in the company of Railroad Sounds (AFSD 1843), Bullring (AFSD 1835), and Johnny Puleo (AFSD) 1830).

By the time this note appears, many stores will have arranged demonstrations and WOR radio and television audiences will have heard snatches of them broadcast by joint use of the two mediums. Just possibly this test, if followed by others, could convince a few network executives of the public's interest in good music and sound, with the ultimate return of a symphony orchestra to television in stereo by this method.

If each release could bring as much improvement over the last as this does over its privately circulated prototype, there will be no doubt about the future of stereo on discs. The sound from a single channel is still not up to the monaural version, but the proof of compatibility must wait until more recording dates are held with the Westrex 45/45 system specifically in mind. Although the solos by the Dukes are acceptable, the clarinet and piano are likely to be overshadowed in the ensemble passages. To solve this problem of balance, it is evident that the two channels on discs must differ from those on tape. The use of three channels in the studio presents a partial solution, but the main responsibility rests on the selective ears of the engineer.

Each album is sealed in a plastic case. An enclosed folder explains the nature of the disc and how it is best put to use, advising that it be played only with a stereo pickup.

**Red Camp:** The New Clavichord
**Cook 1133**

Back in production after a disastrous fire last fall destroyed its stock and interrupted the flow of new releases, Cook Laboratories presents the intimate musing of Red Camp on the infrequently heard clavichord. Its minute tone, reproduced with exactitude when barely audible, provides a musical sequel to the Cook Chromatic Scale Test Record, the Fletcher-Munson side of which is meant to be played at low volume. Like that worthy production, it offers a searching examination of sound at the threshold of hearing, a point where many audio systems fail to encompass the range of frequencies they deliver at higher levels.

Described as a fresh approach both to recording technique and to musical philosophy, it is still an old fashioned record in the sense that it will delight those persons who like to explore the flexibility of their controls. For as the gain is increased, the ancient keyboard becomes a modern electronic instrument, with a different sound and different problems of compensation. Here the test of equipment is more strenuous as bursting chord clusters introduce steep transients. Few systems will run much better than half mast before the tone loses its pearl shape and becomes fuzzy and harsh. With the amount of attention now given stereo, it is reassuring to know that developments are continuing in one of the weakest areas of recorded sound. No hint of how the mechanical sounds of the instrument were excluded from the recording is conveyed in the liner notes.

Both the nature of the clavicord and the shortness of its keyboard presented problems to Red Camp, and from his comment at the close of the session one can only wonder if he has since been able to return to the piano. Besides devising a new technique of playing chords in clusters, he allows his muse to probe jazz or classical veins at will in six preludes. He is most successful in a blues section, but it is music to be enjoyed rather than analyzed. Even the titles *Prelude for Twelve Fingers, Twofer Atonement, Waltz in Left Field,* and *Purdie Diddle Dido Twee Twee* are tempting. Camp also tests his skill on a more conventional blues—*Nagasaki, Cocktails for Two, Ghost of a Chance,* and the ragtime of *Loosiana Piano.*

**Jack Lindstrom Stompers:** Look Dad!
**World Pacific PJ1235**
**Dixieland Rhythm Kings:** At The Hi-Fi Ball
**Riverside 12-259**

Bringing traditional jazz to the environs of Stockholm, Sweden, is the sextet headed by Jack Lindstrom, a trumpeter who admires both Armstrong and Gillespie. Under their influence, his group plays in the linear style of the modernists, emphasizing solos at the expense of ensemble work. It boasts two able trombonists in Folke Rabe, who made two numbers before beginning studies at the Royal Swedish Academy of Music, and Jan Bark on nine others. Such favorites as *Snag It, Ole Miss,* and *Squeeze Me* are seen in fresh perspective.

Based in Dayton, Ohio, the Dixieland Rhythm Kings are traditionalists in the strictest sense, with the tuba of leader Gene Mayl, the ragtime piano of Robin Wetterau, and the banjo of Jack Vastine. Clarinetist Joe Darensbourg takes the chorus on *High Society,* and the band steams through *Chattanooga Stomp, Buddy's Habits,* and *Wabash Blues* with a fine awareness of ensemble. Previously released by Empirical in 1953, in this remastering the sound if a big hall is retained.

**Jonah Jones:** Swingin' On Broadway
**Capitol T963**

Since he played on a Mississippi riverboat in 1929, Jonah Jones acquired many voices on his instrument and he sprinkles them liberally throughout a dozen hits from Broadway musicals. He is a prodigal admirer on *Whatever Lola Wants,* a muted wonder on *Hey There,* a spanking tandem on *The Surrey With The Fringe On Top,* and his quartet is a whole brass band on *Seventy-Six Trombones.* One of his pleasantly jaunty vocals expresses *Just My Luck.* When Jones first came to Swing Street, a number of trumpet players could match his warm, driving style. But the ways of trumpet have changed, and now not many can equal his taste and faultless skill. In the midst of a successful run at Boston's Storyville, with his previous album on the best-seller list, he is claiming the appreciation that is his due. This disc can serve only to widen his audience.

**Freddie Redd:** San Francisco Suite
**Riverside RLP12-250**

The five sections of his impressionistic suite describing various points in San Francisco are sufficinet reason for the introduction of the talents of Freddie Redd, a young pianist who also composed three tunes for the session. A souvenir of a season spent playing in the shadow of the Golden Gate Bridge, his remembrance of the city ranges from that structure to Chinatown, the Barbary Coast, an after-hours club, and finally to the city streets at dawn. He draws his pictures so effectively that the thirteen-and-a-half minutes required for their completion passes quickly, leaving a wish for more. This desire is partly requited by his *Minor Interlude,* and *Blue Hour.* Bassist George Tucker and drummer Al Dreares combine in his support.

**Jimmy Knepper:** A Swinging Introduction
**Bethlehem BCP77**

Having gained recognition as one of the most individual of the new trombonists for his contribution to the Mingus Jazz Workshop, Jimmy Knepper, in his first LP as a leader, continues to solidify his position by writing three pieces to fill out a more personal portrait of his abilities. With the descriptive titles of *Ogling Ogre, Avid Admirer,* and *Idol of the Flies,* they confirm his knack for using his instrument as a tool to create unusual voicings. He wears the technical proficiency of an advanced modernist with a careless air. Rather than form phrases of ironed-out smoothness, he has a way of making them seem almost hesitant as he sings with the composure of a Dickenson, or lashes out with the dramatic impact of a Higginbotham. He avoids well-trodden paths on *How High The Moon,* and *Irresistible You.* Trumpeter Gene Roland alternates as a second voice with Gene Quill, on alto sax, and is vocalist on *Gee Baby Ain't I Good to You.* Pianist Bill Evans meets the challenge set by Knepper with productive solos. Teddy Kotick plays bass, and the drummer is Danny Richmond, a strong cohort in the Mingus group.

**Leroy Vinnegar:** Leroy Walks!
**Contemporary C3542**

Not only does this appropriately named album revolve around the walking bass of Leroy Vinnegar and the basic rhythm it implies, but the key word motivates each of the tune titles. On this sextet session, he is joined by pianist Carl Perkins, his partner in the duo formed on severance of his association with Shelley Manne. The conversations which distinguished his work with the drummer are continued with Perkins and Vic Feldman, an import from Britain and a lucid performer on vibraharp. Gerald Wilson on trumpet and Teddy Edwards on tenor sax are veterans with much to say, and drummer Tony Bazley makes his recording debut.

To categorize his function, Vinnegar introduces his bass on *Walkin',* a pulsating catalogue of his own devising lasting more than eight minutes. He builds a solid foundation before entering into byplay with the other instruments on *I'll Walk Alone, Walkin' My Baby Back Home,* and *Walkin' By the River.* His version of *Would You Like to Take*

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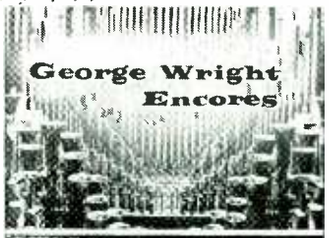


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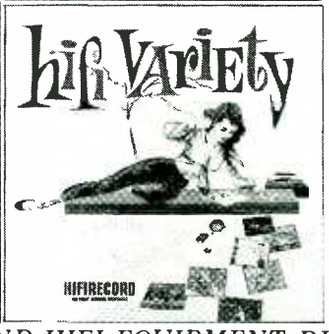


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**John Coltrane:** Blue Train
**Blue Note 1577**
**John Coltrane With The Red Garland Trio**
**Prestige 7123**

The emergence of John Coltrane as an important voice on the tenor sax is one of the most happy events of the past two seasons. It began during his stay with Miles Davis and reached full flower during his association with Thelonious Monk. His resultant engagement as a leader of studio groups is enabling him to reach new heights of personal expression, as exemplified by these two settings. At the head of a sextet, he makes *Blue Train* an impressive revelation of his deep roots in the blues. One of his four originals in the set, it allows for a round of exchanges by Lee Morgan on trumpet, Curtis Fuller on trombone, and a superbly timed interlude by pianist Kenny Drew. A bowed solo by Paul Chambers on bass enlightens *Moment's Notice*, and drummer Philly Joe Jones sets an infectious pace on *Locomotion*. A slow, melodic treatment is given *I'm Old Fashioned*, and *Lazy Bird* flows smoothly.

On the trio session, he rejoins Chambers and pianist Red Garland of his days with Miles Davis, plus Art Taylor on drums. The firmness of his statements on *Traneing In* permits the rhythm members to contribute much more than support. With no need to bolster Coltrane's solos or feed his flow of ideas, they make good use of their freedom. Alonzo Levister's absorbing and moody *Slow Dance* makes for a rewarding group effort. Chambers is featured on *Bass Blues*, and the ballads show Coltrane in two different approaches. He is most vocal on a slow *You Leave Me Breathless*, and charges with intensity through *Soft Lights and Sweet Music*.

**A Night At The Village Vanguard**
**Blue Note 1581**

For twenty-three years, under the guidance of Max Gordon, the Village Vanguard has fostered fresh talent and forecast new trends in entertainment. By coincidence, the first recording date before a live audience on the premises marks the premiere engagement of Sonny Rollins as leader of his own group. In the two opening weeks, he tried working with a trumpet and two different rhythm sections. By the time engineer Rudy Van Gelder set up his equipment in the club, a compact trio, with Wilbur Ware on bass and drummer Elvin Jones, spotlighted the highly personalized Rollins' tenor sax. It is an East Coast version of the instrumentation that worked so successfully on his Contemporary album, "Way Out West".

Similarly calculated to please a varied public, the program lists three standards as settings for the original concepts and fresh melodic ideas of Rollins on *Old Devil Moon, Softly As in a Morning Sunrise*, beautifully paced by Ware's long solo, and *I Can't Get Started*. Two improvisations by Rollins, *Striver's Row* and *Sonnymoon for Two*, show his impassioned and healthy feeling for the blues. His passages on a modern standard, *A Night in Tunisia, are* inventive, and Pete La Rocca, a new drummer, sits in for a well-applauded solo with Donald Bailey on bass. Altogether, a happy session before a friendly and cooperative gathering.

**John Jenkin, Vol. 1** **Blue Note 1573**

In his first LP as a leader, John Jenkins offers his alto sax in unison with the guitar of Kenny Burrell. Numbered among the rising Chicago crop of saxophonists, he is most impressive on the four originals, where he shows a likeness to Sonny Rollins in his ability to speak with more than one voice in the same phrase. *Sharon*, with a strong solo by pianist Sonny Clark, and *Chalumeau*, a memento of his experiences with the clarinet, are thoughtful examples of his style when it is most his own. His *Motif* is a blues, and Burrell contributes *Blues For Two*. As in the case of many of the younger men, he is pleasantly derivative on such tunes as *From This Mo-*

*ment On* and *Everything I Have Is Yours.* But when he relates his more personal moments to ballads, the synthesis gives him an individual style and makes him a figure to be reckoned with. Bassist Paul Chambers is teamed with the able Dannie Richmond on drums.

**Sonny Rollins:** Tour De Force
**Prestige 7126**

One of the distinctive facets of Sonny Rollins' style on tenor sax is his playful quirk of seeming at times to provide his own backgrounds. So secure is he on his instrument that he can alter his tone and style at will. This engaging characteristic is displayed on a blues figure in *Ee-ah,* an extended excursion for his innovations which finds drummer Max Roach entering into the rhythmic byplay. The other tunes for the quartet, with pianist Kenny Drew and George Morrow on bass, bear out the album title. In a spirited and percussive mood, Rollins is uncompromising in his attack, even transforming a waltz into biting four-beat measures. Behind vocalist Earl Coleman, he relaxes and calmly urges the last drop of melody from *Two Different Worlds* and *My Ideal.* When the slow tempos do not cause him to sound too mournful, Coleman's mellow baritone blends well with the horn.

**Chet Baker and Art Pepper:** Playboys
**World Pacific PJ1234**

This collaboration between two West Coasters comes at a time when their evolving styles best complement each other. The stronger, more incisive attack of Baker's trumpet mates well with the rhythmic push of the passionate lines of Pepper's alto sax. In the front line is tenorman Phil Urso, and the sextet is filled out by Curtis Counce on bass, Carl Perkins on piano and drummer Lawrence Marable. All the numbers, except for two by Pepper, come from the pen of Jimmy Heath and include *C.T.A., Picture of Heath,* and a ruminative blue in *For Miles and Miles.* By chancing on the psychological moment to form a team, the leaders stimulate one another with unflagging inspiration and the combination seems destined for a rich future.

**The Chase Is On** **Bethlehem BCP6021**

Elusive enough in actual performance, the spirit of jazz improvisation is not always transferred from the studio to discs. Due to the fortunes of recording, the electricity present at a blowing session, still the most productive source of inspiration, may seem calculated and contrived because of lack of presence, or emerge as just so much nervous tension. Thanks to the perception of producer Chuck Darwin in inviting Charlie Rouse and Paul Quinichette to engage in a tenor-sax duologue, the conversation is conducted here on a high plane, distinguished by insight and spontaneous wit. And thanks to the engineering by Dave Hancock, their fertile exchanges are kept firmly in balance and none of the texture of the blended horns is dissipated.

The title tune ably projects the supercharged atmosphere of the rest of the set. Pianist Wynton Kelly is replaced by Hank Jones and guitarist Freddie Greene is added on the reflective *When The Blues Come On* and *You're Cheatin' On Me.* Drummer Ed Thigpen and bassist Wendell Marshall comment pungently on the Rouse original *Knittin'.* Both of the horns have much to say, as Rouse and Quinichette evolve subtle patterns to complement each other, and are glowingly expressive on *This Can't Be Love, Tender Trap,* and *Last Time For Love.*

**Rendezvous With Kenton** **Capitol T932**

On his return to the Rendezvous Ballroom, the cares of ownership are assumed by Stan Kenton and to unveil his band in its renovated setting in Balboa, by the Pacific, he depends upon unprententious, danceable standards. Ten ballads are framed by his new arranger, Joe Coccia, who contributes *Desiderata,* featuring the bass trombone of Kenny Shroyer, and *Two Shades of Autumn,* for the interweaving of the alto sax of Lennie Niehaus and the tenor sax of Bill Perkins. Trumpeter Sam Noto solos on *They Didn't Believe Me* and *I See Your Face Before Me.* Neihaus encores on *Love Letters,* and Perkins on *This Is No*

*Laughing Matter.* When Kenton serves up this fare, his eye is on patrons of his new venture rather than devotees of concert jazz, but there is something for both on the menu. It is today's version of the stimulating music which first brought the band into prominence at the same spot in 1941. Kenton prevailed on Capitol engineers to record him in his reclaimed home and the acoustics allow him room to stretch. The natural big-hall sound is a delight and a happy forecast of things to come.

### Bill Harris: The Harris Touch
**EmArcy MG36113**

Since 1950 an accompanist for the Clovers, a rhythm and blues vocal group, Bill Harris surprised and pleased quite a few listeners with his first solo album on which he played unamplified classical guitar. This time he also uses the electric guitar and is supported by a rhythm section of varying strength, depending upon the tune and Hank Jones' inclination to switch from piano to celeste. His orientation in the blues is broad, extending from the basic feeling of *Baker's Dozen,* through the modern atmosphere of *Midnight Blue,* and *Golden Sunset,* before returning to *Rock Bottom Blues.*

The two instruments allow for rich contrast in style, and the sound is further enhanced by the celeste. There are a finely formed *Yesterdays,* and *All The Things You Are.* Bongos underline *The Harris Touch,* and *Spring* is a semi-classical study. It is hardly unique to find a jazz guitarist who admires Andres Segovia, but the determination of Harris to realize his full potential in both directions gives his work absorbing value. Still not a stylist in the static sense, his development should hold much interest.

### Billie May: Jimmie Lunceford In Hi-Fi
**Capitol TA0924**

In its heyday the big Lunceford band combined all the elements necessary to still cause Billy May to regard it as "The greatest all-around outfit ever." To pay tribute to Jimmie's organization, he enlists several of the original sidemen to help recreate fifteen of its most popular arrangements. Willie Smith is on hand to lead the sax section on alto and play baritone on *My Blue Heaven.* Joe Thomas comes out of retirement to reclaim his tenor-sax chair and sing the rhythm chorus on *Four or Five Times.* And trombonist Trummie Young returns home to spell Dan Grissom on the familiar vocals of *Ain't She Sweet, Margie, Coquette,* and *Tain't What You Do.* Mannie Klein and Pete Candoli share the trumpet solos and drummer Alvin Stroller sets the Lunceford tempo.

Many bands have sucessfully incorporated portions of the Lunceford style in the two decades since it was set, but none has absorbed them all. Its fusion of the white heat of the stomping bands of the Southwest with the most commercial aspects of East Coast units was unique and still holds a fascination for bandsmen. To display all its sides, Billy May includes the swinging instrumentals *For Dancers Only, Uptown Blues,* and *Rhythm Is Our Business.* Made at Capitol Tower last July, the recording is packaged with several photographs and an account of the original band by Dave Dexter, Jr.

### Jo Ann Miller: Unrestrained
**Audio Fidelity AFLP1864**

One of the last students in the late Tommy Dorsey's school for rising singers, Jo Ann Miller found a niche in smart clubs and hotels after her graduation. With a repertoire broadened to enclose just about every kind of vocal style, she brings a little-girl naiveté to the sophisticated *Good Little Girls* and *Married I Can Always Get.* She seems most natural on *When the World Was Young,* and follows modern trends on *Look to the Rainbow* and *Baubles, Bangles and Beads.* Either her Texas upbringing or her interest in archaeology, studied in a post graduate course at Columbia, prompts a revival of Bessie Smith's *Gimme a Pigfoot.* She finds enthusiasm for *New Orleans* and *Nobody's Sweetheart* before striking a blues mood on *House of the Rising Sun.* Her voice deserves the excellent recording and she makes the best of the arrangements by Dick Marx as played by Benn Arden and his Palmer House orchestra.

**Jackie Gleason: The Torch With The Blue Flame** **Capitol W961**

The man who caused Bobby Hackett to tangle with mood music is back again. This time Lawrence Brown, the former Duke Ellington trombone star, is the subject for conversation and he takes it in stride. His haunting lines on *My Silent Love, Hey There,* and *I've Grown Accustomed To Her Face* are no less than might be expected of him. But the imaginative touch of blithely lining up eight marimbas with orchestra to underline his lyric horn comes from Jackie Gleason, and the complement makes a lustrous sound. The old master of languishing strings and retarded tempos contributes two pensive tunes of his own in *Time,* and *Alone In The Crowd.* Aiming to give pleasure, Gleason has a tight rapport with his listeners.

**A Frenchman In New York** **Riverside RLP12-818**

**Lotte Lenya: September Song** **Columbia KL5229**

During an engagement at the Blue Angel in New York, the young French entertainer Luc Poret introduces the format of his act to a small studio audience. When not accompanying himself on guitar, an accomplishment picked up in a German prison camp, he is joined by the trio from the club, led by pianist Jimmy Lyon. Much of the material gains from his zestful touch as lyricist or composer, and includes his setting of Garci Lorca's *Lola.* Current French and American songs are topped off by a group effort on a medley of children's songs.

Various singers recorded the American theater songs of Kurt Weill before this album by the person who undoubtedly knows them best, having tested and first brought them to life for the composer. In a dozen of the most unforgettable, Lotte Lenya is accompanied by a chorus and orchestra conducted by Maurice Levine. Her normally astringent voice is fluffed out by use of a vocalist's chamber to conform to the pop dimensions of a Polly Bergen or Eydie Gorme, but its emotional coefficient is not reduced to the same common denominator.

**Arthur Lyman: Taboo** **Hifirecord R806**

Recorded in the shiny half-sphere of Henry J. Kaiser's new Aluminum Dome, outside the Hawaiian Village Hotel in Honolulu, the versatile quartet headed by Arthur Lyman contrasts the primitive and the modern in the music of the islands. Nominally, the leader plays vibes, John Kramer, bass; Alan Soares, piano; and Harold Chang is drummer. But they all double on a variety of instruments, including such oddities of percussion as the boobams, guido, asses' jaw, and a sweetly lowing conch shell. The more exotic sounds are lightened by the sprightly *Hilo March,* and Paul Conrad's *China Clipper.* The spacious effect of the auditorium is broadened by the calls of actual birds, native cries, and the beating of Pacific waves.

**9th Regiment Pipe Band: Bagpipes and Drums** **Audio Fidelity AFLP1857**

Formed in 1943, the Ninth Regiment Pipe Band is the only such organization recognized as part of the New York State National Guard and takes a prominent role in Armed Forces Day and other parades in Manhattan. In his capacity as drum sergeant, James Bell, the stately snare drummer on the cover photograph, leads the representation from the 14th Street Armory in the studio. One of the organizers and original members, he restrains any impulse of his corps to take up a marching step. For this is a carefully controlled recording, with no review of passing colors or abatement of the grandness of sound as the formation moves off into the distance. A sense of movement is gained by a skillful separation of the sections, by contrasting the beat of the snare and bass drums, with the skirling bagpipes dancing unimpeded above the solid foundation.

Those persons who frequently wonder if the pipes are really playing a tune on some recordings will have no trouble here in detecting the melodies, and will be even more surprised at their tonal possibilities. An as-

(*Continued on page 58*)

# NEW PRODUCTS

● **Belden Audio Cables.** A number of audio cables intended primarily for speaker extension lines have recently been added to the electronic wire and cable assortment manufactured by Belden Manufacturing Company, Chicago 80, Ill. Types 8460 and 8461 are not shielded and are intended for lines from 16 to 500 ohms and distances from 200 to 2000 feet. Types 8470 and

8471, also unshielded, apply to high-power installations of 50 to 75 watts and are designed for use in open areas for lines 300 to 3000 feet in length. Types 8779 and 8780, illustrated, are intended for use where cables are installed in groups and where shielding is required to reduce induced signals. All of these cables are described in detail in Belden's new Electronic Wire and Cable Catalog No. 857. **E-1**

● **Fisher Stereo Master Control.** Stereophonic facilities of the new self-powered Fisher Model 400 Master Audio Control and Preamplifier provide for the use of tapes, discs, microphones, FM-FM, FM-AM, and FM-Multiplex. Offering extreme versatility, the 400 incorporates monitoring facilities when it is used for stereo or monaural recording, and can be used as an electronic crossover network to drive a dual-channel amplifier-speaker system. Notwithstanding its many uses, the 400 is

simple to operate. Rumble and low-frequency noise are eliminated by a two-circuit rumble filter with exceptionally sharp cut-off for use in both monaural and stereo operation. Sixteen input jacks are arranged in eight pairs for any combination of stereo inputs. Four output jacks are provided on the rear apron. A push-button input selector incorporates jeweled indicator lamps. One-knob channel balance control permits adjustment of stereo balance according to the listener's position with relation to speakers. A versatile 6-position output selector includes a "reverse" position for transposing stereo output. Complete technical specification will be mailed upon written request. Write Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N. Y. **E-2**

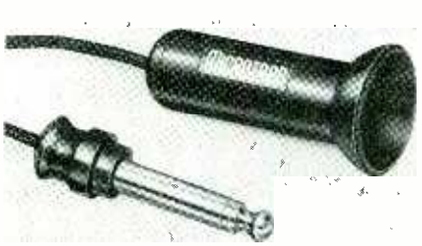
● **Re-Styled R-J Speaker Enclosures.** Enhanced appearance, as well as improved performance, is quickly evident in five completely re-styled models of R-J speaker enclosures. The R-J/8 is a new version of the original R-J single bookshelf model for 8-in speakers. Similar in design is the R-J/12-S, intended for 12-in. speakers and built to fit on two shelves of a standard bookcase. The R-J/12-F and R-J/16, illustrated, are floor models for 12- and 15-in. speakers, respectively, which feature a new molding and tapered legs with brass ferrules. The R-J/Super 8 is a complete ready-to-play speaker system consisting of the R-J/8 enclosure equipped with a Wharfedale Super 8/FS/AL speaker. In the new enclosures triple-rigid laminate board of uniform density is

used in front, rear and baffle panels. This special board is of equal strength longitudinally and transversely. Its purpose is to insure that no spurious resonances are caused by cabinet surface vibrations. For full information on the new R-J enclosures, write Dept K39, R-J Audio Products, Inc., 80 Shore Road, Port Washington, N. Y. **E-3**

● **Tape Strobe.** This is a new stroboscopic device for the ready checking of tape speeds of all tape recorders and reproducers. Known as the Tape Strobe, it comprises a precision-ground wheel mounted in a machined aluminum yoke in such a manner that the user may apply it di-

rectly to moving tape. Under a 60-cps light source, reference marks on the wheel disc appear to stand still if the tape is moving past the capstan at correct speed. Calibrations are provided for 7.5, 15, and 30 ips. Diameter accuracy is ± 0.0005 in. Scott Instrument Labs, 17 E. 48th St., New York 17, N. Y. **E-4**

● **Telephone Pickup Coil.** Useful for transcribing telephone messages through a tape recorder, or for making messages audible to a group through an amplifier,



the Microtran telephone pickup coil is only 2 ins. long and but ⅝ in. in diameter. It may also be used as a probe for locating hum sources. The new unit has improved sensitivity and is more effectively shielded than earlier models. It is supplied with a 6-ft. shielded cable and standard phone plug. Microtran Company, Inc., 145 E. Mineola Ave., Valley Stream, N. Y. **E-5**

● **Altec Lansing 40-Watt Amplifier.** Featuring a 70-volt output for multiple speaker installations, the new Model 350A amplifier delivers 40 watts with less than 0.5 per cent harmonic distortion. Frequency response at full output is 20 to

20,000 cps within ± 0.5 db. Although the 350A was engineered primarily for home high fidelity and public address use, an accessory input line matching transformer is available to adapt the amplifier for use with professional mixing and recording equipment. Altec Lansing Corporation, Anaheim, Calif. **E-6**

● **Professional Tape Demagnetizer.** Engineered specifically for use in video tape broadcasting, music and motion picture recording, telemetering and commercial data recording, the Model N-2 is the latest in the line of "Noiserasers" manufactured by Librascope, Inc. Reels up to 10½ ins. in diameter and tape up to 2 ins. in

width can be handled. Rapid degaussing is accomplished through use of an automatic turntable which eliminates the hand rotation method of most tape demagnetizers. Model N-2 is equipped with a circuit breaker and switch for the degaussing magnet and thermal overload protection is provided to prevent coil burnout. Full information is available from the Commercial Division, Librascope, Inc., subsidiary of General Precision Equipment Corp. 40 E. Verdugo Ave., Burbank, Calif. Ask for Bulletin N-2. **E-7**

# It's HARVEY'S For Hi-Fi!

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**Model 555** ..... **$549.00**

Also available with two James B. Lansing Signature 12" speakers (Model D123) in individual enclosures that combine to form matching carrying case. Complete system consisting of recorder and speakers.
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The new Glaser Steers GS Seventy Seven is the first high fidelity record changer with turntable quality performance. Rumble, wow and fluter have been virtually eliminated by precision engineering. GS-77's table stops – completely – between records! And, with "Speedminder" both record and stylus are protected.
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Elegance and perfection. Meticulously designed and engineered for the ultimate in sound reproduction throughout the entire audible spectrum. Housed within the infinite baffle enclosure are 2 B207A's, a complete 2-way system in itself; 1 B209, a mid-range of the highest clarity; and 1 N102, a convertible crossover network. Affords a wide angle listening area of 120 degrees.
**Price: B-305 Contemporary**..... **$409.50**

## ELECTRO-VOICE
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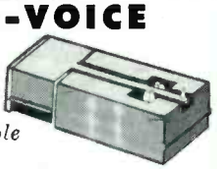

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## LEKTROSTAT
Record Cleaning Kit

Kit contains a non-gumming anti-static detergent, sufficiently concentrated to require only a few drops to eliminate static electricity and clean not only the record surface but the grooves.

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# TWIN-T NETWORKS

(*from page 24*)

the input resistance of either a grounded-base or grounded-emitter stage provides quite a low resistance load for the output of the twin-T.

If the classic values of 2, 2, and 1 are used, the operational conditions will be quite similar to those when a cathode follower is used as a constant-voltage source at the output, feeding into a grid at the input end to represent an open circuit. But if other combinations are used, the relative values of $a$ and $b$ will need to be reversed as represented by the corresponding expressions in the appendix.

The third possiblility in the use of twin-T networks consists of using them to modify a rolloff characteristic. This has been done quite successfully by designing the basic amplifier to roll off gradually elsewhere in its circuit, either by the use of feedback configuration or direct losser circuit. Then the twin-T is used around a straight section of amplification to produce alternative negative, positive, and finally negative feedback characteristics. This is achieved by using values that produce a phase inversion and the way the combined response characteristic is achieved is illustrated in *Fig.* 15.

The amount of positive feedback achieved at the point of critical frequency of the twin-T network is quite precisely controlled by choice of values, using reasonable tolerances in selecting these values. What needs controlling then to produce accurate frequency response is the forward gain of the stage over which this feedback is applied. Usually degenerative cathode feedback takes care of this quite well to insure that the stage gain is controlled within close limits.

The final application puts the twin-T in the forward part of an amplifier, and uses straight negative feedback to sharpen up the response, to get steeper sides than curve (A) of *Fig.* 9. At the null point, there may be some transfer through the feedback network (operating in reverse). This can be offset to produce a true null by adjusting values so that this is balanced out at the output.

## Appendix

Assuming a network with the values shown in *Fig.* 1, at the critical frequency, working from a constant-voltage source into open-circuit load,

$$\frac{V_o}{V_i} = \frac{c^2(a+b) - abc}{c^2(a+b) + a^2(b+c)} \qquad (1)$$

Or, working from constant-current source into short-circuit load,

$$\frac{I_o}{I_i} = \frac{c^2(a+b) - abc}{c^2(a+b) + b^2(a+c)} \qquad (2)$$

Taking the network with the values shown in *Fig.* 2, at the critical frequency, working from a constant-voltage source into open-circuit load,

$$\frac{V_o}{V_i} = \frac{(a+b-c)b}{b(a+b) + c(a+c)} \qquad (3)$$

Or, working from constant-current source into short-circuit load,

$$\frac{I_o}{I_i} = \frac{(a+b-c)a}{a(a+b) + c(b+c)} \qquad (4)$$

For the circuit of *Fig.* 1, the condition for null is,

$$\frac{ab}{a+b} = c \qquad (5)$$

Or, for the circuit of *Fig.* 2, the condition for null is,

$$a + b = c \qquad (6)$$

If the special condition $a = b$ is imposed, Eqs. (*1*) and (*2*) reduce to,

$$\frac{V_o}{V_i} \text{ or } \frac{I_o}{I_i} = \frac{2c^2 - ac}{2c^2 + ac + a^2} \qquad (7)$$

while Eqs. (*3*) and (*4*), with the same condition reduce to,

$$\frac{V_o}{V_i} \text{ or } \frac{I_o}{I_i} = \frac{2a^2 - ac}{2a^2 + ac + c^2} \qquad (8)$$

The maximum phase reversal condition is achieved by the ratio, for condition (*7*) (in *Fig.* 1),

$$\frac{a}{c} = 2(1 + \sqrt{2}) \qquad (9)$$

or, for condition (*8*) (in *Fig.* 2),

$$\frac{c}{a} = 2(1 + \sqrt{2}) \qquad (10)$$

For both these value combinations, the transfer at critical frequency is given by,

$$\frac{V_o}{V_i} \text{ or } \frac{I_o}{I_i} = -\frac{1}{5 + 4\sqrt{2}} \doteq -\frac{1}{10.656} \text{ or } -.09384 \qquad (11)$$

If the values of $a$ and $b$ are varied independently, the condition for maximum phase reversal requires, in *Fig.* 1, progressively higher values of: $b$ in Eq. (*1*); $a$ in Eq. (*2*); or, in *Fig.* 2, progressively smaller values of: $a$ in Eq. (*3*); $b$ in Eq. (*4*).

Fixing a value for $b/c$ in Eq. (*1*), the maximum phase reversal value for $a$ is found by,

$$\frac{a}{c} = \frac{\frac{b}{c}}{\frac{b}{c} - 1}\left[1 + \sqrt{\frac{\frac{b}{c} + 2}{\frac{b}{c} + 1}}\right] \qquad (12)$$

Fixing a value for $a/c$ in Eq. (*2*), the maximum phase reversal value for $b$ is found by,

$$\frac{b}{c} = \frac{\frac{a}{c}}{\frac{a}{c} - 1}\left[1 + \sqrt{\frac{\frac{a}{c} + 2}{\frac{a}{c} + 1}}\right] \qquad (13)$$

Fixing a value for $c/a$ in Eq. (*3*), the maximum phase reversal value for $c/b$ is found by,

$$\frac{c}{b} = \frac{\frac{c}{a}}{\frac{c}{a} - 1}\left[1 + \sqrt{\frac{\frac{c}{a} + 2}{\frac{c}{a} + 1}}\right] \quad (14)$$

Fixing a value for $c/b$ in Eq. (4), the maximum phase reversal value for $c/a$ is found by,

$$\frac{c}{a} = \frac{\frac{c}{b}}{\frac{c}{b} - 1}\left[1 + \sqrt{\frac{\frac{c}{b} + 2}{\frac{c}{b} + 1}}\right] \quad (15)$$

The limiting case for maximum phase reversal occurs when: $b = \infty$ in Eq. (1); $a = \infty$ in Eq. (2); $a = 0$ in Eq. (3); $b = 0$ in Eq. (4). This reduces Eqs. (1) through (4) to, respectively:

$$\frac{V_o}{V_i} = \frac{c^2 - ac}{c^2 + a^2} \quad (16)$$

$$\frac{I_o}{I_i} = \frac{c^2 - bc}{c^2 + b^2} \quad (17)$$

$$\frac{V_o}{V_i} = \frac{b^2 - bc}{c^2 + b^2} \quad (18)$$

$$\frac{I_o}{I_i} = \frac{a^2 - ac}{c^2 + a^2} \quad (19)$$

Using these expressions, the values for maximum phase reversal, in the configuration of *Fig.* 1,

$$\frac{a}{c} \text{ or } \frac{b}{c} = 1 + \sqrt{2} \quad (20)$$

or in the configuration of *Fig.* 2,

$$\frac{c}{b} \text{ or } \frac{c}{c} = 1 + \sqrt{2} \quad (21)$$

For these hypothetical value combinations, the maximum possible phase reversal, which cannot be achieved by a practical circuit, but only approached, is

$$\frac{V_o}{V_i} \text{ or } \frac{I_o}{I_i} = -\frac{1}{2(1 + \sqrt{2})} \doteq -\frac{1}{4.828} \text{ or } -.207 \quad (22)$$

For any circuit giving null condition, assuming one or other of the ideal conditions specified, the transfer response can be given in the form,

$$\frac{V_o}{V_i} \text{ or } \frac{I_o}{I_i} = \frac{\left(x - \frac{1}{x}\right)^2 + j2d\left(x - \frac{1}{x}\right)}{\left(x - \frac{1}{x}\right)^2 + 4d^2} \quad (23)$$

where $x = f/f_o$, $f_o$ is the critical frequency (null), and $d = a/c$ for (1), $d = b/c$ for (2), $d = c/b$ for (3) and $d = c/a$ for (4).

This can be expressed in terms of magnitude and phase response: magnitude,

$$db = -10 \log_{10}\left[1 + \left(\frac{2d}{x - \frac{1}{x}}\right)^2\right] \quad (24)$$

and phase,

$$\varphi_t = \tan^{-1}\frac{2d}{x - \frac{1}{x}} \quad (25)$$

At null, no impedance reflection occurs, and the input impedance, *Fig.* 1, is given by,

$$Z_i = \frac{(1 - j)[c^2(a + b)^2 + a^2b^2]}{2[c^2(a + b) + b^2(a + c)]} \quad (26)$$

and for the circuit of *Fig.* 2,

$$Z_i = \frac{(1 - j)a[b(a + b) + c(a + c)]}{(a + b)^2 + c^2} \quad (27)$$

Similarly the output impedance, for *Fig.* 1, is,

$$Z_o = \frac{(1-j)[c^2(a+b)^2 + a^2b^2]}{2[c^2(a+b) + a^2(b+c)]} \quad (28)$$

and for the circuit of *Fig.* 2,

$$Z_o = \frac{(1-j)b[a(a+b) + c(b+c)]}{(a+b)^2 + c^2} \quad (29)$$

Assume in arrangement (*1*), $a$ has an error of $e$ per cent. This expression then becomes,

$$\frac{V_o}{V_i} = \frac{c^2[a(1+.01e)+b] - abc(1+.01e)}{c^2[a(1=.01e)+b] + a^2(b+c)(1+.02e)} \quad (30)$$

Substituting the correct value of $b = \frac{ac}{a-c}$ this becomes,

$$\frac{V_o}{V_i} = \frac{-.01ec^2}{2a^2} \quad (31)$$

Assume, in the same arrangement, $b$ has the error of $e$ per cent. Eq. (*1*) then becomes,

$$\frac{V_o}{V_i} = \frac{c^2[a+(1+.01e)b] - abc(1+.01e)}{c^2[a+(1+.01e)b] + a^2[b(1+.01e)+c]} \quad (32)$$

Substituting the correct value of $a = \frac{bc}{b-c}$ this becomes,

$$\frac{V_o}{V_i} = \frac{-.01ec}{2(a+b)} \quad (33)$$

Finally, assume $c$ has the error of $e$ per cent. Eq. (*1*) now becomes,

$$\frac{V_o}{V_i} = \frac{(1+.02e)c^2(a+b) - (1+.01e)abc}{(1+.02e)c^2(a+b) + a^2[b+(1+.01e)c]} \quad (34)$$

Making the appropriate substitutions, this simplifies to,

$$\frac{V_o}{V_i} = \frac{.01ec}{2a} \quad (35)$$

Following through with the remaining expressions, for the arrangement represented in Eq. (*2*), $e$ per cent error in $a$ produces,

$$\frac{I_o}{I_i} = \frac{-.01ec}{2(a+b)} \quad (36)$$

With $e$ per cent error in $b$,

$$\frac{I_o}{I_i} = \frac{-.01ec^2}{2b^2} \quad (37)$$

And with $e$ per cent error in $c$,

$$\frac{I_o}{I_i} = \frac{.01ec}{2b} \quad (38)$$

Using the configuration of *Fig.* 2, and the condition represented in Eq. (*3*), $e$ per cent error in $a$ produces,

$$\frac{V_o}{V_i} = \frac{.01eab}{2c^2} \quad (39)$$

With $e$ per cent error in $b$,

$$\frac{V_o}{V_i} = \frac{.01eb^2}{2c^2} \quad (40)$$

And with $e$ per cent error in $c$,

$$\frac{V_o}{V_i} = \frac{-.01eb}{2c} \quad (41)$$

Finally in the condition represented by Eq. (*4*), $e$ per cent error in $a$ produces,

$$\frac{I_o}{I_i} = \frac{.01ea^2}{2c^2} \quad (42)$$

With $e$ per cent error in $b$,

$$\frac{I_o}{I_i} = \frac{.01eab}{2c^2} \quad (43)$$

And with $e$ per cent error in $c$,

$$\frac{I_o}{I_i} = \frac{-.01ea}{2c} \quad (44)$$

Note: In Eqs. (*31*), (*33*), and (*35*) through (*44*), approximations have been made on the assumption that quantity $e$ is small (not greater than the order of 1 per cent). Æ

# JAZZ AND ALL THAT

(*from page 53*)

sortment of medleys includes salutes to a Gaelic neighbor in *Minstrel Boy, Irish Washerwoman,* and *Wearing o' the Green.* There is the picturesque *Black Bear Caller Herrin',* and the final dramatic *Retreat,* with its stirring roll of drums. Its attention to detail and the cleanly defined sound make it one of the finest recordings of pipes and drums, and it will convert many listeners to the music of the Highlands.

**Mike Sarkissian:** Armenian Wedding
**Audio Fidelity AFLP1865**

After excursions to Port Said and other points of enlightenment with Mohammed El-Bakkar, this label continues its examination of the music of the Middle East. Through the good graces of Mike Sarkissian and the ensemble from his Cafe Bagdad, a visit to the scene of an Armenian wedding is as replete with strange rhythms and uncommon sounds as its predecessors. Perhaps because of the colder climate, the strains are even more fiery and exciting. It is a mountainous country and the bagpipe is added to the stringed instruments of more southerly neighbors. The timbre of a native drum is distinctive and its beat is compelling. Born in the United States, Sarkissian first learned from his parents the folk music of their native land. Since then he became an authority on the subject and made his club a center for the furthering of authentic dances. The recording conveys the atmosphere of that Mecca of entertainment.

**Jack Anderson:** Electronic Organ
**Audio Fidelity AFLP1856**

A young Texan who began to play the organ in his early teens, Jack Anderson has a talent for adding unexpected beauty to the ardinary pop tune. There is nothing heavy handed about his approach to *Once in Love with Amy, Indian Summer,* and *Early Autumn.* His own composition, *Page Nine,* has a quaint pastoral charm. On most numbers the Baldwin electronic organ is augmented by woodwinds, gui-

tar, stringed bass and the crisp sound of a versatile percussionist. Under the musical direction of Johnny Palmer, these instruments are introduced casually when they blend best harmonically with the organ. Many unusual tonal combinations result on such numbers as *Caravan, Paradise,* and *Roses of Picardy.* In his native Dallas, Anderson gained wide experience in mood music, but has a background in the classics. An audition acetate won him the chance to participate in this excellent recording and the opportunity for greater recognition.

**The Shanty Boys** **Elektra 142**
**Bob Cort:** Ain't It A Shame
**London LL1774**
**The Delta Rhythm Boys** **Elektra 138**

Known in England as skiffle, it still comes under the loosely applied designation of folk music in this country and, as noted on one liner, the best thing about it is folks singing together. The Shanty Boys refurbish some nearly forgotten songs and spirituals, import *Out After Beer* from Denmark, and include the shanties *Rubin Ranzo* and *Away Rio.* Guitarist Mike Cohen is lead voice of the group, with Roger Sprung on banjo, and Lionel Kilberg on one-string bass. Having traveled through the South, they are more fortunate in a closeness to source material than their British cousins.

A cheerful pub next to the London ffrr studios is the natural setting for the Bob Cort Skiffle session. The bearded leader adapts the jazz tunes *Yes! Suh!, Lulu's Back in Town,* and *Your Feet's Too Big,* in addition to folk songs of the United States. *I Can't Give You Anything But Love* and his own *Bouncing Around,* are solos by Ken Sybora, the excellent guitarist of the quartet.

The Delta Rhythm Boys are simply a good male quartet, somewhat of an oddity among vocal groups today. Pianist Rene De Knight's arrangements of pop and show tunes also are based on tradition being rapidly altered. Tenors Carl Jones and Traverse Crawford, baritone Kelsey Pharr, and bass Lee Gaines purvey good nature and a happy group sound.

**Mohammed El-Bakkar:** Sultan Of Bagdad
**Audio Fidelity AFLP1834**

Because the strange and curious sounds of the first volume featuring Mohammed El-Bakkar and his Oriental ensemble caught the fancy of the record-buying public, a second caravan of his exotic music is sped on its way. In another dozen selections, he makes use of a rich instrumental palette to conjure a vision of the Middle East. Whether it is the odd quarter-tone melodies, or the persistent urge of dance rhythms, which makes for the greatest attraction, there is no doubt but what the leader is a practiced showman who has found the secret of universal appeal. He knows how to create a mood and build to a climax. Unfortunately, only the titles of the verses are translated on the liner, but even they are a refreshing change from the usual popular song, with such enticing names as *Golden Hair, Send My Heart, Girlish Laughter, Empty of Love, Come With Me,* and *Glorious Fatima.*

**Jazz Swings Broadway**
**World Pacific PJM404**
**Kenny Drew:** Pal Joey
**Riverside RLP12-249**

The manner in which jazz groups are encouraged to adopt the showtunes of Broadway as a starting point for inspiration is resulting in some happy marriages and some unfortunate mismatches. These two discs show that ordinary tunes often are given an extended life, and the superior ones set forth in fresh flights of fancy. As a convenient way to assimilate the divergent styles and schools of jazz, they illustrate an important coincidental part of this trend. In the first, four West Coast groups examine numbers from "Li'l Abner," "My Fair Lady," "Damn Yankee," "The Most Happy Fella," "Bells Are Ringing," and "Happy Hunting." The Bud Shank-Bob Cooper Quintet sticks closest to musical-comedy conventions; the Chico Hamilton Quintet shifts the emphasis to quiet chamber music; and the Stu Williamson Quartet and Russ Freeman Trio are both paced by drummer Shelly Manne in vital inventions. Produced by pianist Russ Freeman, the record shows the considerable variety in groups lumped together in one school.

For "Pal Joey," the scene moves to his natural habitat on the East Coast. Pianist Kenny Drew follows the scheme of the movie version in adding to five tunes from the original score three other Rodgers and Hart numbers. They are *My Funny Valentine, The Lady Is a Tramp,* and *I Didn't Know What Time It Was.* With Wilbur Ware on bass and Philly Joe Jones on drums to keep a sharp, Eastern edge to the performance, he can be unrestrainedly melodic without losing any of the qualities belonging to jazz. The extent to which Drew combines a lyric tenderness with the zest of a quick succession of creative variations makes him a most successful purveyor of show material.

**June Christy:** Gone For The Day
**Capitol T902**
**New Voices** **Dawn DLP1125**

In place of a seasonal, wintry collection, June Christy looks forward to spring and a day in the country. On a dozen blithe and carefree ballads, she ranges from *Lazy Afternoon* to *When The Sun Comes Out* and *It's So Peaceful In The Country,* then back to *Lazy Mood.* Arranger Pete Rugolo employs three varied instrumental groups to complement the Christy excursion, and is the composer of the summery *Interlude.*

Like the three new voices on the second disc, all of whom have been married to musicians, away from the studio she is Mrs. Bob Cooper, wife of the West Coast tenor saxist. This is an advantage for a young singer, equalled only by the steady work that Miss Christy had with the Kenton band. In these days of the entertainment tax, such experience is not easy to come by and all suffer accordingly. If they could spend a few months singing in public, backed by the men gathered for this date, there would be some pleasant results. Rita Reys, the most promising, has the benefit of the arrangements of accordianist Mat Mathews, who leads a unit that includes Harry Lookofsky on viol d'amour. Sylvia Pierce is helped by her husband Nat, as arranger and pianist. Peggy Serra has similar aid from husband Hal, and sings *Ain't Misbehavin'* to the sole accompaniment of Oscar Pettiford on bass.

**Linda's Player Piano**
**Audio Fidelity AFLP1846**

As the eight-year-old daughter of a theater organist, Linda numbers a reconditioned player piano among her toys. Her father Leon Berry, who has appeared on two albums at the Wurlitzer for this label, bought it for twenty-five dollars and fixed it up from the inside out. When Sidney Frey heard it on a visit to the Berry home in the Chicago suburbs, it gave him the idea of putting some of the old music rolls on a record. For a choice of selections and the preparation of the liner notes, he enlisted the aid of Max Cortland, who in 1914 established Imperial Industries Company, now the leading producer of piano rolls in the world. After spending some time with the repertory of twenty million rolls, they decided that the masters punched by J. Lamston Cooke are most characteristic of the player piano sound. Most of the dozen popular numbers preserved are played by him with the numerous effects so typical of the perforated music sheet. They include *Mary Lou, In the Evening, Jolly Coppersmith, Under the Double Eagle,* and *National Emblem March.*

The sound might seem more natural if the piano were out of tune, but this is one occasion when an automatic instrument can be heard with good balance and dynamics. Two of the new Electro-Voice Model 667 microphones are partly responsible. They were developed by the staff under Louis R. Burroughs, vice president in charge of EV's broadcast and recording equipment, to fill the need for a mike with a variable response which would permit adjustments to be made from the con-

trol room. Its ruggedness was tested by the Navy in recording the take-off of jet aircraft at Las Vegas, but its two to one greater working distance makes it equally effective with a piano keyboard, especially in this instance where a close mike would pick up mechanical noises.

### Rolf Ericson And His American All-Stars
**EmArcy MG36106**

A memento of the tour the Swedish trumpeter Rolf Ericson made to his native land in the summer of 1956 with a group of American musicians, after leaving his chair as soloist in the Les Brown band, this album relocates him as part of the New York jazz scene. During his two trips to this country in 1947 and 1952, each lasting three years, he worked mainly on the west coast and made the big band circuit. But for his return home, he selected the team of Cecil Payne on baritone and pianist Duke Jordan, supported by drummer Art Taylor and bassist John Simmons, to highlight his thoughtful and fluid choruses.

Jordan's original *Forecast* allows Ericson to declare his allegiance to Miles Davis, and his *Flight to Jordan* has touches of Grieg's *Anitra's Dance* and the spiritual *Jericho*. A minor blues *Vacker Flicka* and the romping *Visby Groove Alley* recall the town where the unit made its headquarters. The ballads feature Ericson on *Everything Happens to Me*, Jordan on *I Cover The Waterfront*, and Payne is in good form on *Laura* and *This Time The Dream's On Me*.

### Herbie Mann: Great Ideas of Western Mann
**Riverside RLP12-245**

On his last album for this label, Herbie Mann used a bass clarinet to supply a deeper shading to the sound of the flute, his usual instrument, and ended up by playing it on one number. It proved more than a passing fancy and on a trip to Los Angeles he enlists four West Coasters to make the first LP devoted to its full-scale use throughout. Because it blends better than the flute in many ensembles, it should become a valuable adjunct as a second horn. Its distinctive tonal qualities are especially appropriate when augmenting the trumpet of Jack Sheldon, or weaving phrases around his solid line.

As this is in the nature of a test flight, Mann is not above injecting humor into *Get Out of Town* and *Is It True What They Say About Dixie*. He soars through his original *A Stella Performance* and relaxes on *The Theme*. He is melodic on *A handful of Stars* and fluent on Tadd Dameron's *Lady Bird*. Pianist Jimmy Rowles, and the team of Buddy Clark on bass and Mel Lewis on drums, are the other guests at the session at Capitol Tower. When Mann decides to put the flute and bass clarinet together on a date, it should be something to hear.

### Interplay For Two Trumpets And Two Tenors
**Prestige LP7112**

The guiding thought behind this session is that the two front lines of trumpet and tenor sax, one ostensibly of the cool school and the other of the modern hot school, might provide an informative illustration of the contrasting styles. Trumpeter Webster Young and Bobby Jasper on tenor sax represent the cool division, as opposed respectively to Idrees Sulieman and John Coltrane. On four numbers by pianist Mal Waldron, they test their strength in numerous solos and exchanges of varying length. A jazz battle it is not, but the mythical dividing line is crossed several times by the cool team as they warm up under the pressure of events, the persuasive lines of Coltrane and Sulieman's plunging trumpet. The surging rhythm section helps throw the balance of power in their direction. It includes Paul Chambers on bass, Art Taylor on drums, and is sparked by Kenny Burrell on guitar. Although he is a follower along the path Miles Davis charted, Young seems to favor a more positive phrase and a pungent tone. The exercises comprise two rhythm numbers, a fast blues and the expressive ballad *Soul Eyes* Æ

# AUDIOCLINIC

(*from page 4*)

internal impedance, $R_i$, and the external load or test resistance, $R_L$, are in series. $R_L$ and $R_i$ form a voltage divider. When $R_L$ is large with respect to $R_i$, a larger voltage will be developed across it than $R_i$. In fact, the voltages will divide in accordance with the ratios of the values of the resistances. Therefore, when the two resistances are equal in value, the voltage drops across them will be equal. The generator is supplying a constant voltage to the two resistors. When $R_L$ is infinite and $R_i$ some finite value of resistance, all the voltage available will develop across $R_L$. As the value of $R_L$ is reduced, more voltage is dropped across $R_i$ and less across $R_L$. When the values of $R_i$ and $R_L$ are equal, equal voltage drops will appear across the two resistances. Because the voltage of the generator has remained constant, the voltage across $R_L$ is half as much as it had been when $R_L$ was infinite. (When the test instrument has an impedance at least ten times that of the device being tested, the impedance of the meter may be considered infinite, and therefore will have negligible effect on the results of the test.

The reason for measuring impedance in this manner, rather than directly with an ohmmeter is that inductance and/or capacitance in the device to be measured cause it to have an impendance value different from the *resistance* value that which would be shown on an ohmmeter. **Æ**

# RECORD REVUE

(*from page 47*)

**The New Clavichord.** Red Camp.
**Cook 1133**

This is the clavichord jazz improvisation mentioned in the April AUDIO, ETC. It's an absolute recording, as then discussed, and if you will put the volume very low, almost to inaudibility, you'll hear what a jazz pianist sounds like in your room when he tries an actual clavichord for the first time.

Mr. Cook, with characteristic flamboyance, lists the player as "Red Camp, Clavichordist"—and his accompanying explanation, partly quoted in my earlier account, suggests that this recording makes a new instrument out of the clavichord. Just turn the volume up. It does—no doubt about that. But to say that the "old" clavichord is thus put out of the running is just silly and betrays, shall I say, a certain lack of knowledge of the musical qualities of the instrument. Why not—who expects everybody to know such things; I'm only saying again, for the record, that the clavichord is a great little classical instrument, capable of the most extraordinary refinement in the playing.

Which is to suggest that the Red Camp jazz is just what it is, the sound of a jazz pianist playing on a strange and unexpected keyboard. In fact, the guy didn't even know what he'd played until he heard the tapes, and was he surprised! Interesting stuff as jazz, if not as clavichord music.

**George Gershwin's Oh, Kay:** Orch. Chorus, solos, Lehman Engel.
**Columbia CL 1050**

I'll toss this one in here for your info, though, again as an interested outsider, I found it a let-down after all the sentimental build-up attached. Sure, it was 1924 and in the midst of the great nostalgic Twenties and all that; but this faithful re-creation of the original just says to me that Gershwin & Gershwin were, after all, a successful and inimitable pair of Broadway professionals who could turn out a polished product—and toss in all the current platitudes, too, a bit faster than the next guys.

So was a gent named George Frederick Handel, who was his own business manager and hired his own theatres and companies of performers, too. The comparison is interesting and maybe, some day, Gershwin & Gershwin will show up as the kind of all-time theatre that comes through in Handel (who wasn't always a big success, for that matter). Right now, I find "Oh, Kay" pretty padded and on the feeble side; but I expect to be outvoted vociferously by a million or so Gershwin fans. (Come to think of it, this kind of review will probably sell more records for Columbia than a rave notice. So be it.) **Æ**

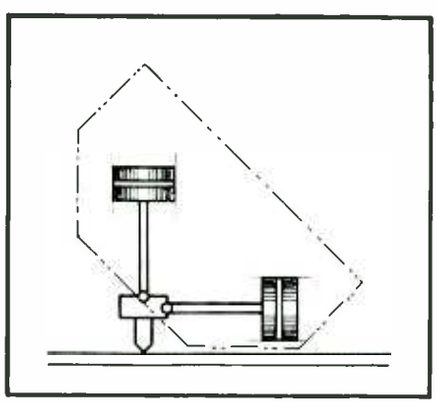
# AUDIO ETC

(*from page 14*)

Thus you see how a Westrex 45/45 cutter can also cut lateral-vertical recordings. You don't have to turn the cutter around 45 deg. physically—tipping it drunkenly sidewise at a 45-degree slant so one "piston" pushes up and down and the other is canted all the way over to the pure lateral!

Instead, you simply run signals $L$ and $R$ through an electrical matrix. One of them comes out entirely vertical, the other entirely lateral. Your cutter still does its cutting at the two 45-deg. angles, but the resulting record groove has one track up and down and the other sidewise. Tricky.

Suppose that you have a record in which tracks $L$ and $R$ are lateral-vertical, as in the excellent English Decca discs of last fall, demonstrated here in New York. You



can play the lateral-vertical record with a 45/45 stereo pickup—but what will come

out, you can see, is a combination of both tracks from each of the pair of responsive elements in the pickups. Each of them, operating at a physical 45-deg. angle, responds to both vertical and lateral motion —each produces half of each, track *L* and *R*, but oppositely, according to the opposed angle.

What can you do with such a mixed-up signal? Again, run it through an electrical matrix and it will come out, as nicely as you please, one resulting signal all-vertical and one all-horizontal. Your lateral-vertical record will then play correctly via the 45/45 pickup, as though you actually had rotated things an eighth-turn. (The only trouble is that transformers and associated circuitry may run into cash; other simpler ways of doing it might be easier, if and when.)

So the conclusion is that 45/45 signals can be converted into lateral-vertical signals and the reverse; anything may be made to play, or cut, anything. Interchangeability, via electrical matrixing.

### The Essential Stereo Message

Now for CBS again. The CBS laboratory study is exactly the sort of canny figuring that Dr. Goldmark's group is already famous for. The CBS Labs have always been intensely interested in the information aspect of sound reproduction. What are the *essential* information elements in musical or other reproduction? This has wonderfully interesting theoretical aspects, but also some hard-boiled commercial usefulness. Anything that simplifies sound reproduction, giving more effective sound for less cash, is highly practical in the commercial sense.

Readers, for example, will remember the first Columbia 360 phonograph, the original "hi-fi" table model, which used an ingeniously tricked up speaker enclosure to achieve a "big" sound in a very small box with small speakers. (The entire inside of the machine, with the lid closed, was part of the enclosure, and the two speakers pointed out sidewise in opposite directions, for spatial effect.) That was not literal high fidelity, but it was a typically ingenious economizing of the essential musical effect.

A more significant addition was the extra small speaker optionally available with the 360 phonograph; it was not merely another speaker on an extension cord, but had a special "curve" applied to its signal and to the speakers in the main phonograph, dividing the spectrum between the two to give a maximum pseudo-stereo effect. That's the sort of thinking that CBS likes to do, and the sort that has gone into the new and immensely more significant development. First, the Goldmark researchers made a long attack upon the nature of those two combined signals we've already mentioned, the sum of the two tracks and the difference.

Now you'll remember that if two identical signals are fed into a pair of stereo speakers (correctly phased, so both push and pull together), you will hear the resulting sound exactly halfway between the two speakers, in the center. That was the basis of my recent description of the three-track stereo technique, as combined into two tracks; the center track, equally divided between the two speakers, is heard in the middle between them.

In any two stereo tracks, the sum element, the parts of the sound that are the same, in all their varying degrees of sum-loudness, are heard in the middle and monaurally. *This is the bulk of the music* in all stereo.

On the other hand, the elements that make for the stereo effect—the differences between the two signals—are contained in the difference signal, which can be "extracted" by subtracting one track from the other. If you play only the sum signal on your two speakers (having put the two tracks through the adding-and-subtracting process) you'll hear a monaural recording, without spatial side-to-side differences. The stereo message is contained in the difference signal that is derived from the two tracks.

You can guess what concerned the Goldmark-CBS team. Can this difference signal be "boiled down" to its essential ingredients in terms of concentrated stereo effect—and so *reduced in power?* If so, then you can have a more efficient stereo recording, with the normal monaural element just as in standard LP records and the stereo difference element added in minimum form. If you assign the monaural or sum signal exclusively to the lateral part of the recording—the standard part—and concentrate your boiled-down difference signal into the vertical part of the stereo record, then the vertical element will be significantly reduced in power and the vertical "bumps" on the record will be much smaller. Result: Compatibility.

With reduced vertical excursion of the groove, standard LP cartridges can play the stereo disc. What they "hear," the lateral signal, will be the full monaural effect of the music—exactly as in a standard LP right now. To the monaural cartridge, the specially treated CBS stereo disc will seem like a standard record, with a slight vertical modulation that will not interfere with stylus tracking. To the stereo pickup—any stereo pickup—the disc will play with full stereo effect, if CBS is right, though RCA claims this method will result in a reduction of stereo effect. This disc will be all things to all pickups, ultra compatible. (Only a very few monaural pickups with extremely low vertical compliance will run into any trouble.)

### ASRA—The Black Box

The crux of the whole thing, of course, is in first, the listening and, second, the nature of the CBS "Black box," the gadget that does the streamlining of the difference signal, for the vertical cut. As to the listening—I heard a press demonstration and the stuff sounded just like any stereo, to me, granted poor listening conditions. The stereo difference was very definitely present, and no doubt about it. Though it may not be "perfect," I suspect that the system works, and works very well.

The "black box" itself is called ASRA, Automatic Stereo Recording Amplifier, which is a fairly significant name. It is, I gather, available to anyone for a consideration; you insert it before the stereo recording head and make your records. (Any type.) The statistics on what ASRA

actually does to the vertical signal are certainly impressive. CBS says that on AB testing, there is no audible stereo change as between a standard stereo reproduction and the same with ASRA inserted in the circuit to cut down the difference signal, leaving the monaural sum signal intact. Yet at some sound levels (the crucial higher levels) the ASRA difference-signal output has no more than *two per cent* of the energy of the corresponding sum signal. That's fantastic!

In terms of lateral and vertical modulation, at peak levels the ASRA vertical cut does not exceed *one eighth* or so of the modulation in the lateral direction—the standard monaural part. The recording really *is* almost a standard disc.

Now the pay-off: WHAT IS ASRA? Well, CBS isn't saying, but most of us are doing some fast deducing. My first deduction is that ASRA isn't very complicated, relatively speaking. It is an amplifier (says its name) and it must have a tube or tubes. It is automatic, which implies quite clearly, along with other parts of the CBS account, that it is dynamic; it does more to the signal at high volume levels than at low ones. It adjusts itself to the incoming volume, cutting out more power at the higher levels, letting through virtually all the original difference signal at low levels. (Might as well, since the vertical component won't be bothersome then.) This is my guess—without studying the specs.

In fact on the very face of it, this ASRA gadget just has to do certain things. If its peak difference-signal output is down to two per cent of the energy in the sum-signal, then clearly it is removing much of the bass, where the sound-signal energy is largely contained. ASRA clearly lets through the upper end and suppresses the entire lower end of the difference signal. (It doesn't suppress the bass in the *sum* signal, the monaural element, and this bass still appears on *both* final channels.)

It just happens that stereo effectiveness is already known to be concentrated largely in the middle highs, from perhaps 250 cps up to 7000. Above that, we don't get much sense of spatial location out of sound, nor do we from lower tones. (Their overtones do the space-locating.)

So it seems to me that any good technician—following the Columbus-and-the-egg theory—could now sit down and work out a reasonably effective limiting circuit to cut down on the stereo difference signal, before recording, using simple filters, fixed or even dynamic (like the H. S. Scott, but, we trust, not infringing on Mr. Scott's rights) plus a compression circuit that would keep the difference signal from growing as loud as the sum-signal. Details are unimportant—even a rudimentary application of this sort of thing would do something to improve a standard stereo signal in the desired respect. Maybe just a simple set of filters, removing bass and reducing the mid highs a bit.

### Commercial?

That's all my own speculation—you take it from there. It remains finally to look a moment at the great commercial world. If the CBS modification of the stereo recording signal works (and I think it does), who else will buy it?

I point out, first, that though perhaps a good many recording companies would go along with CBS directly, others might not be willing to, notably CBS's arch-rival of well known name. Would they have to? Consider that:

(a) A straight 45/45 record is entirely compatible with a CBS-modified 45/45 on all *stereo* pickups. The stereo pickup will play both, with equal ease. Any 45/45 stereo pickup. Moreover, a good many monaural with high vertical compliance can cope with the regular 45/45 reasonably well without groove damage, for a sound exactly like the CBS sound.

But CBS has the advantage in compatibility. Some may argue that ASRA isn't *that* perfect and who wants to play stereo discs with monaural pickups anyhow?

(b) It is even more probable that, if the CBS plan shows signs of catching on, other companies will develop their own modification of the vertical groove component (the difference signal) to match CBS. The titles and trade marks could be anything under the sun and probably will be; but the fact is, as I understand it, that a similar result could be approximated at least, by other companies, in varying degrees, to taste. So it doesn't look as though everybody would have to go along with CBS, except in the general principle —which can take on any old fancy name you wish in commercial practice.

(c) Does CBS really have an exclusive and protectible principle here? I wouldn't dare hazard a flat statement. But my own feeling, at this early stage, is that it would seem unlikely. There are too many tricky patents and what-not already involved. The exact ASRA circuit and the trade production model may well be exclusive in practice—but somebody else is likely to be able to develop an approach to the same without too much trouble. My guess, anyhow, and purely, strictly unoffical.

(d) But, on the other hand, and knowing Dr. Goldmark's type of work, I strongly suspect that CBS does in fact have an exceedingly good circuit—I suspect that ASRA is both simple and devilishly efficient in its chosen purpose, which is to squeeze the maximum of energy out of the difference signal, yet leave a maximum of intelligence-carrying signal intact.

It may be that by sheer superiority in a very simple circuit, superiority in the arrived-at values, the Columbia stereo record might actually be as good as any other in sound (both stereo and monaural) *and* the most compatible, for the changeover period. If so, the other companies might just as well resign themselves to a species of ASRA once and for all. They can always re-name it for their own products.

(e) As a matter of fact, it would appear almost certain that a modification of the difference-signal will eventually be made on *all* stereo records, of any and every make. It's just plain necessary, in order to allow for full cutting level; a full-strength vertical modulation is almost bound to run into groove complications, even with variable groove depth control along with the usual "margin control." So what's the argument?

After all, CBS used a pair of RCA Olson speakers for the ASRA stereo press demonstration! Sign of compatibility on an intercompany level, we can hope. *Æ*

# ABOUT MUSIC

## Opera on TV

HAROLD LAWRENCE*

A NEW KIND OF opera impresario is in the making. In most respects he resembles the traditional variety, but there are some novel and curiously modern sides to his job. Along with an extensive background in the theatre, he must possess the technical equipment of a film and recording director, his audience is vastly larger than that encountered in the opera house, and the choice and nature of his productions revolve around factors never before dreamed of by the pre-World War II composer. He is the TV opera director, an authentic product of the electronic age.

No aspect of operatic production remains unaffected by the transition from opera house to television studio. Casting is no longer a matter of finding the right voice for the right role. Now the right face, height, and dramatic capabilities are equally important. Since overweight, barrel-chested Romeos and mature, full-bosomed Juliets will not do, this automatically rules out some the world's leading singers.

TV opera directors all agree that two hours of opera is about as much as their mass audience will take. With this time limitation, all of Wagner and a large number of works in the standard repertoire cannot be mounted for the television screen —at least not in uncut versions. Length alone, however, is not the deciding factor in the medium's avoidance of certain extended works. Indeed it is far less important than two other considerations: action and credibility.

For an opera to be successful on TV, it must be fast-moving and a delight to the eye as well as to the ear. Static Wagnerian scenes like Gurnemanz's monolog in *Parsifal* would only provoke mass channel migrations. Stories must be selected with great care since all operas staged on TV are performed in the viewers' language. Hence the labyrinthian plot of the *Ring of the Nibelungen* is best left to the opera house in its original German form. The same applies to other "classic" operas with stilted libretti. Assuming that the bulk of the TV audience never, or rarely, attends operatic performances and is consequently unprepared to enjoy this art form for its purely musical values, the TV opera director cannot risk forfeiting the interest of his audience because of a libretto which offends, bores or appears ridiculous in modern eyes.

The physical dimensions of his viewers' "stage" must also be taken into account by the TV opera director. For a stage ranging in size from 17 to 24 inches, obviously *Grand Opera* in the traditional sense is out of the question—and that means half of the operatic literature. Mob scenes, parades, immense palace interiors and craggy mountain tops will all have to be reduced or omitted to conform to the TV tube. A dozen soldiers will have to do for a hundred, a bit of shrubbery for a forest.

Now that the cast has been assembled and an opera of proper duration, scope, and dramatic quality selected, the actual work can begin. On the studio set, singers will have to contend with the intrusion of an element absent from theatre performances: the TV camera. Under this probing and ubiquitous eye, musical and dramatic values applicable to the stage are altered drastically. The extreme mobility of the camera brings into sharp focus the singer's every gesture and expression, thus putting his acting ability to the acid test. Under these conditions, singers can no longer get away with stock-in-trade arm-flapping and exaggerated poses. Greater subtlety in characterization is demanded by the very nature of the close-up. Details like the quiver of an eyelid, the closing of a fist, or the lifting of a hand will now suffice where, in the theatre, the grand gesture was required to portray a similar emotion.

No less mobile than the TV camera is, of course, the microphone. One of the rituals of the opera house involves the singer facing the audience at all times, regardless of to whom his words are directed. The performer can now move about as the action requires, and still be heard, thanks to the microphone. Thus, when lovers rush into each other's arms during an impassioned duet, they need not disengage abruptly in order to face the audience.

In TV opera, the microphone replaces the gallery. The singer therefore need not possess a big voice to be properly heard. In fact, less rather than more voice is preferable due to electronic amplification. A "heldentenor" would only be wasting his lung power were he to sing as he does in the opera house, since a flick of the dial on the engineer's panel would surely whittle him down to TV size.

Although the TV screen cannot hope to duplicate the spacious effect of the opera house proscenium, it can employ certain

* *26 West Ninth Street, New York 11, N. Y.*

techniques of its own to recreate the atmosphere of the setting. For example, a most effective background was provided for a B.B.C. broadcast of Puccini's *Il Tabarro*. The action of this opera takes place on or near a barge along the Seine. The producer of the program, George Foa, spent a week on a river barge on the Seine prior to staging *Il Tabarro*. "There, in the late autumn," he wrote, "[my] camera caught pictures from the same source as the composer's inspiration. The melancholy of the slowly drifting water, the falling leaves, the towers of Nôtre Dame, fitted naturally into the rhythm of the long symphonic descriptions and enhanced the power of the story beyond the possibility of the static scene." Films can also be used to portray dreams and visions superimposed on the screen as the character refers to them.

In terms of actual production, the TV opera theatre is an extraordinarily complex affair. Several sets of scenery are left standing during the entire program due to the absence of lengthy intermissions and the frequent necessity of shifting rapidly from one scene to the other. Cameras on power-driven trucks and on "booms" track the singers. There is also the orchestra, chorus, crew of directors, sound and light engineers, and a platoon of stagehands. This situation is further complicated by the use of dual casting (practised chiefly in Italy). That is, actors mime the voice parts while the actual singing is done off-vision. In this way, a "large" Mimi with just the right voice will be "ghosting" for a shapely, talented actress.

With so many forces involved, it was only natural that the twin-studio technique should have developed. Picture and voices (in uni-cast productions) come from one studio, while orchestra and off-vision chorus is heard from another. Under each microphone in the first studio is a loudspeaker which transmits the sound of the orchestra to the singers. A "sub" conductor watching the chief conductor by means of a closed TV circuit, relays the latter's beat to the singers. Earphone communication is established between the control booth and all the technicians swarming about over cables, under camera turrets and behind scenery —which may account for some of the unscheduled noises we hear from time to time during broadcasts.

Needless to say, the twin-studio system does not facilitate perfect coordination between singers and orchestra. But even when they are together—and despite technical hurdles, there are few instances of faulty ensemble—the balance is *never* correct. For the sake of verbal intelligibility, the voice always predominates over the orchestra. Furthermore, there is no such thing as true dynamic range in TV opera sound, due to the mixing process. Voices all seem to be confined to a sonic area in which they are never soft or very loud, but somewhat in the mezzo-forte range. Thus the viewer has no real idea of 1) the full capacities of the singers, and 2) the instrument-voice fusion that is such an integral part of the operatic picture. Æ

# COLUMBIA STEREOPHONIC RECORD

(*from page 28*)

but appreciably reduced vertical amplitude.

Studies were made of the nature of stereophonic sound radiated by two loudspeakers separated by a sufficient amount of space. The composite sound arriving at the observer was analyzed in terms of the sum $S = L + R$ and the difference $D = L - R$ signals. It was found that by far the most significant portion of the energy of the radiated sound was conveyed by the sum signal. Following this the minimum amount of difference signal was determined which was needed to achieve full stereophonic effect as a function of the frequency and of intensity.

The results were significant and a law was evolved according to which the difference signal was limited by varying amounts at different frequencies. An "electronic brain" was then developed (called the ASRA, for Automatic Stereophonic Recording Amplifier) capable of modifying the difference signal automatically in accordance with the established requirements. When inserted between the original stereo tape and a stereophonic monitoring speaker system as shown in *Fig.* 5, instantaneous switching of ASRA in and out of the circuit gave most critical evaluation of the modified difference signal. For such rigorous comparative tests the sum and difference signals were converted through matrixing into right and left channel signals: $L = (S + D)/2$ and $R = (S - D)/2$ which were then reproduced through two conventional amplifiers and loudspeakers.

If $D$ was the original difference signal extracted from the master tape by matrixing, and $D'$ the modified signal produced by the ASRA, when switching back and forth for comparative tests the following right and left hand signals could be heard:

For $D$, [switch position (1)]

$$L = \frac{S + D}{2}$$

$$R = \frac{S - D}{2}$$

For $D'$, [switch position (2)]

$$L' = \frac{S + D'}{2}$$

$$R' = \frac{S - D'}{2}$$

With adjustments set to optimum conditions, switching between (1) and (2) gave no detectable differences. The

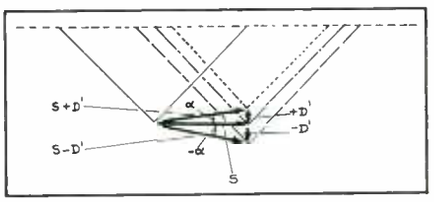



**Fig. 6. Effect of ASRA is to reduce relative amplitude of difference signal with respect to sum signal.**

settings of ASRA now were suitable for cutting a compatible stereophonic record from a two-track master tape. The ASRA is now located between the master tape and the recording amplifiers of the stereo cutter. If the latter is the so-called 45/45 type the $S$ and $D'$ outputs of ASRA are rematrixed to furnish $R'$ and $L'$; if a lateral-vertical type cutter is used, no rematrixing is needed and $S$ and $D'$ are directly supplied to the recording amplifiers.

The type of modulation obtained with the use of the ASRA is shown in *Fig.* 6. If, for example, $R = 0$ then $S = L$, however the modified difference signal $D'$ does not generally equal $L$. Thus depending on frequency and amplitude $D' \neq L$. At peak level of modulation the displacement of the groove apex would be as shown by the vector $S + D'$ which is directed at an angle $\alpha$. For $L = 0$ the displacement of the groove apex will be shown by the vector $S - D'$, directed at $\alpha$. It should be noted that the groove profile remains similar to that of the LP record (*Fig.* 2) and thus there are no significant tracking or distortion problems when used with a monaural pickup.

Because $\alpha$ may assume a variety of values when $R = 0$ or $L = 0$ depending on frequency and amplitude, the resulting method of modulation was called "elliptical modulation," where the large axis is $S$ and the small axis $D'$. For values of $S$ and for certain frequencies, the eccentricity of the ellipse is $0$ or $S = D'$. This type of modulation is shown at (B) in *Fig.* 7. In the conventional stereophonic systems $D$ and $S$ are always equal when $R = 0$ or $L = 0$ and therefore the eccentricity is always 0, as shown at (A) in *Fig.* 7.

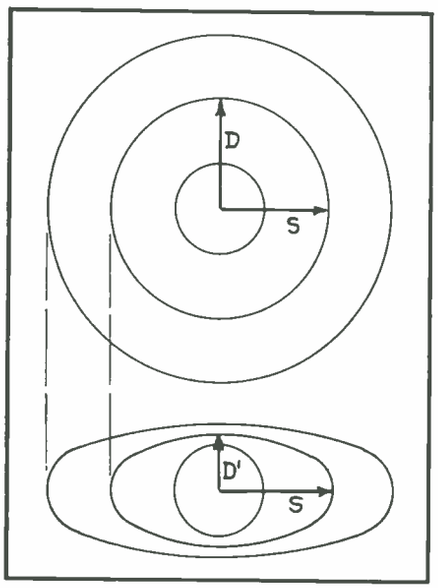



Fig. 7. The type of modulation obtained with the system described is known as "elliptical." These figures show extremes of the loci of stylus tip.

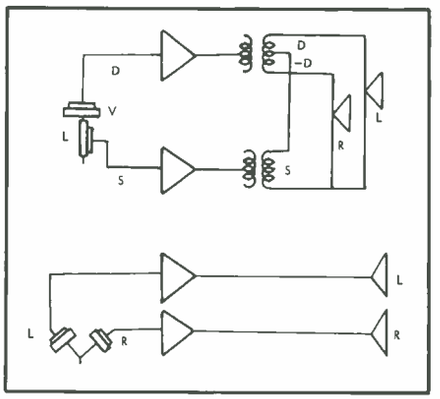



Fig. 8. Methods of connecting pickups for stereophonic reproduction. (A) with vertical-lateral pickup (note matrixing in output circuit); (B) with 45/45 pickup.

In the new stereophonic system the maximum amplitude of the vertical modulation is only about one-eighth that of the lateral amplitude though the ratio of the two can approach unity at low levels as well as at certain frequencies. Because of the small amount of vertical modulation the wear qualities of the new stereophonic records are equal to those of the standard LP record as confirmed by tests.

Stylus wear was also investigated using the popular low-cost cartridges. Here again stylus wear was found to be the same as with standard LP records.

Any type of stereophonic pickup can be used with the new compatible stereophonic record. Diagrams of several possible connections to be used with lateral-vertical and the so-called 45/45 pickups are shown in *Fig.* 8. Æ

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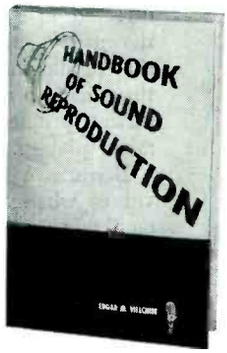


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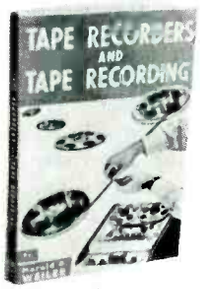


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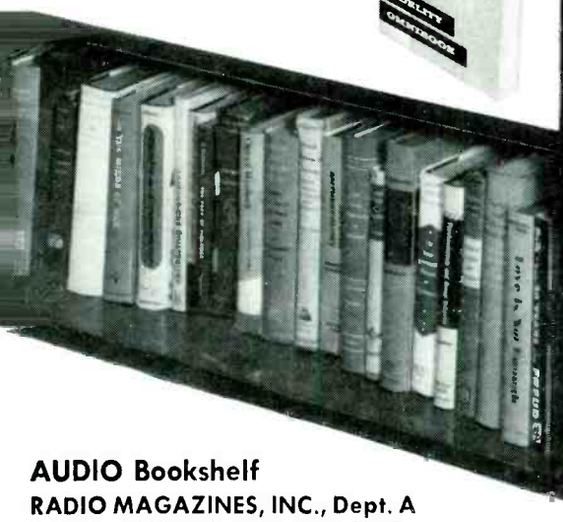


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# SIMPLE TRANSISTOR TESTER

(*from page 30*)

normal use means battery replacement only once every 2 or 3 years.

The d.c. current gain β is measured by passing a 50-microampere current through the base-emitter circuit and measuring the resulting collector current on a d.c. milliammeter. Full scale current is 5 milliamperes corresponding to $\beta = 100$ and the meter reads linearly. Good transistors produce β readings of 15 or more.

The collector voltage for this measurement varies from 3 to 5.2 volts depending upon the collector current. This does not matter because the collector current in transistors is practically independent of collector voltage. The 50 microamperes is obtained from a 0.1-meg. dropping resistor in series with the 5.2-volt battery after allowing for 0.15 volts drop across the base-emitter junction.

Leakage $\beta I_{co}$ is read in milliamperes in the same circuit by disconnecting the base current. The reading for low-leakage transistors is less than 0.5 milliamperes. Transistors producing nearly the same meter indication in milliamperes for both β and $\beta I_{co}$ measurements are extremely leaky and should be discarded.

### Construction

Construction of the tester is straightforward as shown in *Figs.* 1 and 2. Precision wire-wound resistors are used for accuracy and stability. The 2-gang, 6-position switch is a complication not found in some commercial testers of this type. This switch reverses both the meter and the battery when changing from PNP to NPN type transistors. It thereby permits measurement of the collector current rather than the emitter current and gives a more accurate reading of β when testing low-gain transistors.

Since it is necessary to multiply the milliampere readings by 20 to obtain β, the constructor may find β more easily readable if he marks the meter scale directly in terms of β, from 0 to 100. A simpler alternative would be the substitution of a 0 to 1 milliampere meter with a shunt to reduce its sensitivity to 5 milliamperes, thus raising the multiplier to 100. Another alternative would be to substitute a 0–100 scale for the normal scale of the meter.

Anyone who constructs and uses this tester for his work will soon find the instrument to be indispensable.

PARTS LIST

| | |
|---|---|
| $B_1$ | 5.2-volt battery (four 1.34-volt mercells) (Mallory RM-502-R) |
| $J_1$ | 3-pin transistor socket |
| $M_1$ | 0–5 ma milliammeter, 6 ω d.c. resistance (Triplett 221T or equivalent) |
| $R_1$ | 0.1 megohms, 1%, ½ watt, wire wound |
| $R^2$ | 400 ohms, 1%, ½ watt, wire wound |
| $R_3$ | 1034 ohms (made up of 1000-ohm 1% ½-watt wire wound resistor in series with 33 ohms, 5%, ½-watt composition resistor) |
| $S_1$ | 4-pole, 6-position rotary switch, non-shorting |

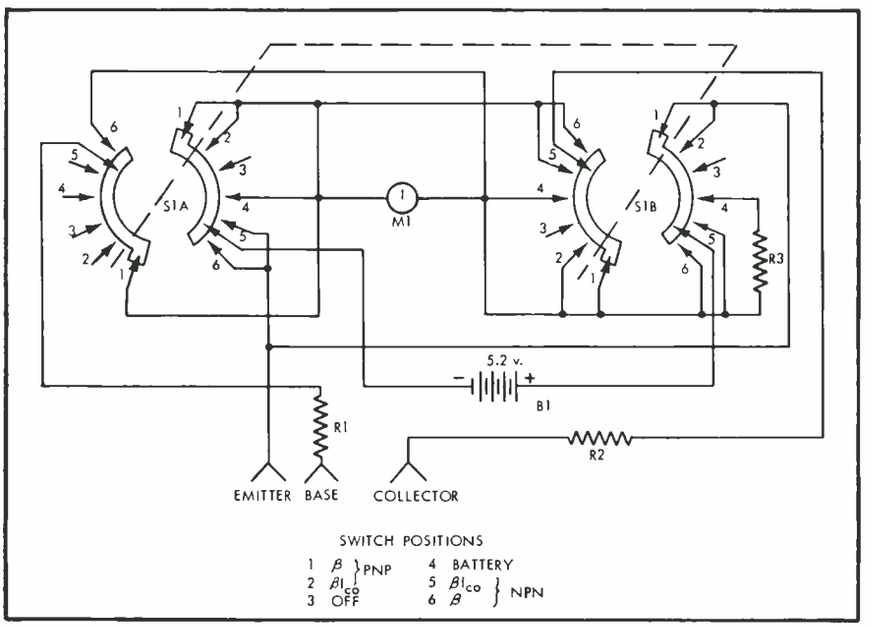


Fig. 3. Schematic of tester designed to determine $I_{co}$ of transistors.

# LETTERS

(*from page 6*)

factory "feel." Used in tension, as it must be in a speaker surround, the physical properties seem to me to be all wrong. The cells are not compressed but merely elongated and the prime features of the foam are not utilised at all. Better results would be got by using a thin sheet of an unfoamed elastic material, even the rubber aprons we used in 1925.

Even then a further trouble arises. It is possible to *foam the material directly on to the cone,* but in terms of industrial economics the cost would be prohibitive. So the polyurethane has to be cemented to the cone and this requires a *compatible* cement. The surround is a device to keep the outer edge of a cone in place; it should be aperiodic and frictionless, and should impose no load on the cone; if it does then cone break-up is aggravated. Any cement which changes the physical properties of the edge of the cone or interferes with the behaviour of the surround introduces a new factor which will detract from the speaker's performance.

So far as I know, the only compatible cements are that mentioned above, and triphenylmethane tri-isocyanate, both of which are attended by industrial hazards. Recent developments in isocyanate chemistry have produced aqueous suspensions which are promising but expensive and not all that easy to find.

Mr. Briggs says "dissipation of high frequencies at the edge of the cone is better" (when using polyurethane) but it is generally agreed that the high frequencies only emerge from the apex of a paper cone. What he may be getting is what I got from my 215 speaker, which seemingly had wonderful top. The addition of any sort of a compliance—mid-cone or edge-of-cone, rigid or pliant—gives more top because it assists cone break-up, and this spurious top is merely harmonics of lower frequencies. I shall shortly submit for your approval a paper on this virtually unknown subject.

H. A. HARTLEY,
62, Latymer Court,
London, W. 6, England

### Errata in "Auto Audio System"

SIR:

I was pleased to see my article on the auto system in the March issue, but there are a few minor errors, as follows:

My current address is as shown below.

In *Fig.* 2, the B+ lead from $V_3$ is unidentified. It should have been marked 245 v.

On page 22, the $V_4$ in the top line of the left column should be $V_3$. About one third of the way down in the same column, the sentence beginning "Feedback in the combination of ½ of $V_4$ . . ." should read $V_3$. Three lines further down, $V_4$ should read $V_3$ and $V_5$ should read $V_4$.

While none of these discrepancies is serious, the correction may help unconfuse some of your readers. As to reliability, my own equipment—which is essentially a duplicate of that shown in the article—has been operated extensively for about two years without difficulty of any kind.

WILLIAM B. FRASER,
Quarters 549,
Presidio of San Francisco,
California

# NEW LITERATURE

• **Electronic Instrument Company, Inc.,** 33-00 Northern Boulevard., Long Island City 1, N. Y., describes and illustrates the complete line of Eico high-fidelity equipment and electronic test instruments, in both kit and wired form, in a new 16-page 2-color catalog which has just been issued. The Eico hi-fi units listed include an FM tuner, preamplifier, power amplifier, and bookshelf and floor speaker systems. Your copy of the new 1958 Eico catalog will be mailed free—write for it. **E-13**

• **Altec Lansing Corporation,** Anaheim, Calif., has recently issued a new brochure on the design and construction of high-fidelity loudspeaker enclosures. Prepared by Altec's engineering staff, the brochure gives construction diagrams, features comparative bass performance charts of several popular enclosures, and includes information on proper phasing. Also incorporated in the 12-page booklet is a discussion on four enclosure types currently marketed, giving detailed reasons for Altec's choice of the bass reflex. A copy of this interesting publication will be mailed upon request. **E-14**

• **Argonne Electronics Mfg. Corp.,** 165-11 South Road, Jamaica 33, N. Y., importer and manufacturer of specialty audio items, has available a new catalog sheet No. ASC-200. Described and illustrated are the Argonne Model AR-3 all-purpose dynamic microphone, and a complete line of synthetic-sapphire phonograph styli for replacement and new-equipment applications. **E-15**

• **Livingston Audio Products Corporation,** P. O. Box 202, Caldwell, N. J., is now releasing the "Livingston Stereo Tape Treasury," a 28-page catalog which lists a large number of stereo tapes in addition to the Livingston monaural tape library. In view of the fact that this booklet contains the latest listings of a number of well-known tape labels, it will be a worthy addition to your reference material on stereo tapes. **E-16**

• **Partridge Transformers Ltd.,** London, England, has announced the publication of a new 4-page booklet illustrating and describing their new line of high fidelity output transformers designated the P-5000 series. These transformers have a frequency response within ± ½ db from 20 to 30,000 cps with no feedback and with a resistive load. In normal circuits with feedback, flat response extends from 10 to 100,000 cps. Requests for copies should be addressed to M. Swedgal, 258 Broadway, New York 7, N. Y., sole agent and importer in the U. S. A. **E-17**

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WANTED: Western Electric Model 728-B Loudspeakers and Model 713-C High Frequency Drivers. These must be in excellent condition. Indicate lowest price and condition in first letter. E. L. Mleczko, 710 West Adams Park Drive, Covina, California.

FOR SALE: Janszen 1-30 Electrostatic tweeter, walnut; Acoustic Research AR-1W woofer, walnut. Demonstrator models, used 140 hours clocked. Combination $220 firm. E. Strode, 428 N. Church St., West Chester, Pa.

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## PROFESSIONAL DIRECTORY



## *Industry People..*

**Adolph L. Gross,** one of the best known and best liked individuals in the industry, passed away April 21 in London while on a business trip. "A," as he was known affectionately by his friends and co-workers, started in radio as a counterman and achieved considerable success in all phases of radio and high fidelity merchandising.

**Henry Kloss, Malcolm Low and Anthony Hoffman,** the **K, L** and **H** of KLH Research and Development Corporation, joined forces with **Saul B. Marantz,** president of Marantz Company, and **Joseph Grado** of Grado Laboratories in a press showing of new products during the I.R.E. convention in New York. KLH introduced its new moderate-priced high-performance Model Six speaker, Marantz a new economical 30-watt amplifier, and Grado a new hi-fi pickup arm . . . **Abraham B. Cohen** has resigned as engineering department manager of University Loudspeakers, Inc., to engage in enterprises on his own behalf. **Sidney Levy,** president of University, is also director of engineering and plans to continue in that capacity.

**George Silber,** founder and first president of the Institute of High Fidelity Manufacturers, has been unanimously elected to a two-year term as chairman of the Institute's board of directors, according to an announcement by **Joseph Benjamin,** president. Mr. Silber, a resident of Malverne, N. Y., is president of Rek-O-Kut Company, and one of the pioneers of the high-fidelity industry . . . **Peter Meisinger,** formerly vice-president in charge of engineering, has been elected president and general manager of L.E.E. (Laboratory of Electronic Engineering) Inc., Washington, D. C. . . . **Eugene W. Gawel** made the long trek from Tulsa to New York to preside over the impressive Magnecord exhibit at the I.R.E. show. Featured was the new Stereo Magnecordette.

Entire audio industry mourning the untimely death of **Jay Quinn** of British Industries Corporation . . . Strengthening its research department, ORRadio Industries, Inc., manufacturer of Irish brand recording tape, has added **Henry G. Sellers, Jr.,** chemist, to the staff as assistant director of research . . . **Larry LeKashman** and **Jim Johnson** of Electro-Voice, Inc., were beseiged by hundreds of visitors to the I.R.E. show as they manned the E-V exhibit. The reason: the new E-V stereo cartridge was on demonstration . . . **Woody Gannett,** whose direction of public relations for the I.R.E. might well be a pattern for the entire electronics industry, was on deck as usual—exhausted from his efforts to keep everybody happy.

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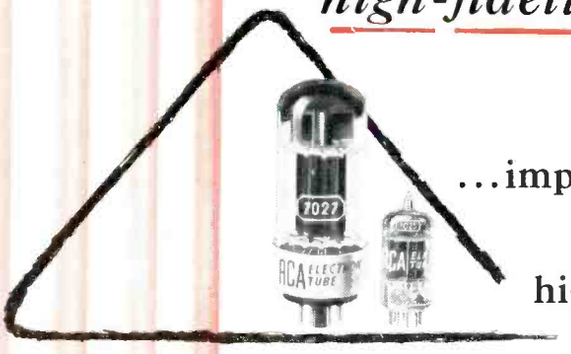



## ...important contributions to designers of high-quality audio amplifiers

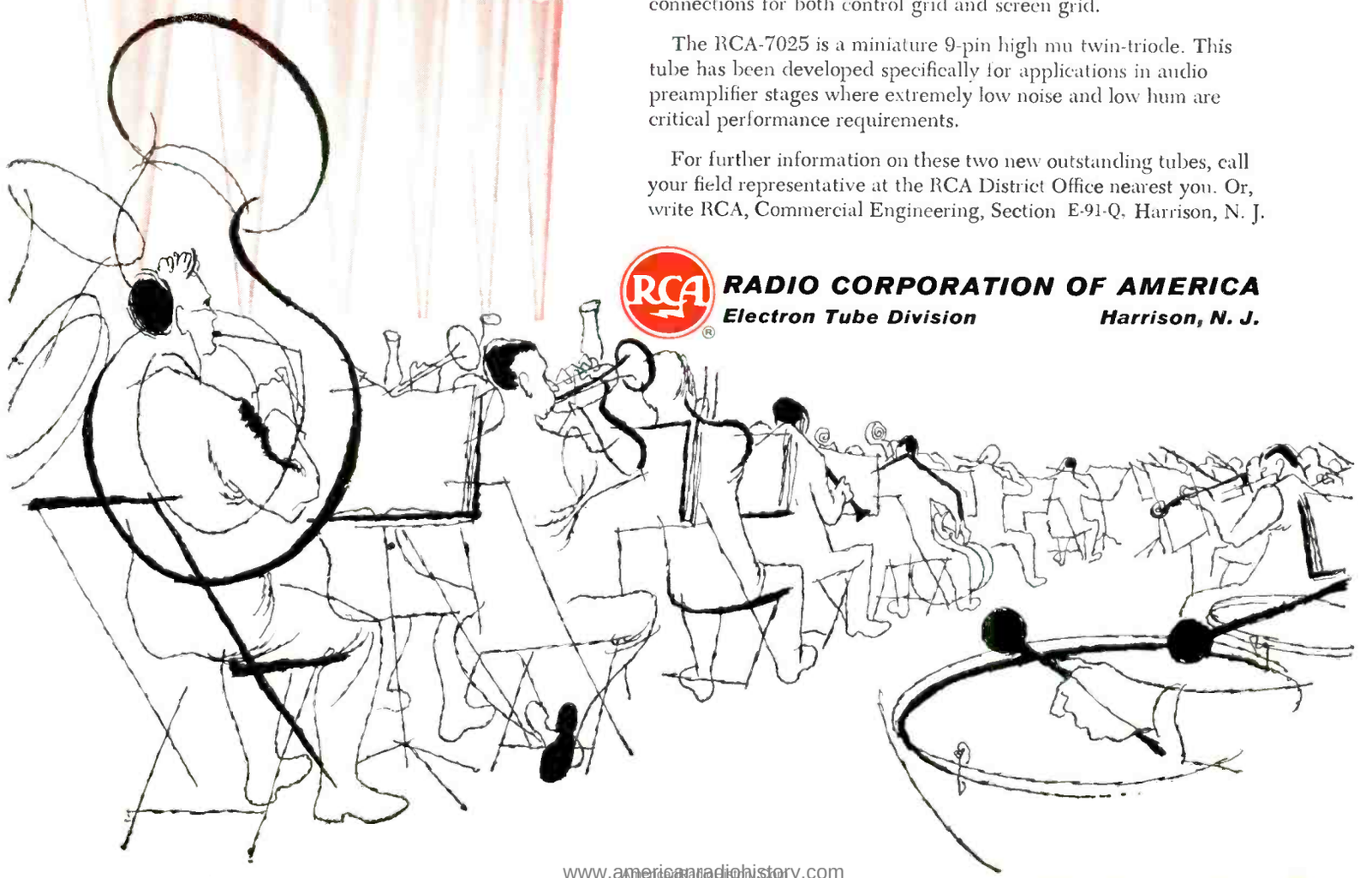
The organ hurls its thunderous tones! The piano strikes an answering chord! A triangle sparkles its crisp note and an orchestra expands to full forte! These are the exciting, timbre-rich sounds which require full realism in reproduction and make extraordinary demands on the performance capabilities of your audio amplifier designs. The RCA-7025 and -7027 have been developed specifically for such performance requirements in high-quality high-fidelity audio amplifiers.

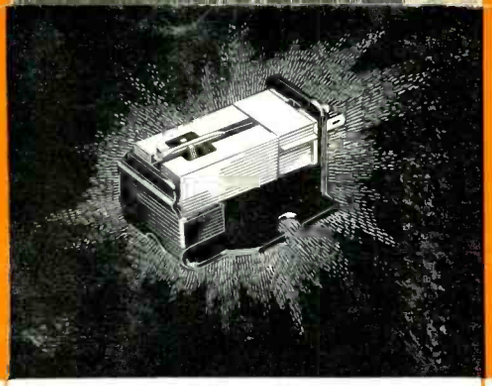
The RCA-7027 is a glass-octal type beam power tube. Two 7027's in class AB, push-pull service *with only 450 volts on the plate* can handle up to *50 watts of audio power* with only *1.5 percent distortion*. Structural features contributing to the exceptionally high plate dissipation (25 watts) of this compact tube are: metal base collar, heavy stem leads having high heat conductivity, heavy plate material, radiating fins on control grid, and double base-pin connections for both control grid and screen grid.

The RCA-7025 is a miniature 9-pin high mu twin-triode. This tube has been developed specifically for applications in audio preamplifier stages where extremely low noise and low hum are critical performance requirements.

For further information on these two new outstanding tubes, call your field representative at the RCA District Office nearest you. Or, write RCA, Commercial Engineering, Section E-91-Q, Harrison, N. J.

**RADIO CORPORATION OF AMERICA**
**Electron Tube Division** **Harrison, N. J.**





# NOTICE!
# DON'T BUY A NEW

*high fidelity phonograph cartridge until you've read this vital stereo report . . .*

**SPECIFICATIONS**

| | |
|---|---|
| RESPONSE: | 20-16000 cps. ±2.5 db to RIAA |
| ELEMENTS: | Ceramic |
| OUTPUT: | (Westrex 1A) .5 volt rms. |
| COMPLIANCE: | 2. x $10^{-6}$ CM/dyne |
| TRACKING FORCE: | 6 grams |
| WEIGHT | 2.4 grams |
| STYLUS: | .7 mil |
| MOUNT: | EIA (RETMA). Standard ½" and 7/16" centers |
| CHANNEL ISOLATION: | 20 db |

THE MISSING LINK to popular-priced stereophonic sound reproduction has been found: It's the new Electro-Voice TOTALLY COMPATIBLE Stereo Cartridge . . . plays the new stereo discs superbly . . . LP's too . . . even better than existing cartridges.

By breaking the stereo cartridge cost bottleneck, Electro-Voice has made popular-priced quality stereo a reality. E-V's ceramic stereo cartridge (Model 21D with .7 mil diamond stylus) sells for only $19.50 (Audiophile net) and is available now at your audio dealer or from your serviceman.

## Here are some of the answers to your questions concerning stereo:

**Q** How does the COMPATIBLE E-V Stereo Cartridge differ from CONVENTIONAL cartridges?

**A** It has the ability to play both the new type stereophonic discs and conventional records. Inherent in its design is an improved monaural performance. *Exclusive* design for rumble suppression of 15 db or better will permit the use of Electro-Voice's Stereo Cartridge *with any type of changer or transcription player!*

**Q** Are stereo discs compatible with conventional cartridges?

**A** Most cartridges damage the stereo record. DO NOT BUY STEREO DISCS UNTIL YOU HAVE AN E-V STEREO CARTRIDGE. You may then play monaural or stereo discs monaurally. Add a second speaker and amplifier, and you have stereophonic sound.

**Q** What about modification problems?

**A** Using an Electro-Voice Stereo Cartridge, which is constructed so that its output is already corrected to the RIAA curve, you will not require the equalization of the *second* amplifier. Inserting the cartridge is simple. It will fit virtually any standard tone or transcription arm. The addition of a second amplifier and speaker is not complicated.

**Q** What about record availability?

**A** Recordings by major record manufacturers will be available in mid-1958.

**Q** What effect will stereo cartridges and records have on your present equipment?

**A** Only your cartridge will be obsolete. All other components are compatible with stereo.

**Q** What if you don't have a HI-FI system now . . . should you wait?

**A** *No.* Proceed as before—with one exception: you should insist on a stereo cartridge initially. When you are ready for stereo, merely add a *second* speaker and amplifier.

**Q** How do you go about getting your Electro-Voice Stereo Cartridge?

**A** Visit your dealer. If you don't know the name of your nearest dealer, please write Electro-Voice. Ask for E-V Stereo Model 21 D with .7 mil diamond stylus or E-V Stereo Model 26 DST Turnover with .7 mil diamond Stereo tip and 3 mil sapphire tip for monaural 78 rpm records ($22.50).

# STEREO IS HERE

*don't buy an obsolete cartridge . . . replace with the totally compatible Electro-Voice stereo cartridge*

Electro-Voice®

ELECTRO-VOICE, INC.
BUCHANAN, MICHIGAN
CANADA: E-V of Canada Ltd., 73 Crockford Blvd., Scarboro, Ontario

FOREMOST IN ELECTRO-ACOUSTICS . . .

*Microphones, Phono-Cartridges, High-Fidelity Loudspeakers and Enclosures, Public Address Speakers, Marine Instruments, EVI Professional Electronic Instruments and Military Material.*