AUDIO

NOVEMBER, 1959
50¢

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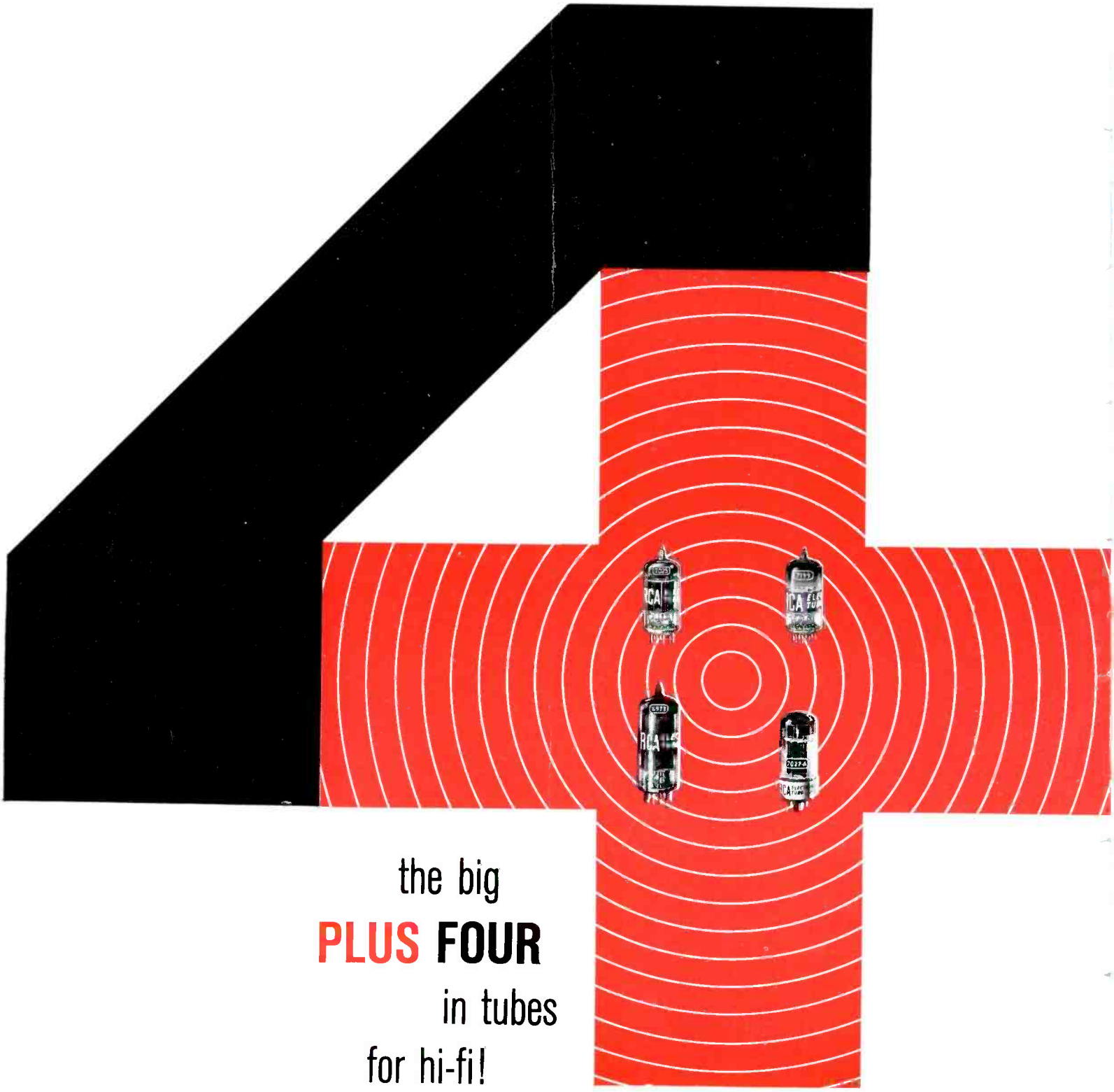

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NOVEMBER, 1959 VOL. 43, No. 11

Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

COVER PHOTO—The Forecast Music Sphere, latest in Aluminum Company of America's continuing series of designs in aluminum for tomorrow. This unit, created by industrial designer Lester Beall, was on display at the recent New York High Fidelity Show. The components installed in the Sphere are: Pickering Gyropoise 800 Stereotable, 196 Unipoise arm, and 371 Stereo-Fluxvalve, Grommes 209 preamp-control unit, Dynakit Stereo 70 amplifier, and Jensen Galaxy II speaker system. The dual-coil woofer is in the lower half of the hemisphere with the two satellite tweeters on the "outriggers."

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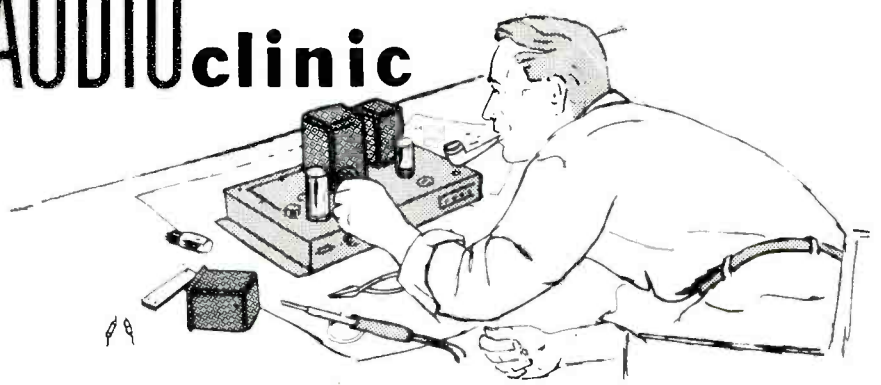
AUDIO clinic



JOSEPH GIOVANELLI*

A Stereo Adaptor

Q. My problem concerns conversion to stereo. I have the following equipment: a Fisher 80-R AM-FM tuner, an Eico HFT90 FM tuner, a Fisher 80-C audio control, a 60-watt McIntosh power amplifier, a Scott 210C preamplifier, a Ferrograph tape recorder, and two speaker systems. I know that I could build a stereo adapter which would suffice to mate my equipment if certain questions were answered. These are the questions:

1. How can I design a single volume control for both channels after they have been balanced using the controls on the Scott 210C and the Fisher preamplifier?

2. Where do I tap off the signal from the Scott and the Fisher, and into what kind of potentiometer and resistor, and so on do I lead it?

3. Next—how do I feed the signal back to what place in the Scott and McIntosh?

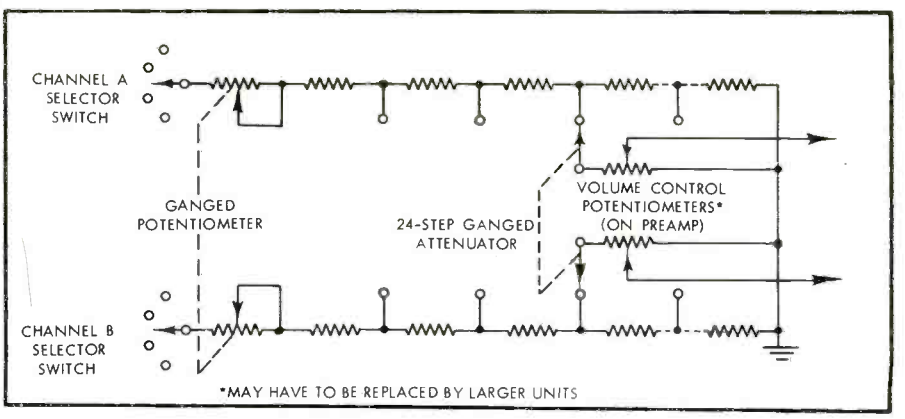
4. Monophonic playback I'm not worried about since the McIntosh will do nicely without help. However, nowhere have I seen how you can parallel two dissimilar amplifiers. John A. Timm, Boston, Mass.

A. 1. The problem of adjusting the volume of both channels with one potentiometer is a difficult matter. The best solution is the use of a two-deck step switch made up as an attenuator. The maximum number of switch positions you can find will probably be 24. This will mean that you must design your attenuator in 3 or 3.5 db steps. With such an arrangement there may be times where you might desire having a volume control setting somewhere between these positions. This can be done by using a potentiometer having a fairly low resistance compared to that of the attenuator, and place it in series with the hot side of the attenuator. The potentiometer sections should be wired as rheostats. (The reason you cannot use a potentiometer to do the entire job is that ganged potentiometers which track uniformly between gangs are difficult to obtain.) Of course, the attenuator sections will not track unless all resistors making up the attenuator are 1-per-cent units. The use of the series potentiometer may be justified in two ways: (A) Although this potentiometer is placed in series with the load, thereby causing the load to see different impedances with different control settings, the effect will be negligible since the total resistance of the pot section is small compared to that of the total into which the load works. (B) There will be some error in tracking between the two sections of the potentiometer because the total resistance of the potentiometer is small compared to that of the attenuator. The amount of tracking error cannot be severe enough to cause sufficient unbalance between channels to be detected aurally, and that is the only kind of detection which really matters.

It should have been stated that the total resistance of the potentiometer should be figured in such a way that it can give a total variation of perhaps 3 db when placed in series with the attenuator.

2. There are two ways of tapping the signal: (A) The easiest is simply to feed the output of each preamplifier into the series combination of attenuator and potentiometer, the output of each preamplifier going to its respective gang. The arm of the attenuator would be connected to the input of its appropriate power amplifier. In some instances, low capacitance

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



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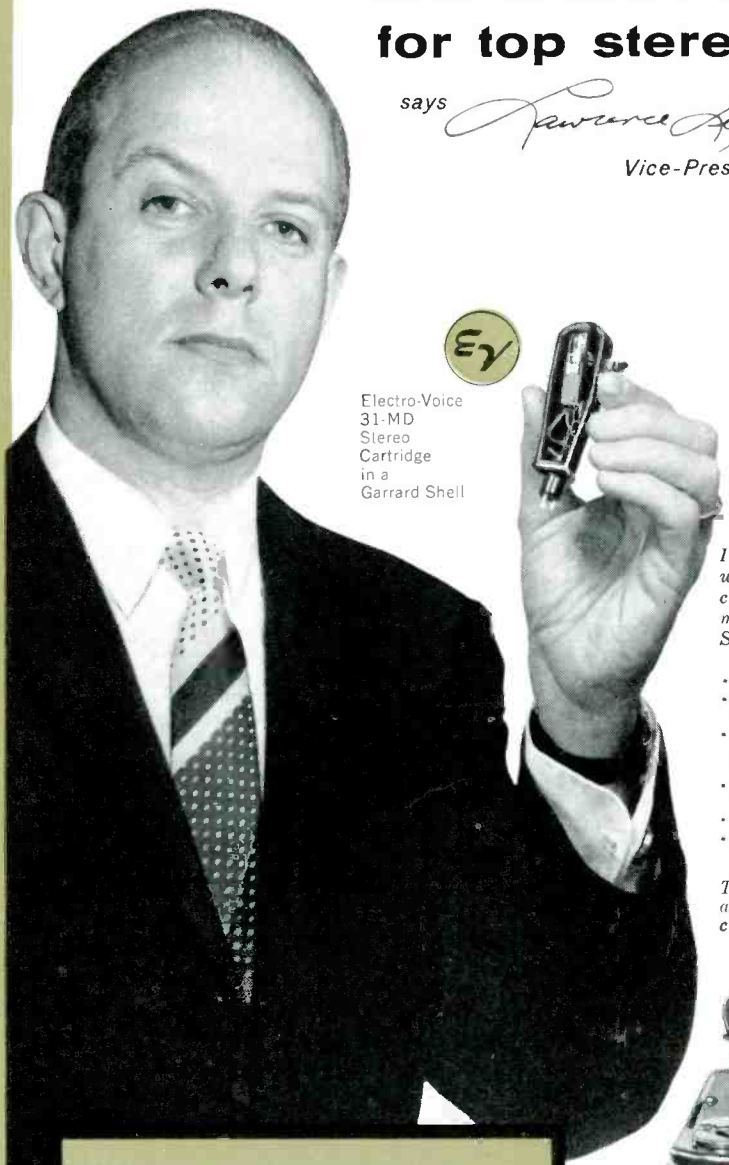

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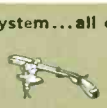
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shielded cable should be used. This is true when the attenuator load is 1 megohm or higher. (B) An alternative method would be to make wiring changes in the preamplifiers themselves. Tap the signal from the arms of the selector switches in the preamplifiers. Feed the signals to the proper gangs of the attenuator network, feed the arm of the attenuator back to the volume controls of the preamplifiers. This can be made clearer by schematic of *Fig.* 1. No values are given for the components since their values will be determined by the impedance of the output circuit and by the impedance of the circuit into which the attenuator feeds.

4. I do not believe it necessary to parallel two dissimilar amplifiers. Merely arrange some switching on your proposed stereo adaptor in such a manner that it will feed the same signal simultaneously to the inputs of the two power amplifiers. The outputs of the amplifiers are connected to their respective speakers.

As stated in your letter, the sound in each channel can be balanced by means of the separate volume controls of the preamplifiers. You can, however, include another refinement to your adaptor—namely, a balance control. This consists merely of a ganged potentiometer, with each section wired backward to the other. This means that as the potentiometer rotates, the level of one channel will be raised while that of the other channel will be lowered. Tracking error of the pots is of no importance.

The idea of this type of balance control circuit is an interesting and simple one. If this method is used, however, considerable gain will be lost. Therefore, if there is insufficient reserve gain in your equipment, adoption of this circuit is inadvisable. In this event, you may wish to try the more elaborate stereo balance control circuit shown in AUDIOCLINIC for June, 1959, under the heading, "Stereo Balance Control."

Tonearm Chatter

Q. *I have a Livingston Universal playing arm and a GE magnetic pickup which I use solely to play 78-rpm records. When playing 12-inch records, an excessive amount of chatter or vibration of the needle occurs which is very undesirable when playing the outer grooves. As the needle moves an inch or so toward the center of the record, the annoyance gradually diminishes and disappears. The needle force is as recommended by GE, and increasing the force does not eliminate the trouble. Eccentricity of the outer grooves seems to be one cause of the trouble since it does not occur on all records and seldom on 10-inch discs. What is the cause of this condition? How can it be corrected? Howard J. Murray, Philadelphia, Pa.*

A. The chatter in your tonearm may be caused by loose side screws. These can be tightened by first loosening the locknuts, tightening the screws *slightly*, and resetting the locknuts.

When following this procedure, be sure that the screws are not tightened too much. By so doing, the freedom of the arm to move vertically will be restricted. This vibration may also be caused by the car-

(*Continued on page 106*)

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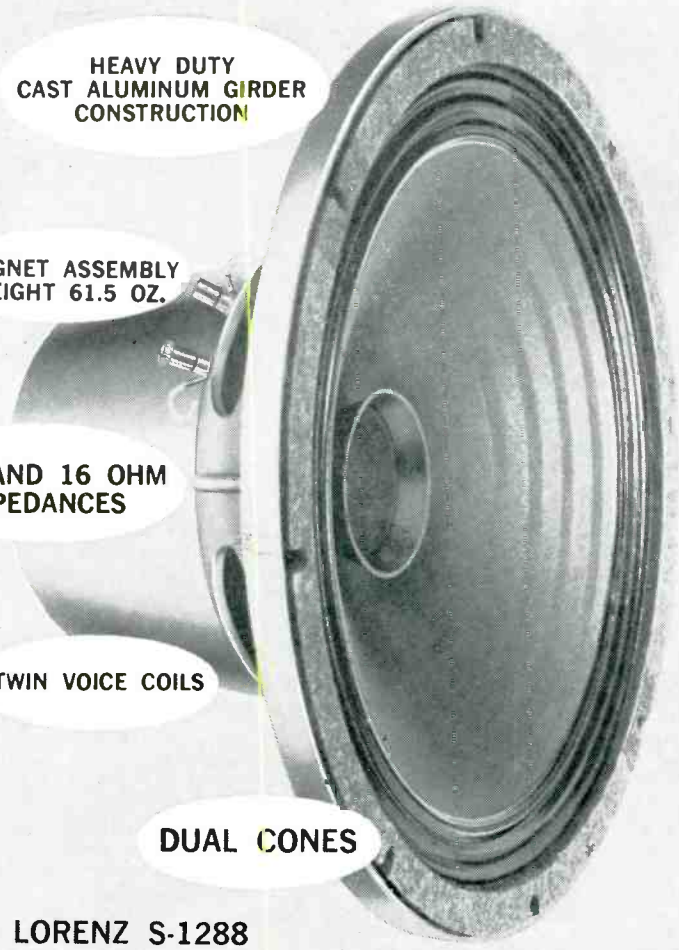

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LETTERS

Validity of IM Measurements

SIR:

The October issue contained two rather indefinite "knocks" at IM distortion measurement: (1), the IHFM standard on amplifiers omitted any reference to this form of measurement, without stating why; (2) Leon Kuby detailed methods for making accurate measurements of this type, and also showed that such measurements are often completely invalidated because an indication is obtained, but not identified —by using a 'scope.

For a long while IM distortion figures have enjoyed a superior social status over harmonic figures. It is true that the IM *kinds* of distortion are more representative of *some* forms that happen on musical programs than is harmonic measurement. At the same time, the writer feels they have been given an exaggerated importance, due to failure to correlate the different "variables" involved.

First there are at least three IM standards: the CCIF difference tone, the SMPTE 4:1 and a similar 1:1. These represent two specific kinds of musical distortion. The CCIF test is directly relatable to a transfer characteristic that produces in-phase second harmonic. But this is the kind of distortion produced by single-ended stages, or push-pull ones *working out of balance*. As most people feel distortion measurements should indicate what is left when the amplifier operation is optimized to balance out this component, the SMPTE test is more popular in the U. S. This is the test Mr. Kuby detailed.

The SMPTE test has been shown to produce a rather unpredictable relationship to harmonic tests, for which reason it has been felt that the SMPTE is probably the better test. What seems to have been overlooked in this area is that harmonic tests are usually taken at 1000 cps, while the IM test is basically a measure of distortion to the *low-frequency* characteristic.

This is why the IM test can be very dependent on the low frequency chosen. As Mr. Kuby points out, this may be anywhere between 30 and 100 cps. If harmonic measurements are made at the same low frequency, the results are much closer. The IM test is then only slightly more sensitive to the order of distortion than the harmonic method. But the result of either test is apt to be quite critical of the precise low frequency used.

The present trend in amplifier specifications is to give frequency response (not necessarily at maximum power), power, and distortion figures. Even if the distortion stated is IM, it indicates little about the low-frequency power capability of the amplifier unless the measurement frequency is also specified. Standardizing this frequency would set an arbitrary industry standard for low-frequency power requirement, in effect limiting the specification of fidelity.

Under the circumstances, I feel the new term that the IHFM Amplifier Standards Committee introduced (Section 2.1.5) called POWER BANDWIDTH, as there defined, is highly commendable. It gives a consistent basis for measurement and comparison that will tell more than a single IM test has ever been able to.

True harmonic measurement of a single tone does not "catch" all forms of distortion. Nor does any known IM test. As we do not yet have suitable test(s) to evaluate some of these elusive but important forms of distortion, I feel the IHFM standard is a very definite step forward, as it provides a simple means for giving consistent indication of the relative magnitude of "known" forms of distortion.

NORMAN H. CROWHURST, Consultant
216–18 40th Avenue,
Bayside 61, N. Y.

(NOTE: *The Amplifier Standards Committee had prepared a paragraph stating the IHFM position on IM measurements to the effect that the standardization in this area was being studied and an addendum would be presented as soon as possible. Unfortunately, neither the official IHFM booklet nor our reprint of the Standards carried this paragraph.* ED.)

Wrong Picture

SIR:

Inasmuch as the Leak preamplifier in the Equipment Profile in the September issue was in actuality a Varislope III monophonic preamplifier and not a Leak Stereo Point One preamplifier, as described, we would greatly appreciate it if a picture of the re-styled Stereo Point One preamplifier could be shown in a forthcoming issue.

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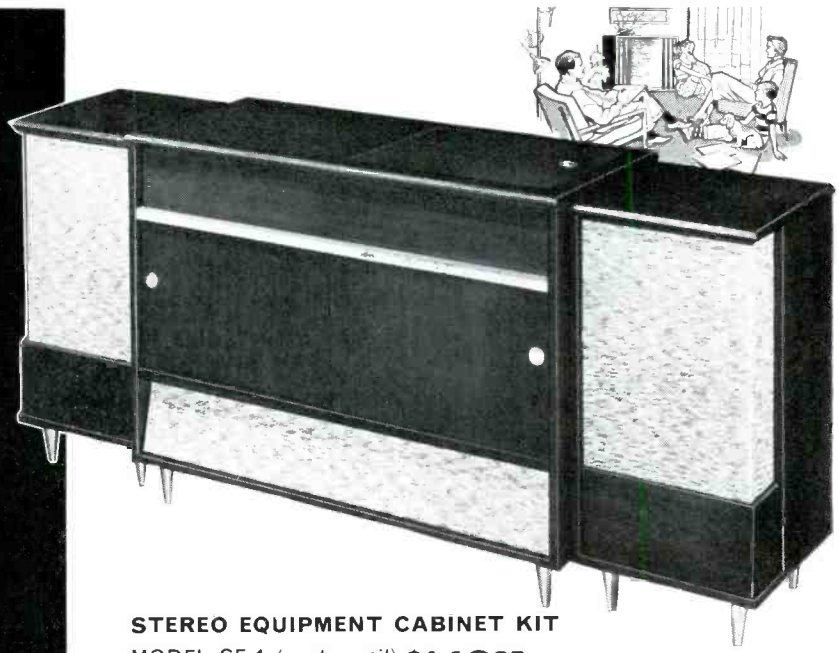

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NEW

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TRADITIONAL
Model CE-1T Mahogany

- No Woodworking Experience Required For Construction.
- All Parts Precut & Predrilled For Ease of Assembly.
- Maximum Overall Dimensions: 18" W. x 24" H. x 35½" D.

CHAIRSIDE ENCLOSURE KIT

MODEL CE-1 **$43.95** each

Control your complete home hi-fi system right from your easy chair with this handsome chairside enclosure in either traditional or contemporary models. It is designed to house the Heathkit AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier, along with the RP-3 or majority of record changers which will fit in the space provided. Well ventilated space is provided in the rear of the enclosure for any of the Heathkit amplifiers designed to operate with the WA-P2. The tilt-out shelf can be installed on either right or left side as desired during the construction, and the lift-top lid in front can also be reversed. All parts are precut and predrilled for easy assembly. The contemporary cabinet is available in either mahogany or birch, and the traditional cabinet is available in mahogany suitable for the finish of your choice. All hardware supplied. Shpg. Wt. 46 lbs.

IT'S EASY . . . IT'S FUN AND YOU SAVE UP TO ½ WITH DO-IT-YOURSELF HEATHKITS

Putting together your own Heathkit can be one of the most exciting hobbies you ever enjoyed. Simple step-by-step instructions and large pictorial diagrams show you where every part goes. You can't possibly go wrong. No previous electronic or kit building experience is required. You'll learn a lot about your equipment as you build it, and, of course, you will experience the pride and satisfaction of having done it yourself.

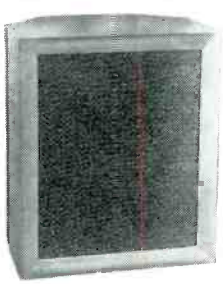
DIAMOND STYLUS HI-FI PICKUP CARTRIDGE

MODEL MF-1 **$26.95**

Replace your present pickup with the MF-1 and enjoy the fullest fidelity your library of LP's has to offer. Designed to Heath specifications to offer you one of the finest cartridges available today. Nominally flat response from 20 to 20,000 CPS. Shpg. Wt. 1 lb.

"RANGE EXTENDING" HI-FI SPEAKER SYSTEM KIT

The SS-1B employs a 15" woofer and super tweeter to extend overall response of basic SS-2 speaker from 35 to 16,000 CPS ±5 db. Crossover circuit is built in. Impedance is 16 ohms, power rating 35 watts. Constructed of ¾" veneer-surfaced plywood suitable for light or dark finish. Shpg. Wt. 80 lbs.



MODEL SS-1B
$99.95

SEND FOR FREE CATALOG

Describing over 100 easy-to-build kits in hi-fi, test, marine and ham radio fields. Also contains complete specifications and schematics.

"BASIC RANGE" HI-FI SPEAKER SYSTEM KIT

The modest cost of this basic speaker system makes it a spectacular buy for any hi-fi enthusiast. Uses an 8" mid-range woofer and a compression-type tweeter to cover the frequency range of 50 to 12,000 CPS. Crossover circuit is built in with balance control. Impedance is 16 ohms. Power rating 25 watts. Tweeter horn rotates so that the speaker may be used in either an upright or horizontal position. Cabinet is made of veneer-surfaced furniture-grade plywood suitable for light or dark finish. All wood parts are precut and predrilled for easy assembly. Shpg. Wt. 26 lbs.

MODEL SS-2 **$39.95**
Legs: No. 91-26 Shpg. Wt. 3 lb. $4.95

LEGATO HI-FI SPEAKER SYSTEM KIT

MODEL HH-1 **$299.95**

The startling realism of sound reproduction by the Legato is achieved through the use of two 15" Altec Lansing low frequency drivers and a specially designed exponential horn with high frequency driver. The special crossover network is built in. Covers 25 to 20,000 CPS within ±5 db. Power rating 50 watts. Cabinet is constructed of ¾" veneer-surfaced plywood in either African mahogany or white birch suitable for the finish of your choice. All parts are precut and predrilled for easy assembly. Shpg. Wt. 195 lbs.

HEATH COMPANY • BENTON HARBOR 25, MICH.

pioneer in "do-it-yourself" electronics

a subsidiary of Daystrom, Inc.

☐ Please send the Free Heathkit catalog.

Enclosed find $.....
Please enclose postage for parcel post—express orders are shipped delivery charges collect. All prices F.O.B. Benton Harbor, Mich. A 20% deposit is required on all C.O.D. orders. Prices subject to change without notice.

name

address

city & state

QUANTITY	ITEM	MODEL NO.	PRICE

ROGER DANIEL,
British Industries Corporation,
80 Shore Road,
Port Washington, N. Y.

(*The correct picture appears on page 6, and thanks for correcting us.* ED.)

Open House

SIR:

Acoustic Research, Inc., (AR) will hold its annual "open house" this year on Friday, November 27. Tours of inspection of the AR plant, which is located at 24 Thorndike St., Cambridge, Mass., will be conducted at 10:00 a.m. and 2:30 p.m. Visitors will have the opportunity to watch production and quality control test procedures, including speaker checks in AR's anechoic chambers.

Coffee will be served, and all visitors are welcome.

ROY F. ALLISON,
Assistant to the President,
Acoustic Research, Inc.,
Cambridge, Mass.

More on Doppler Effect

SIR:

This is in reply to the letter by L. D. Dalessandro and Larry S. Rogers II questioning the audibility of Doppler distortion in loudspeakers. (Published in the September issue.) I assume they fed to a loudspeaker a 40-cps and a 10,000-cps signal (and not a 10,000-cps sine wave, the way the letter read) and listened to the combined output, switching the low-frequency signal in and out. This test method is untenable, because it compares unlike signals. The correct way of testing for Doppler distortion is to place a microphone in front of the speaker, and then filter out the 40-cps tone so that the reproduced signal of the A-B test will always be 10,000 cps. This distortion becomes the more objectionable the more reflected sound is picked up by the microphone, because the interference pattern of the sound in the room is changed by frequency modulation, due to phase shift, the frequency modulation distortion assuming the character of amplitude distortion.

The resulting sound is "rough," not "clean," "swimming."

VIRGINIA RETTINGER,
5007 Haskell Ave.,
Encino, California

Errors Again

SIR:

Several errors crept into the article "A ten-watt all-triode amplifier," by Robert Ellis and the writer, in the September issue.

1. The frequency response curve shows the amplifier cutting off at about 15 kc instead of 50 kc. (*Mistake in drawing.*)

2. The power output curve extends down to only 30 cps instead of 20. (*Mistake in drawing.*)

3. In reference to *Fig. 7* and the associated text, one other change is necessary for variable damping. The cathode resistor of the first stage must now be connected to the "0" output terminal instead of ground in order to complete the current feedback loop. This was an omission of the authors.

4. One other matter of interest is that after submission of the manuscript Mr. Ellis and I found that we could increase the low-frequency stability by using larger coupling capacitors to the output stage. We found 0.25 μf to be optimum.

The authors would appreciate your calling these errors and additions to the attention of your readers.

ROBERT M. VOSS,
697 West End Avenue,
New York 25, N. Y.

Collaro

stereo record players with typical British precision steadfastly guard your records and stylus from wear and accidental damage

The Constellation, Model TC-99—$59.50

The Continental II, Model TSC-840—$49.50

The Coronation II, Model TSC-740—$42.50
*The Conquest II, Model TSC-640—$38.50

Transcription Turntable, Model 4TR-200—$49.50

Manual Player, Model TP-59—$29.95

ROCKBAR *Corporation*

Every Collaro stereo record player is built with typical British attention to every detail. They are precision engineered and rigidly tested to give truly professional performance and the ultimate in operating convenience. Here are some of the important features that make Collaro the logical choice for stereo or monophonic records. • Performance specifications exceed NARTB standards for wow, flutter and rumble—with actual performance test reports accompanying each model TC-99. • Extra-heavy, die-cast, non-magnetic turntables (weighing up to 8½ lbs.). Extra-heavy weight is carefully distributed for flywheel effect and smooth, constant rotation. • Shielded four-pole motors are precision balanced, screened with triple interleaved shields to provide extra 25 db reduction in magnetic hum pick-up. • Detachable five-terminal plug-in head shells (on TC-99, TSC-840, TSC-740, TP-59) provide two completely independent circuits, guaranteeing ultimate in noise reduction circuitry. • Transcription-type stereo tonearms are spring-damped and dynamically counterbalanced to permit the last record on a stack to be played with virtually the same low stylus pressure as the first. • All units are handsomely styled, available with optional walnut, blond and mahogany finished bases or unfinished utility base. There's a 4-speed Collaro stereo record player for every need and budget! Prices slightly higher in the West. For free catalog on the Collaro line, write to: **Rockbar Corporation, Dept. A-11, Mamaroneck, N. Y.** (*Not shown. Similar in appearance to The Coronation.)

RC16

AUDIOMAN NO. 2

Ellett N. Shepherd, of Denver, Colorado, Deputy District Attorney, music lover, criminologist, and—by his own admission—"Audio Ham" becomes the second Audioman of the Month

WHEN A MAN DESIGNS a house to contain a listening room and components which create reproduction as near as possible to perfection—or as far as the state of the art will permit—then he well deserves to become an Audioman. His listening room is 16 by 28, with a 10-foot ceiling, and one end has a corner right in its center, to accommodate the folded horn built by Ben Drisko, erstwhile AUDIO contributor. The other end of the room consists of windows that slant outward at the top at an angle of 22 deg. so any reflected sound is absorbed in an acoustical ceiling. The complement of speakers in the horn are an Altec 515 for the low end and an Altec 802D with a Drisko sectoral horn for the highs, with an occasional switch to a pair of JBL D-175's in parallel. For stereo, the second channel is an AR-3.

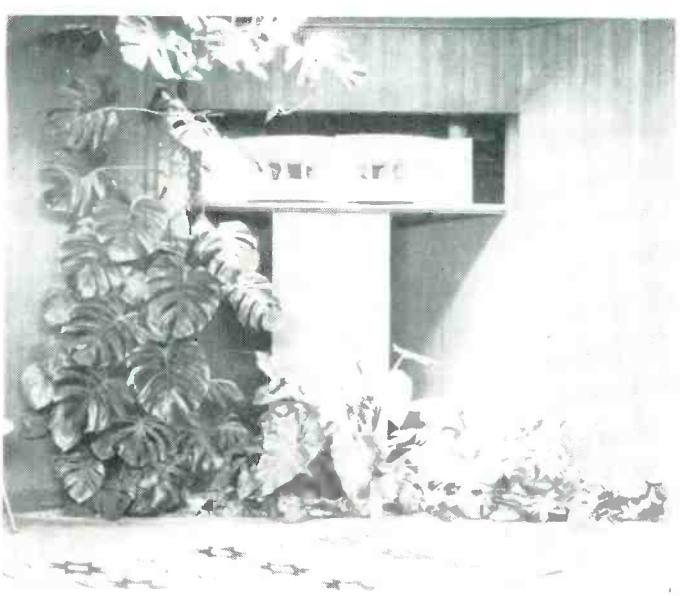
For amplifiers, Mr. Shepherd uses a home-constructed Williamson for channel 1 and a 30-watt McIntosh for channel 2. For records, he uses a Garrard 301 turntable with a 22-in. home-constructed arm which has an agate pivot, with a Grado Professional Stereo pickup for microgroove and a Pickering for 78's. His tape machine is an Ampex 960, and he uses an Altec M20 condenser microphone system for recording.

According to Leonard Rose, cellist (Columbia Records), Mr. Shepherd's sound is "better than any he has heard, including recording studios." Since Mr. Shepherd is a devotee of chamber music, he attends all he can get to from Denver to the coast, perhaps ten a year, and he assisted in six chamber music festivals in his home town, as well as others in Colorado Springs, Sewanee (Tennessee), and in Salt Lake City. He seldom goes a month without demonstrating his system, and some of the best systems in Denver were planned by him. He gets calls almost weekly from strangers who want to know how to get the best results for themselves.

Mr. Shepherd once laid out an installation for an acquaintance, and the cost was determined in the vicinity of $1900. The acquaintance balked to the point of buying a package set for some $450, was dissatisfied, and had someone else set up essentially the same system that had been recommended. But now the acquaintance doesn't speak to him.

Since the listening room is such a good studio, particularly for chamber music, Mr. Shepherd often records these groups and he made the tape that won 4-year 'cellist scholarships at both Oberlin College and Curtis Institute this year. And with this background, he offers a few suggestions to manufacturers:

1. Make better power supplies.
2. Develop less-noisy input tubes.
3. Make functional parts, with easy-to-read knobs like ham equipment rather than fancy eye-catchers.
4. Realize that the real music lover and the Audio Ham buys most of the expensive parts. Madison Avenue doesn't sell the real Ham.
5. Promote tape of good music.



The attractive speaker system at the end of Mr. Shepherd's specially built listening room

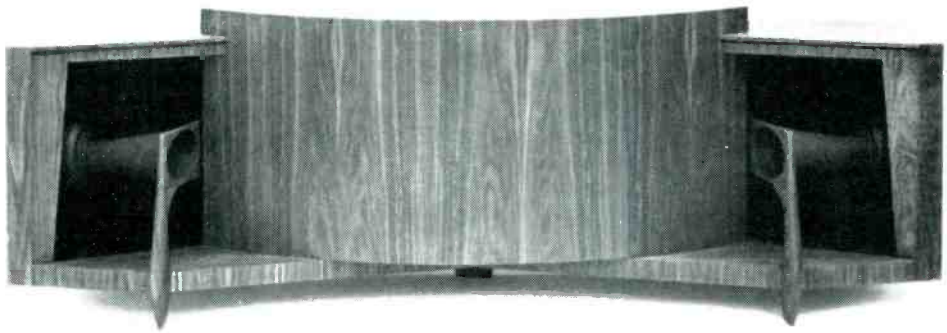
precision loudspeaker systems

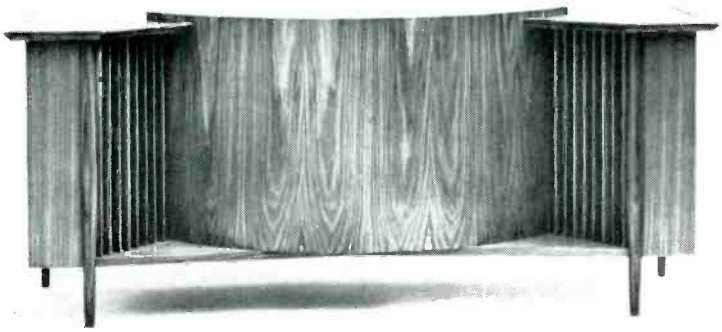
DESIGNED AND ENGINEERED BY JBL

specifically for stereophonic reproduction

JBL RANGER-PARAGON

Consummate stereo . . . the fabled JBL Paragon integrates through radial refraction two JBL theater speaker systems mounted in folded exponential horns to reproduce music with the ultimate stereophonic realism.



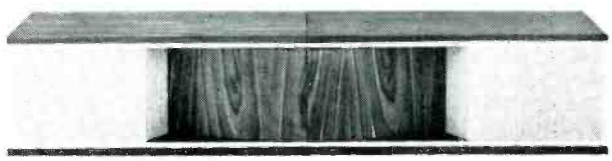


JBL RANGER-METREGON

Stereo distributed smoothly over a wide area through radial refraction is available in a bass reflex acoustical enclosure of moderate dimensions — the JBL Metregon. Seven different speaker systems may be used with the Metregon.

JBL RANGER-MINIGON

Newest stereo system by JBL is the Minigon, an "infinite baffle" enclosure of minimal dimensions designed for the new JBL Linear-Efficiency Loudspeakers. Hangers for suspension on wall are built in. Small enough for placement on bench or in book cases. Halves may be separated. Choice of grilles.



JBL DALE Model C49

is an elegant minimum volume enclosure for table or shelf. Dale and Madison are provided with brackets for wall mounting.

JBL MADISON Model C48

measures just 23¾" x 13¼" x 11¾", yet reproduces bass tones magnificently when a JBL Linear-Efficiency Loudspeaker is enclosed. Finished five sides so it may be placed vertically or horizontally.

Owners of JBL single channel speaker systems may obtain for their second channel identical systems that are matched for stereo. In enclosures such as the JBL C37, C40, C34, in which drivers are asymmetrically mounted, a mirror-image arrangement for the second system is advisable and available. Write for the name of the Authorized JBL Signature Audio Specialist in your community, free catalog, and new bulletins describing JBL Linear-Efficiency Loudspeakers.

JAMES B. LANSING SOUND, INC.

3249 Casitas Avenue Los Angeles 39, California

AUDIO ETC.

Edward Tatnall Canby

RCA'S CARTRIDGE TAPE RECORDER

. . . And now we come to the much-heralded and long-postponed RCA Victor cartridge stereo tape recorder, which has reached commercial form in an initial model, SCP-2, that I've been trying out. (Don't ask me about SCP-1, if there was such an animal.) It is a home-type recorder and player, complete with ceramic mikes for making your own stereo and an extension second-channel speaker box. I've had two of these machines on hand, which has given me a chance to average out my observations on this particular subspecies of the genus *cartridge*. There'll be other examples later on, needless to say.

This SCP-2, let me note first, has done a great deal to clarify for me the intention of the tape cartridge (AUDIO prefers to call it a magazine, but so long as "tape" precedes "cartridge" we will probably have to go along. ED.) as RCA conceives it—for as you can imagine, the specific size, shape, features and décor that a manufacturer drapes around a basic device betrays his thoughts and intentions better than any press release or advertisement. There's no purely theoretical reason why the tape cartridge should not be built into a super-recorder with dual VU meters, multiple mike inputs, mixers, circuits for monitoring and so on. Needless to say, the SCP-2 is not a recorder of this type, for the simple reason that RCA's marketing intentions are not in the direction of the professional engineer. (For that trade, RCA might want to sell its fabulous cartridge tape duplicator with the air-jet pulleys, described in a recent technical journal.)

Ready to Play

What you will find here, instead, is a large, somewhat gaudy semi-portable home instrument of the semi-suitcase type, tweedy looking with fancy heavy gilt trim inside (made of plastic) and a high-style set of modern clear-plastic saucer-shaped controls to catch the eye as well as the fingers. Everything is done by pushbutton and if you make a mistake the machine lets out a loud squawk (below) and stops you before anything happens. There is nothing whatsoever of the technical in this "look," not even in usual hi-fi terms. The only cryptic indication at all was something called STR. My musical mind read "strings" but, of course, it meant STEREO.

There aren't even the ordinary hi-fi inputs and outputs on this machine. A pair of phono inputs looks standard, and two sockets take the ceramic mikes; but if you want to play tapes through your regular hi-fi components you must use the phono inputs for outputs—a double-purpose circuitry I've never run into before. No fancy terms to confuse the button-pusher, no HI LEVEL, LO LEVEL, PREAMP OUTPUT and so on—no "hi-fi stuff" at all. Only one volume control, ganged for both channels, for both playback and recording; the nominal playback balance (to cope with speaker vagaries) is actually just an extra volume control on the second channel, over and above the main control. The balance on recording is fixed—you aren't supposed to know anything about such things. There's a simple flashing-light record-level indicator, normal and overload, combining both channels (it flashes on playback too but you are told to ignore that) and you can't make a mechanical mistake with the pushbuttons because you must always push the STOP button between all other functions—the buttons are interlocked.

The whole thing is clearly designed to be worked by the man, woman, or child who has never seen tape and probably never wants to, who wouldn't know a hunk of Soundcraft, Irish, Scotch, or Audiotape from a piece of sticky tape or ticker tape, or maybe elastic tape for underwear.

The machine comes complete and ready to play, that is, if you've bought the "extras" that complete it. You get built-in speakers, a mike, all cords, controls and the rest, and just like Daddy's big new car, the radio and heater are extra—i.e., your stereo isn't stereo until you buy an "extra" mike and an "extra" speaker system. This is perfectly normal standard practice in the package-goods industry these days, of course. Ah well, no use grousing about such ingrained American habit!

For all the "extra" functions beyond the basic one of playing and recording cartridge tapes, RCA lists more extra accessories, cables to connect to particular RCA phonographs for taping your disc records, for example—one end plugs into the special jack on the phono's rear, and so on. These accessory cables are wired at both ends to match only specific RCA instruments. There's no mention of, say, a cable that might connect a Columbia record player to the RCA tape recorder. (You can do it, natch, but nobody is going to tell you so in so many words.) This, too, is merely standard practice in the industry and is surely not exclusive to RCA Victor—it's just an indication as to where this cartridge tape machine finds its intended place in the home scheme.

You'll find the same thing reflected in the good looking instruction booklet, which is replete with three-color diagrams and art work. For each likely major function there's most of a page, telling you what cable to plug where, which buttons to push, always assuming you know nothing—but *nothing*. Reminds me, somehow, of those careful instructions that come with new cars—"to place the car in motion, depress the clutch pedal (A), move the gearshift lever (B) forward, and . . ." you know what I mean. Depressingly elementary and therefore dismally complicated. When you start from the beginning, man, you start from the beginning. These instructions are well-nigh incomprehensible for the ordinary hi-fi man, until the accessories and the switchings are translated into the terms that *we* know so well.

The Pushbutton Mind

Proceed no further. You can now quite accurately infer the gist of RCA Victor's main attitude and intent with this tape cartridge. It is meant for the pushbutton mind, for the person who doesn't want to know *why* or *how*—and there are millions of them. The cartridge will doubtless appeal to the soul who falls for electric toothbrushes and power can-openers, spray-can enamel, and automatic car windows; it's ingenious. But more likely this new form of tape is aimed, very simply, at the grand old-fashioned market we used to call "ordinary" or "mass-production" home music equipment (now curiously labeled hi-fi, to nobody's confusion). That is the market which has supported the bulk of the home music entertainment business straight up from the days of the morning glory horn and the mantel radio and it still does, hi fi or no, in this age of the transistor, the pop-up TV and the all-in-one stereo portable.

(Pop-up TV? Haven't you seen the new folding TV sets? Convenient as a folding chair and much less collapsible.)

I beg you to note that, up to this very day, the tape recorder for all its terrific progress and expansion has not really invaded the big mass market for home music in force. It has spread widely, it is spreading fast—but this can't hide the fact that millions of people have not even thought of trying tape, have shied away from it, refuse to touch it. There's the catch! Millions of them *never will bring themselves to touch it*.

But these people will buy the tape cartridge. It fits their needs, their concept of a workable home machine, *as no reeled tape will ever do*.

Ask any of your casual friends and don't just blame me for seeming to take sides. I'm on the other side. I use tape on reels and always will. I was shocked, the other day, when my own brother, who has played disc records these 25 years and has a species of hi-fi installation (with changer), saw a roll of tape in my home for the first time in his life. So *that's* what it looks like, he said. What's it made of? I was so surprised I said right back, why tape, of course. I mean plastic—what did you think? He didn't know. Hadn't even thought, had no reason to.

(*Continued on page 76*)

EDITOR'S REVIEW

POWER RATINGS vs. DISTORTION

CONSIDERABLE FOOD FOR THOUGHT was contained in a recent announcement in the columns of *Home Furnishings Daily* telling of the intent of the Electronic Industry Association to adopt a power rating figure based on a distortion of either 5 per cent or 10 per cent. In this meaty announcement, it appears, the basic difference between real high fidelity, as represented by the entire component industry, and "hi-fi" as presented in the daily newspaper advertisements with various complete systems being offered anywhere from $49.95 up, is brought out. Since no *performance* standards have been accepted by which the true quality of reproducing equipment can be assessed, who is to say that the stuff labeled "hi-fi" is not high fidelity? Even in the area of real high fidelity—components—neither the manufacturers individually nor the Institute of High Fidelity Manufacturers have attempted to set performance standards; the amplifier and tuner standards that have already been adopted by the IHFM refer only to the methods of measurement and the ways in which the results of the measurements may be set forth. Not once do the standards specify a minimum performance to entitle the product to be called "high fidelity."

In attempting to correlate the standards of the IHFM with the EIA—a practice that is common throughout all industry—it became apparent that the idea of one per cent distortion was not at all acceptable to the EIA, whereas practically all high fidelity components are rated at the one-per-cent point, some even lower. For years, the tube handbooks have rated output tubes at 5 per cent, but with the better designs of feedback amplifiers tubes are worked to about the same outputs with distortions not exceeding one per cent.

The horsepower race among automobile manufacturers is quite closely paralleled by the radio, TV, and "hi-fi" manufacturers. Whereas many fine component amplifiers are rated at, for example, 30 or 40 or 50 watts, many of the other amplifier products on the market employ much higher figures in rating their equipment. No one who has ever built an amplifier or who has ever made any measurements on one will believe it when he reads of a 40-watt amplifier which employs a pair of 6V6's, but such statements appear in ads at times. Even the rating of "Music Power Output" which is specified as the "greatest single-frequency power that can be obtained without exceeding rated total harmonic distortion" becomes a large figure with good equipment, and if everyone used the same method of measurement the performance of different amplifiers could be compared fairly. The term "Peak Power Output" gave a higher numerical figure to use in advertisements, since it is by definition exactly two times the normal power output. However, this rating is not included in the new standard. If some manufacturer should decide to use "Peak Music Power Output," he would have some astronomical figures to advertise, particularly if his rated distortion were to be 10 per cent.

Since the power output figures have achieved an importance all out of proportion to their actual meaning with respect to quality of reproduction, we believe that a brand new term should be employed by all component high fidelity manufacturers to rate their amplifiers, and this rating would be in—

HI-FI WATTS

which would, by definition, be the music power output, in accordance with the IHFM Standard, at *one per cent distortion*. This would automatically differentiate ordinary phono equipment from true high-fidelity equipment, and ratings given in Hi-Fi Watts would almost invariably indicate the quality of equipment that was being described in the ads.

Not everyone needs 50-watt amplifiers, but even when listening at one-tenth or one-quarter watt levels, the critical listener still wants his distortion held down to less than one per cent. And that there is a difference practically anyone who has listened to professional-quality equipment will agree.

STEREO vs. HIGH FIDELITY

The fact that stereo has burst onto the advertising pages of the daily papers has made stereo the one thing that attracts people, and we believe that the component industry has been a little lax in allowing the importance of stereo to overshadow the real end object of high quality sound reproduction—high fidelity. Anything can be stereo, as we all know from the ads, but only high quality equipment will sound good. It is as though the automobile industry decided to push the station wagon as the greatest thing in the world. Anybody can make a station wagon, but only Rolls Royce can build a Rolls Royce.

SPEAKING OF ROLLS ROYCE—

In case you didn't win the one Shure Brothers offered in their recent contest, you may at least be interested in who did. Kenneth E. Shutts, of Chagrin Falls, Ohio, was the lucky man. But anyway, try again next time.

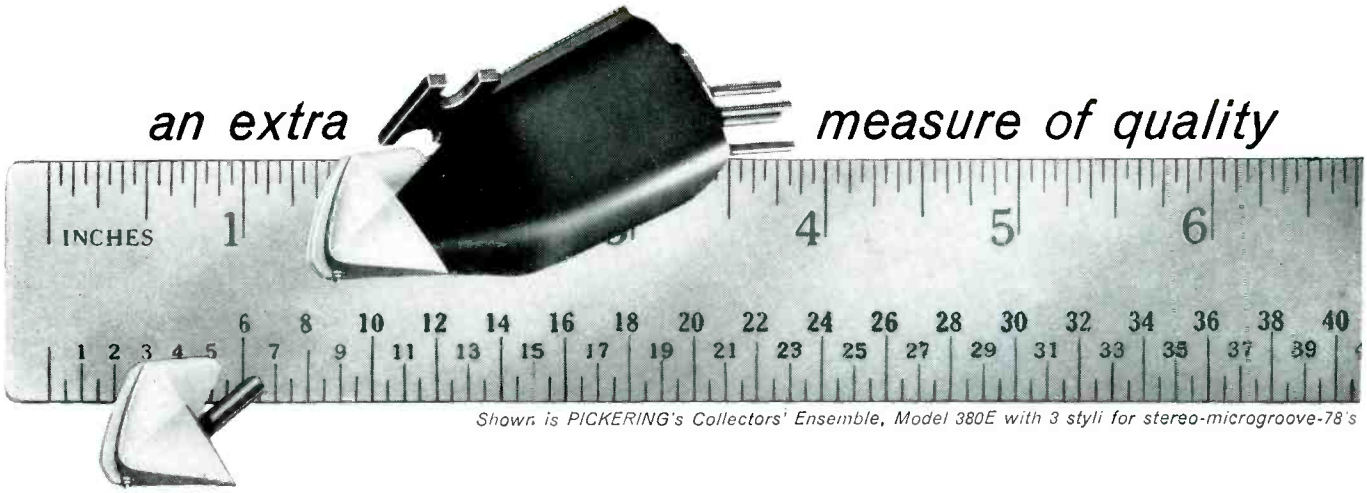
AES CITATION

While we realize that it is not considered in the best of taste to blow one's own horn, we also realize that AUDIO readers are not likely to see any mention of it elsewhere. On the occasion of its Eleventh Annual Banquet, October 8, the Audio Engineering Society honored us with a Citation

> *"in recognition of the contributions of* AUDIO *magazine to the education of the audio fraternity under our editorship."*

We are indeed pleased, and we trust we may continue to enjoy the esteem of the Society.

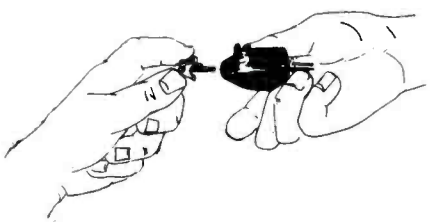
an extra measure of quality



Shown is PICKERING's Collectors' Ensemble, Model 380E with 3 styli for stereo-microgroove-78's

The extra measure of quality in every PICKERING product **adds extra value... extra convenience**...to any high fidelity system! The beautifully simple sculptured lines...the low, sleek profile...the **new** look in quality stereophonic pickups—this is the shape of good things to come—this is the PICKERING **Collectors' Series.**

Without question, the 380 is the **finest—** with more features and more flexibility than any other stereo pickup in the world. For example— the 380 is fully encapsulated in **precious mu-metal** for absolutely hum-free performance.



Only the Stanton Stereo FLUXVALVE features the safe, comfortable, easily replaceable stylus assembly.

Visit your dealer for a demonstration today, you will love the **live, eager** response to every nuance in the record groove...you will find yourself listening to a **bright, delightful quality**...second only to the original live performance. The only true way to judge a high fidelity component is to compare it with another...measure its performance with the most vital instrument of all...the ear. Those who can **hear** the difference... choose PICKERING*.

COLLECTORS' SERIES

Totally new and unique to high fidelity is the "Collectors' Ensemble"...a complete quality "pickup-package" for reproduction of all records—stereo—microgroove—78's.

Model 380E—Collectors' Ensemble, includes the Stanton Stereo FLUXVALVE with 3 "V-GUARD" styli for stereo, microgroove and 78 rpm records **$60.00**

Model 380A—Includes Stanton Stereo FLUXVALVE with D3807A "V-GUARD" stylus for transcription arms **$34.50**

Model 380C—Includes Stanton Stereo FLUXVALVE with D3807C "V-GUARD" stylus for auto-changer arms **$29.85**

PRO-STANDARD SERIES

It may interest you to know that in one short year, PICKERING'S Pro-Standard Series has become an industry standard...the universal choice of professionals. Now, the new and revolutionary PAC* technique developed by PICKERING has effected economies in manufacture which permit a reduction in the price of the Pro-Standard Series.

Model 371A Mk II Stanton Stereo FLUXVALVE Pickup now **$26.40**

Model 371C Mk II Stanton Stereo FLUXVALVE Pickup now **$24.00**

Model 196 Mk II UNIPOISE Arm with integrated Stanton Stereo FLUXVALVE Pickup now **$49.50**

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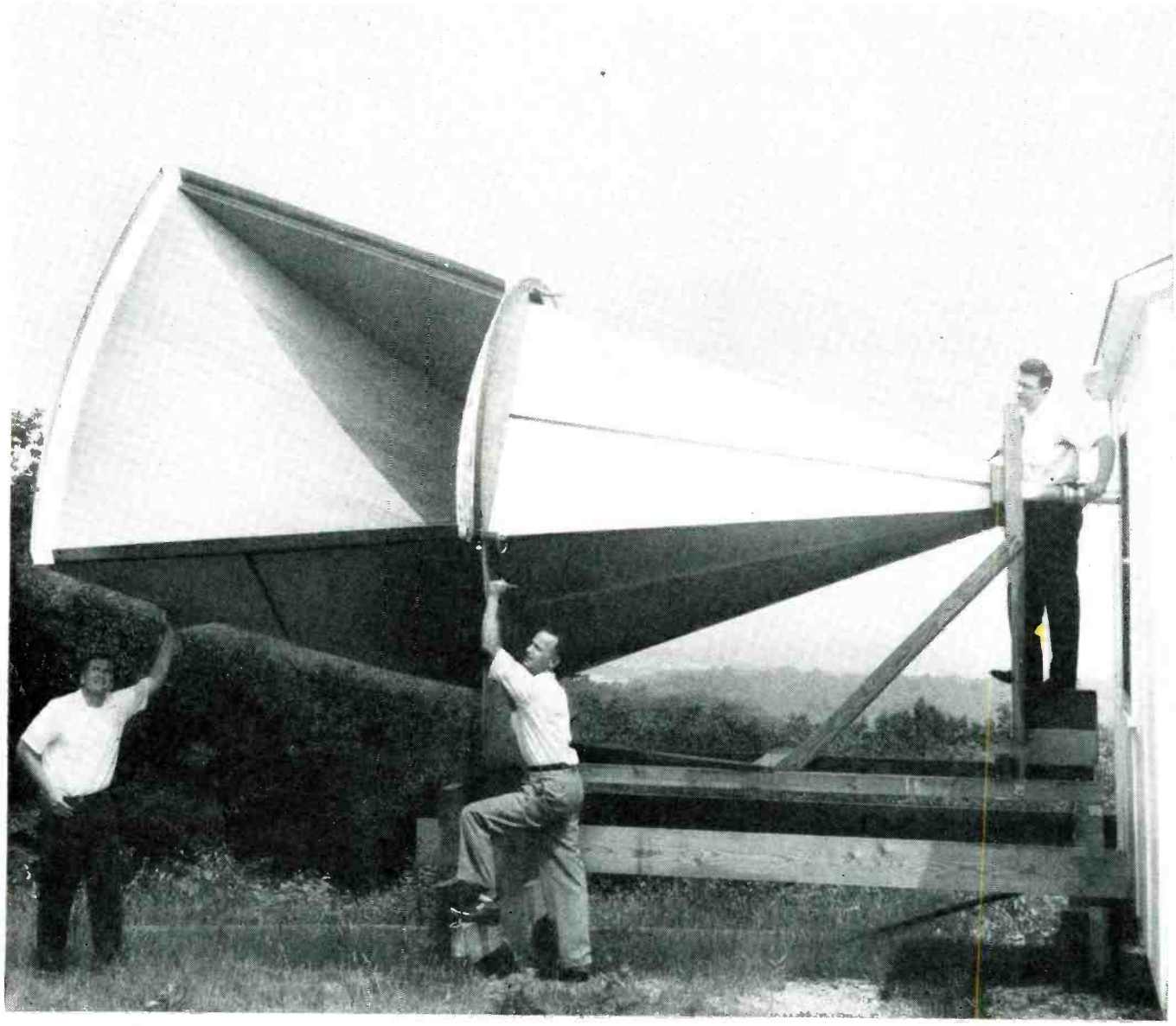


At Bell Laboratories, Holmdel, N. J., a horn reflector antenna is beamed skyward by scientists Edward Ohm, David Hogg and Robert DeGrasse. The maser amplifier, which employs a ruby cooled in liquid helium, is inside building at right. Over-all "noise" temperature of antenna, amplifier and sky is only 18°K at 5600 megacycles.

ANOTHER STEP TOWARD SPACE COMMUNICATIONS

The above antenna is part of a new ultra-sensitive radio receiving system under development at Bell Telephone Laboratories. It has extraordinary directivity. Beamed skyward, it ignores radio "noise" from the earth, yet picks up extremely weak signals from outer space.

The signals are amplified by the latest Bell Laboratories "maser" amplifier. The maser principle was first demonstrated, using gas, by Prof. C. H. Townes and his collaborators at Columbia University. Bell Laboratories scientists applied it to the solid state guided by a theoretical proposal of Prof. N. Bloembergen of Harvard University. Their latest traveling wave maser amplifier employs a ruby mounted in a waveguide. The ruby is excited to store energy. As signals pass through, they absorb this energy and are thus amplified. The device uniquely combines the characteristics needed for practical space communication: extremely low inherent noise and the ability to amplify a broad frequency band.

At present the receiving system is being used to pick up and measure minute radio noise generated by the atmosphere. It also foreshadows important advances in long distance communications. For example, it could extend the range of space-probe telemetering systems, could help make possible the transatlantic transmission of telephone and TV signals by bouncing them off balloon satellites—and has numerous applications in radio astronomy and radar.

This pioneer development in radio reception is one more example of the role Bell Laboratories plays in the pursuit of better communications technology.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

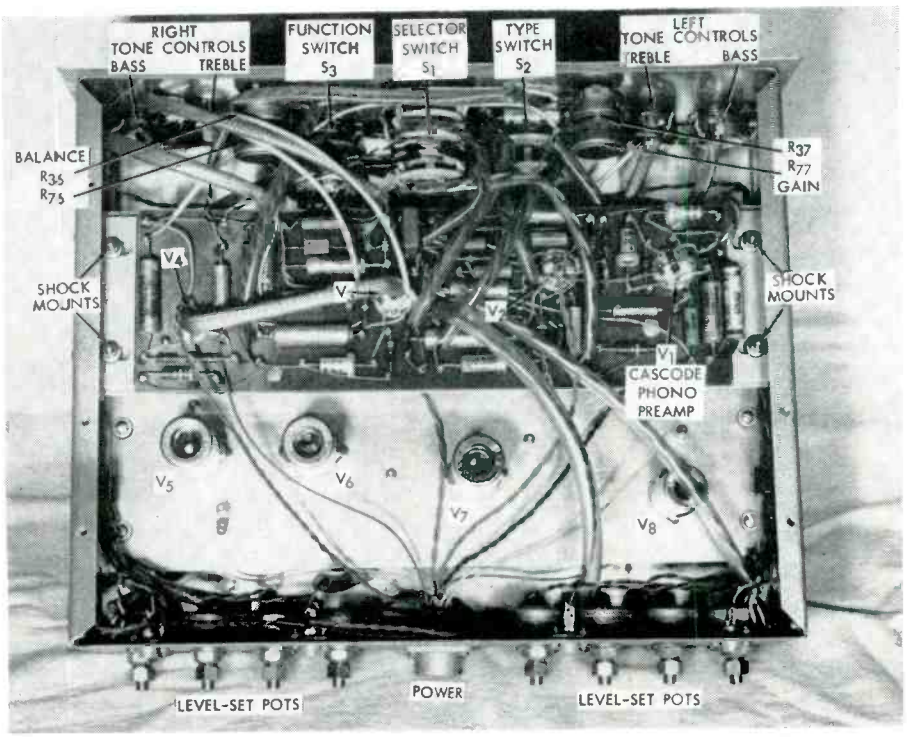
Universal Stereo Control Center

FRANCIS A. GICCA*

Not for the absolute novice, but the more experienced constructor will find this preamplifier-control unit gives practically everything necessary in the way of flexibility to the modern stereo system.

THERE WAS A TIME when the audiofan could feel fairly secure that his audio system would not become obsolete. The last two years have created quite a bit of doubt. Disc stereo has so revolutionized high-fidelity and there can be no doubt that stereo will dominate the industry from now on. Everyone wants to participate in this revolution and so many have quickly added another speaker and power amplifier to allow them to play stereo discs. Frankly, the sudden rapid growth of inexpensive stereo has caught nearly everyone unawares and so the early problems of high-fidelity are re-occuring. To the dismay of long-suffering wives, once cabinetted audio systems are now over-running the living room with additional amplifiers, loudspeakers, and "temporary" cabling.

Perhaps the most urgent need is for a stereo control center from which all stereo and monophonic sources can be controlled conveniently. This would allow all temporary wiring and switching to be removed and amplifiers to be hidden. Over a year ago the author realized the need for such a control center and began its design, testing and construction. The resulting control center meets all the original design objectives and provides performance which exceeds many monophonic control centers.



Inside view of the preamplifier. The two halves of the circuit are essentially identical —one is mounted with the tubes upward, the other with the tubes downward.

Design Consideration

When design was first started it was decided that there should be no skimping in this control center. No short-cuts would be taken to either simplify the circuit or reduce its cost at the sacrifice of quality. It was also decided that the unit should be as flexible as possible in order to prevent obsolescence.

The most critical and important section of any control center is the preamplifier, particularly since records and tape predominate as stereo sources. An ideal phono preamplifier must provide: (1), extremely accurate playback equalization throughout the audio spectrum; (2), high signal-to-noise ratio; (3), low hum level; (4), low harmonic and intermodulation distortion; and (5), high gain. In order to preserve low distortion, it is important that the first stage be devoted to wide-band, low-noise voltage amplification without any attempt at playback equalization. Similar requirements obtain for the tape-head preamplifier.

Because of its extremely low noise capabilities, the "cascode" circuit so often used in TV tuners was chosen for the first stage (V_1 and V_5 in *Fig.* 1). The cascode circuit uses two triodes connected grounded-cathode, grounded-grid which gives the high gain of a pentode with the low noise of a triode. This high gain is very useful since it supplies the capability to handle all magnetic cartridges and allows the use of feedback to reduce distortion. In order to further enhance the low-noise capabilities of the cascode circuit, the 12AY7 double-triode was chosen for this stage.

Unfortunately, the cascode amplifier has one main disadvantage. Since the cathode of the grounded-grid stage is "floating" above ground (pin 3 of V_1 and V_5), any stray voltage induced on this cathode will appear at the output. Therefore, the heater supply can easily produce hum due to heater-cathode leakage. This disadvantage can be overcome by using a d.c. heater supply, at least for the cascode stage, and making certain that the d.c. supply is adequately bypassed to ground.

The final cascode preamplifier has a signal-to-noise ratio of over 80 db and a signal-to-hum ratio of about 65 db. Table I lists a figure of 63 db, which is predominantly hum. Actually, this represents the *worst* condition measured and an actual figure of over 70 db can be obtained by careful lead dressing. In any event, this spurious noise level cannot be heard with even the lowest level inputs.

Following the cascode input stage is a conventional triode voltage amplifier with feedback equalization. Unlike many equalization circuits, however, at least 10 db of negative feedback is maintained *throughout* the frequency range (feedback resistors R_{12} and R_{52} in *Fig.* 1). This is extremely desirable in order to lower distortion at very low frequencies where there is no equalization feedback to help. Feedback equalization requires reserve gain in the preamplifier since feedback will remove at least 50 db of gain if equalization is to be maintained over the total audio band. Since there is gain to spare in the cas-

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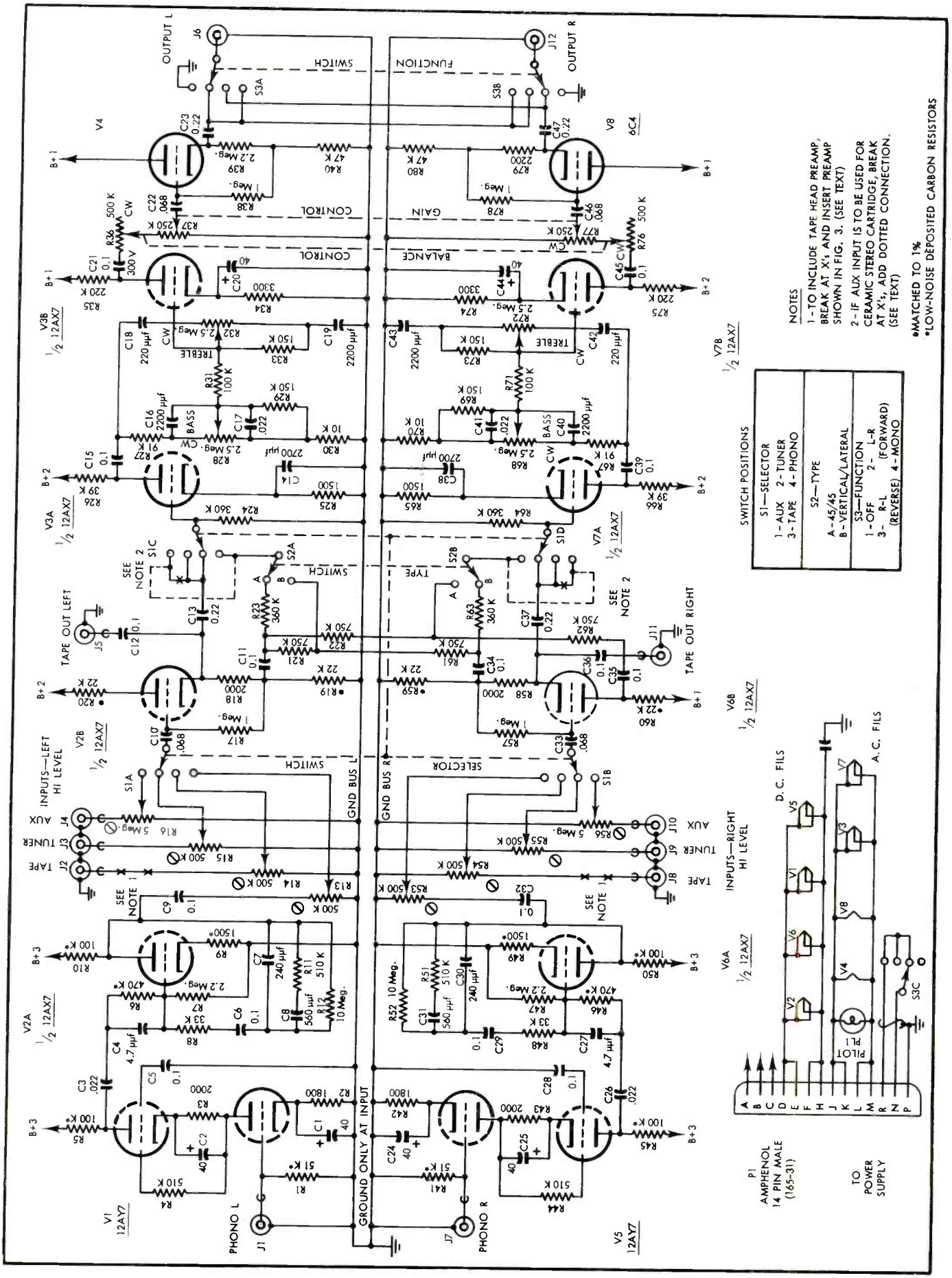

Fig. 1. The complete schematic of the stereo control unit.

TABLE I

PERFORMANCE CHARACTERISTICS

INPUT SIGNALS FOR 1-VOLT OUTPUT—

High-level channels	20	mv
Phono channel	0.66	mv

FREQUENCY RESPONSE (tone controls set for flat response)—

High-level input:	10-20,000 cps ± 0.5 db
Phono input:	RIAA ± 0.5 db from 10-20,000 cps

TONE CONTROLS—

Bass, at 50 cps	12 db boost, 16 db cut
Treble, at 15,000 cps	13 db boost, 26 db cut

HUM AND NOISE—

High level inputs: 70 db below 1.0 volts output with gain control set for 100-mv input

Phono input: 63 db below 1.0 volts output with gain control set for 5-mv input

HARMONIC DISTORTION—

Measured at 2.5 volts rms output, and corrected for source distortion

	20	1000	15,000	cps
High-level inputs:	0.32	0.17	0.23	per cent
Phono input:	0.83	0.24	0.44	per cent

INTERMODULATION DISTORTION—

Measured with 60 and 7000 cps, 4:1 ratio. Tone controls flat, gain control maximum, output level control adjusted for required output. Phono input corrected for RIAA characteristic

Output level:	0.5	1.0	1.5	2.0	2.5	volts rms
High-level inputs:	0.18	0.28	0.35	0.58	0.67	per cent
Phono input:	0.48	0.50	0.52	0.55	0.62	per cent

CHANNEL SEPARATION—

High-level inputs:	60 db
Phono inputs:	50 db

BALANCE CONTROL RANGE—

± 10 db on each channel; ± 20 db total

code phono preamplifier, it is possible for equalization to follow the RIAA playback curve within ± ½ db over the entire range of 10 to 20,000 cps. Because of the universal acceptance of the RIAA characteristic, it is felt unnecessary to incorporate equalization other than RIAA, particularly since older monophonic curves can be approximated with tone controls. The design objectives for the preamplifier section have been met. Equalization is accurate to within ± ½ db, hum and noise are exceptionally low, and distortion is less than 1 per cent (refer to Table I).

Ceramic and crystal stereo cartridges need no preamplification or equalization since their output is relatively high and the cut of the piezoelectric element causes its response to approximate the RIAA characteristic when loaded as recommended by the manufacturer.

In these days of universal 45/45 stereo releases, it is important that any control center have the capability of playing conventional monophonic recordings without any loss in quality. This requires that the vertical component of conventional lateral monophonic LP's be removed from the output of the control unit. Recent monophonic recordings have carefully controlled vertical outputs which are low in distortion. However, in older monophonic LP's, vertical modulations consist primarily of highly distorted signals and groove noise. Unless the output of the stereo cartridge is converted to vertical-lateral coordinates and the vertical component removed when monophonic LP's are played, the distortion apparent on older LP's is objectionable. Tests were made with monophonic frequency-test records in order to determine how much distortion was present as vertical modulation. Distortion as high as 60 per cent was measured. Obviously, it is important to remove this distortion component if we expect older recordings to sound as well as they once did.

Luckily, the conversion of 45/45 output into vertical-lateral coordinates is relatively simple. If the 45/45 left-right modulations are *in*-phase, that is; one groove wall moves inward while the other moves outward, and *vice versa*,[1] the stylus will only move laterally. Therefore, if the 45/45 left-right outputs are added, the result is the lateral component of the 45/45 groove modulation. Conversely, if the 45/45 left-right modulations are *out*-of-phase, that is, the groove walls move inwards and outwards together, the stylus will move only up-and-down, or vertically. Therefore, if the right 45/45 output is subtracted from the left output, the result is the vertical component of the 45/45 groove modulation. These relations can be readily checked by drawing a sketch of groove wall motions.

A phase-inverter in the right channel, V_{6B}, produces two outputs, + R and − R. + R on the cathode of the phase-inverter and − R on the plate. Correspondingly, + L output is present on the cathode of an identical phase-inverter, V_{2B}, in the left channel. Resistive mixers combine these signals and produce L + R and L − R, or lateral and vertical outputs accordingly. The lateral component is then fed to the left channel and the vertical component is fed to the right channel. For monophonic disc playback, both speakers are connected to the left channel thereby playing only the lateral component of monophonic LP's.

The selector switch, S_{1}, is arranged so that the vertical or lateral outputs can only be selected in the "Phono" position thereby avoiding inadvertent combination of left-right signals from other stereo sources, such as tape or tuner.

[1] By industry agreement, in-phase signals in the two channels result in purely lateral movement of the stylus.

Tone Controls

Following the vertical-lateral mixing circuit is a fairly conventional tone-control circuit. It is important that each channel have individual bass and treble controls so that tone corrections may be made separately in each channel since there is no guarantee that both channels will require equal adjustment. However, tone control must be used with reservation so as not to destroy the delicate stereophonic phase relationships. With most tone-control circuits, the flat response region is difficult to locate and small control rotations produce large tonal variations. The tone-control circuit decided upon uses a shunted linear control which produces a broad middle control region where control rotation only slightly affects frequency response. This allows the flat response region to be readily located.

A ganged volume control and separate balance control for both channels is essential. Nothing is more annoying than a constant juggling of separate channel-gain controls to adjust volume and stereo balance.

Two cathode-followers form the output stages of the control center. The output impedance of these cathode-followers is about 500 ohms, so as much as a 100 ft of shielded cable may be used between the control center and stereo power amplifier without loss of high-frequency response.

Evaluation Tests

Several stereophonic control centers have been built by audiofans at the Raytheon Manufacturing Company during the past few months allowing extensive evaluation tests on several models. Table I gives the performance figures of the control center as verified on several units.

It might pay to compare these specifications with the specifications of commercially available stereophonic control centers. Certainly, few commercial units will produce one volt rms output with only 0.66 millivolts phonograph input while maintaining a signal-to-noise ratio of 63 db. This specification alone char-

(*Continued on page 89*)

Calculation Chart for Vented Cabinets

VICTOR BROCINER*

Calculations for port area or duct length are not difficult, but to fit a specific case it is much easier to refer to a chart so as to accommodate a number of variables with one solution.

With the increasing popularity of high-mass, high-compliance speakers, and their use in small enclosures, the vented cabinet[1] has been enjoying a new wave of popularity. The vented cabinet is a Helmholtz resonator. Conventionally, its resonance is made equal to the free-air resonance of the speaker being used. With high-compliance speakers having free-air resonances as low as 15–20 cps, it is considered desirable by some designers to tune the cabinet to about 30 cps, there being virtually no program material below this frequency.

For resonance, the reactance of the inertance of the air in the vent must equal the reactance of the compliance of the box.

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[1] U. S. Patent No. 1,869,178, A. L. Thuras.

Fig. 1. University C-12HC woofer, typical of the high-compliance speakers commonly used in small enclosures.

$$\text{Compliance } C = \frac{V}{\rho c^2} \qquad (1)$$

where ρ = density of air, grams per cubic centimeter

c = velocity of sound, centimeters per second

$$\text{Inertance } M = \rho \frac{l'}{S} \qquad (2)$$

where l' = effective length of the air mass in the port, in centimeters

S = area of the port, in square centimeters

At resonance:

$$\omega_o M = \frac{1}{\omega_o C} \qquad (3)$$

Therefore

$$\omega_o = \sqrt{\frac{1}{MC}} = C\sqrt{\frac{S}{l'V}} \qquad (4)$$

or

$$f_o = \frac{C}{2\pi}\sqrt{\frac{S}{l'V}} \qquad (5)$$

The effective length of the port

$$l' = l + \Delta l \qquad (6)$$

where l = the physical length of the port

Δl = the end correction.

The end correction is somewhat approximate. A good intermediate value is given in convenient form by

$$\Delta l = 0.8\sqrt{S} \qquad (7)$$

Inserting this into (5) we have

$$f_o = \frac{C}{2\pi}\sqrt{\frac{S}{V\ (l + 0.8\sqrt{S})}} \qquad (8)$$

Transforming this formula to permit dimensions to be expressed in inches:

$$f_o = 2145\sqrt{\frac{S}{V\ (l + 0.8\sqrt{S})}}$$

Usually, we know V, and assign a value to f_o. We then want to know S. For a simple port, l is the thickness of the cabinet wall. Since S occurs twice in the expression for f_o, the expression is difficult to solve. A graphical solution would facilitate design.

The accompanying chart covers a wide range of designs. It involves no approximations[2] and includes data for the design of ducts as well as ports.

The use of the chart comprises the steps outlined below.

If small vent openings are indicated by the chart, the use of a duct should be considered. Small orifices involve some undesirable effects. The high air velocity produced by them results in audible "rushing" noise; non-linearity can also occur, causing distortion. If the use of a simple port requires an area around 5 sq. in. or less, a duct can be used to provide a greater area. Examination of the chart will indicate that tuning a small enclosure (less than 3 cu. ft.) to 45 cps or less, requires the use of a duct.

It might be well to add a word of caution. The chart tells how to tune a vented cabinet to a selected frequency of resonance. It does *not* provide complete design data for design of a system comprising speaker and cabinet. Selection of optimum cabinet size for a given speaker, correct damping, shape of cabinet, its material and construction, shape and location of the port or duct, are matters that require careful consideration for good performance.

Example: A University C12HC high-compliance woofer, *Fig.* 1, is to be mounted in a 1.8 cu. ft. cabinet made of ¾" thick wood. Resonance is to be at 30 cps. Find the port size.

Starting at 1.8 cu. ft. on the top, center, CU. FT. scale, move to the right to intersect the inclined line at B, then down to the inclined line marked 30 cps RES. FREQ., at C. Then project horizontally to the left until you reach the inclined DUCT LENGTH line marked ¾". The intersection is slightly off the chart, at D, indicating a port area less than 1 sq. in. This is below the desirable

[2] In some charts previously published, a simplifying assumption is made that l is negligible compared to $0.8\sqrt{S}$. Then $f_o = \frac{C}{2\pi}\sqrt{\frac{\sqrt{S}}{.8V}}$. For wood thicknesses of ½ to ¾ in., the error introduced is not negligible.

USING VENTED CABINET CHART

For a given volume[3] of cabinet (in cubic inches)

(1) Find intersection with inclined line (lower right) for desired resonant frequency.
(2) Carry point of intersection to the left to meet the inclined line for the duct length selected,[4] in inches.
(3) From this point, move
(a) down to find area, in square inches
or (b) up and to left for diameter of circular aperture or duct, in inches.

If the cabinet volume is given in cubic feet, start with this figure on the appropriate vertical scale at the top of the chart; move to the right to intersect the inclined line and so obtain the equivalent number of cubic inches. Now move downward and proceed as in (1) above.

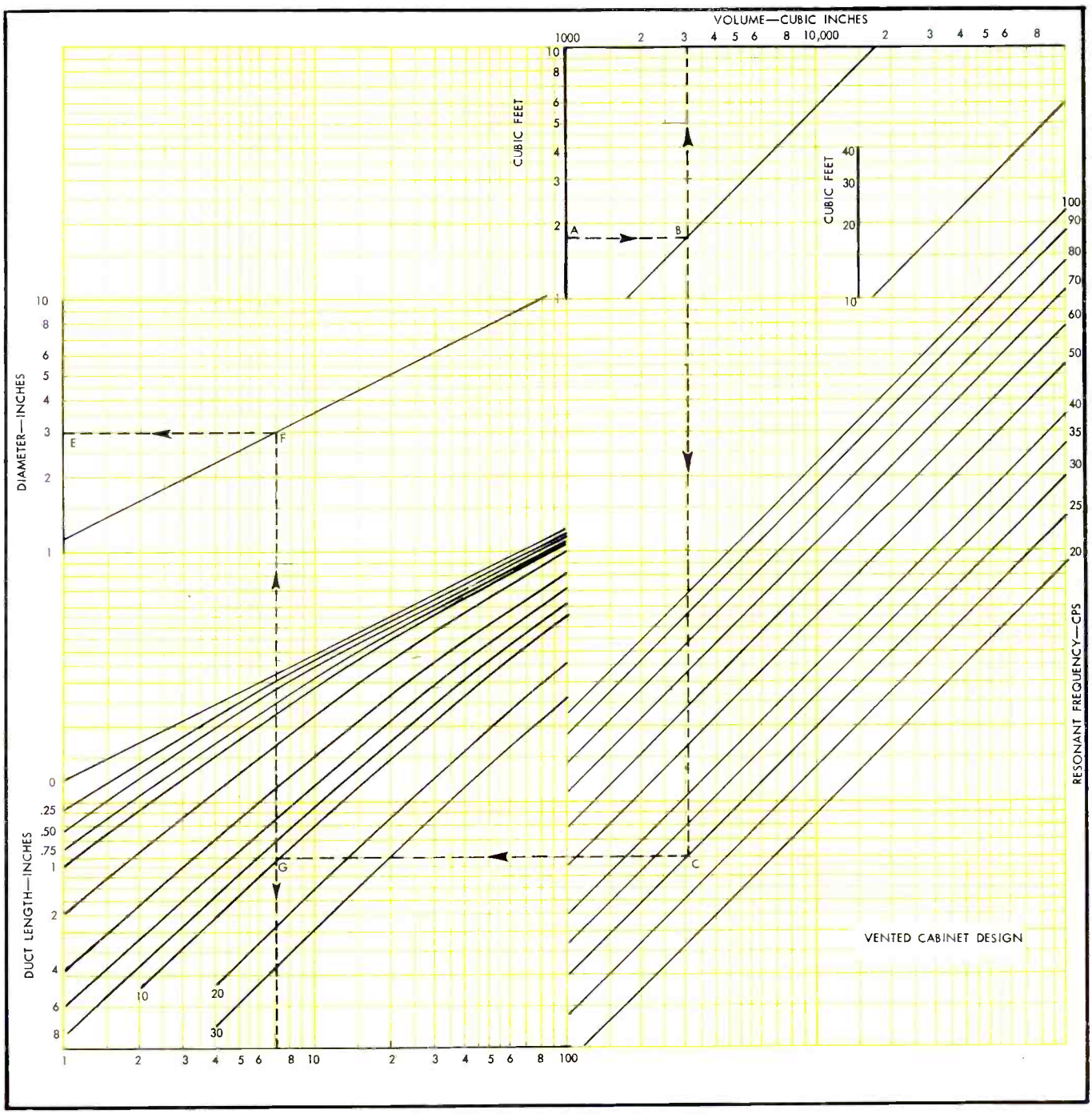
lower limit given in the text, so the use of a duct is indicated. A 3″ mailing tube is easily obtainable and convenient to use.

At the upper left, find 3″ on the DIAMETER scale. E, move to the right to intersect the inclined line at F, then downward to cross the previous horizontal line from C, at G. This is near on the inclined DUCT LENGTH line for 10″. The correct length of 3″ diameter duct is 9½″.

[3] Strictly speaking, the cabinet volume should have deducted from it the volume occupied by the speaker itself. The table below gives approximate figures for speakers of various nominal diameters.

Diameter, in.	Volume, cu. in.
6	13
8	41
10	100
12	227
15	507
18	1050

[4] This duct length includes the thickness of the cabinet wall. If a port is used instead of a duct, it *is* the thickness of the wall. It may be more convenient to select the duct *area* first, instead of the length. In this case, the length will be given by intersection of the vertical "area" line with the horizontal line of step (2) above. Æ



VENTED CABINET CHART

Puzzled About Amplifiers?

NORMAN H. CROWHURST

Is a triode amplifier better than a pentode amplifier, or vice versa? The author shows you that either type of tube can be incorporated into an excellent amplifier if the design is correct—and then he tells you about some of the design problems.

IF YOU FOLLOW the reports of certain consumer testing organizations, you may be puzzled why it is a certain manufacturer's product can be rated as "best buy" one year, while the following year the same product is rejected as "unacceptable, not worthy of further test." The answer to that question does not appear to be a technical one so we won't attempt it here. However, there are differences in amplifier performance which make a very similar question—that *is* technical—quite pertinent. What really is the best type of amplifier circuit?

This question repeatedly occurs in various guises, so it is not untimely to review it. One still hears from people who have triode amplifiers and who tell us that their neighbors and friends testify the "good old amplifier" still gives performance comparable with the best modern one.

Others who hear reports like this want to know just what the score is. If the "good old triode" was the best kind of output stage for an amplifier, why is it that manufacturers universally adopted pentodes or tetrodes in various types of output circuits?

When we examine the difference between the two types of tube we find that the pentode is more efficient and consequently, for a specific amount of dissipation, or dollars' worth of tubes, it is possible to deliver a larger output power. Also, having a higher gain than the older triode tubes, it is easier to apply a greater amount of feedback and thereby reduce distortion to a lower figure. Consequently a modern amplifier, using the same dollars' worth of components, can quote a higher power output with lower distortion than the "good old triode" amplifier.

One would imagine that such statistics, which are measurable objectively, should be more reliable than the opinion of a number of people who listen to modern amplifiers against the older triode counterpart and who still aver that the triode sounds as though it does a better job. However, a serious investigation of the technical performance of amplifiers, beyond just the simple specifications usually quoted, turns up a number of reasons for this difference.

In the first place, the transfer characteristic of pentodes contains *much higher order* harmonics than the triode type characteristic which, single-ended, produces predominantly second harmonic and, in push-pull, produces a relatively small amount of third and not much above this. A pentode-type output, in contrast, produces third and fifth harmonics and sometimes even seventh in quite sizable proportion. True the feedback reduces these dramatically, but the amount of feedback necessary to do a real cleaning up job on the harmonic and intermodulation distortion can also produce other troubles. These occur under a variety of circumstances.

Blocking

One of them is what happens at overload. Measurements merely tell how pure an amplifier is up to a certain point. They do not say what happens when a sharp peak momentarily drives the amplifier beyond this point, as can often happen with program material. The average "good old triode" amplifier merely lopped off the high peak and carried on working. More recent work with transistor circuits, which achieve the same results by somewhat different methods, has shown that such peak clipping can become quite drastic before it is appreciably audible.

But many amplifiers employing a large amount of feedback, particularly those using pentode output tubes, do more than clip off the peak. When such a high peak comes through, it throws the amplifier out of balance in such a way as to block the signal that immediately follows it. This produces a noticeable interruption or breaking up in the program. As the amplifier comes back into action, after the blocking, it distorts because the tube that was blocked does not suddenly come back to its correct operating condition. Thus the effect of the sudden peak is to block the amplifier and allow it to come back with a sort of strangled effect. This is generally given the name "break up."

Let's take an example. A 25-watt amplifier is capable of handling a peak power of 50 watts. The average power in a program signal may not be more than 2 to 5 watts. But such average program material may well include a peak here or there that runs up to what should be 60 watts, 10 watts beyond the maximum handling capacity of the amplifier. This is what causes the trouble. Each such peak momentarily overloads and blocks the amplifier so that, for a fraction of a second thereafter, it will not even handle one watt and then it comes back into action distorting the 2- to 5-watt level that follows the momentary peak.

Obviously such an amplifier will not appear to give as much good, clean output as one that handles say 15 watts and then clips for a moment. Even though the corresponding peak may still run up to what would be 60 watts, this just gets lost and the following 2- to 5-watt level is amplified without further distortion. Using the latter amplifier, the level could probably be turned up so it runs at from 6 to 15 watts instead of 2 to 5 watts, an increase in level of about 5 db, which is quite noticeably louder, and yet will still sound clean as compared with the 25-watt amplifier working at an average output of 2 to 5 watts. This comparison is illustrated at *Fig.* 1.

Are we to conclude then that, in spite of the better figures a pentode will give, it does not really produce better results than the triode? Not at all. A pentode properly used can produce quite good results and still retain the advantages, apparent in the figures, of better efficiency and improved gain which also enable the distortion to be satisfactory reduced.

The twin-coupled amplifier[1] described in these pages in November, 1957, is an example of this. A great many readers have written in saying that they have compared this amplifier with others, using much larger nominal outputs, and

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[1] Louis Bourget, "Stereo-monaural companion amplifier for the Preamp with Presence," AUDIO, Nov., 1957.

that the twin-coupled gives superior performance, both as to apparent undistorted output and general cleanness. And yet the twin-coupled circuit uses the output tubes strictly as pentodes with a variety of unity coupling. This well illustrates that pentodes *can* be operated in such a way as to achieve the benefits of their improved efficiency and give performance that is quite acceptable to critical listeners.

The Best Circuit

What then is the best of the modern output circuits? This is a question quite often asked and one to which there is no direct reply. It depends on how well each type of output circuit is designed or used.

For quite a while, there seemed to be a belief among amplifier designers that optimum performance is achieved if all the stages reach overload point at about the same level of amplification. Another school of thought recommends that the earliest stages have quite a nice margin (which is easier to do), while the drive and output stages should run into overload pretty well at the same point. Often it has been recommended that the output stage should overload before all earlier stages, because this means that only one stage is responsible for producing distortion instead of many stages running into distortion conditions at the same time.

Each of these recommendations may have its point, considering the amplifier without feedback. But when feedback is applied, as it is on all modern amplifiers, the situation is considerably altered.

Feedback theory is usually confined to the condition where the amplifier is assumed to have all its gain. Unfortunately, as soon as clipping occurs the amplifier does not have all its gain. This does not necessarily introduce any instability, but it can result in the sudden appearance of signals having excessive amplitude.

For example, suppose, at maximum output, the input is really 1 volt but is held down at the grid of the first stage to an effective 0.1 volt because there is 0.9 volts of feedback. Then the onset of clipping results in a signal that suddenly looks like the 1 volt it really is because the 0.9 volts signal gets chopped off short. This results in a high peak being amplified by the early stages of the amplifier until some stage fails to handle it. An increase of actual input from 1 volt to 1.1 volts in a waveform at the first grid that suddenly shoots up from 0.1 volt to 0.2 volts, and proportionately through successive stages. (*Fig.* 2)

What happens due to this sudden peak then depends on further details in the amplifier design. If this sudden peak produces overload at a point where there is direct coupling, say between an amplifier and phase-splitter stage, the ampli-

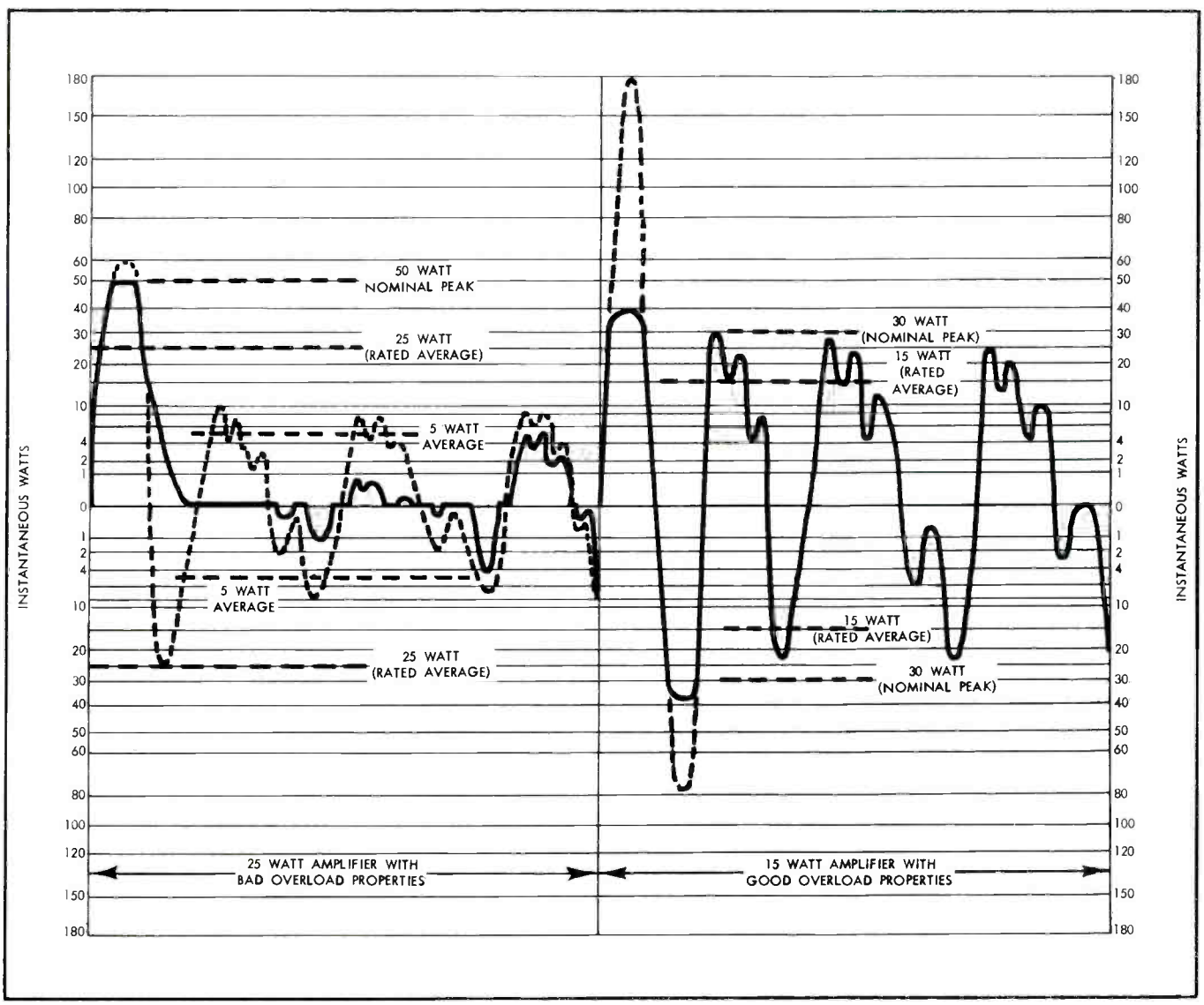


Fig. 1. Comparison of the same transient waveform amplified by (left) a 25-watt amplifier with bad overload characteristic, and (right) a 15-watt amplifier with good overload characteristic. In each case, the solid line represents the actual waveform, while the dashed line shows the correct waveform where the amplifier departs from it. The 15-watt amplifier is handling the same waveform at three times the power level.

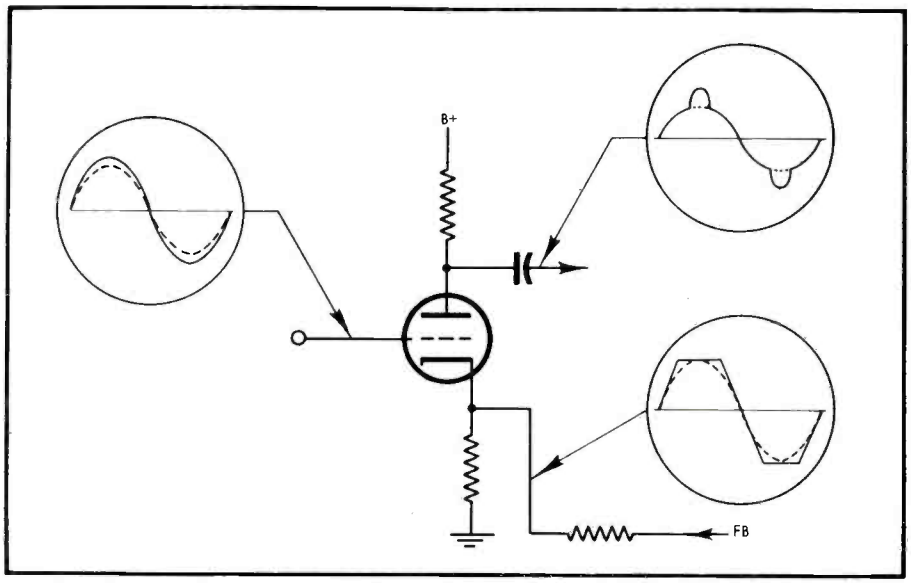


Fig. 2. What happens in any feedback amplifier when clipping occurs. This shows the waveforms associated with the input stage. Dashed line is the waveform at maximum undistorted signal level. Solid line at a level 10 per cent above this.

fier will not be disturbed by it. As soon as the peak disappears the amplifier reverts to its normal operating condition and carries on amplifying normally.

But if this peak reaches its limit of amplification at a stage that is resistance/capacitance coupled, a grid may be driven a long way positive, causing a negative charge to appear on the grid side of the coupling capacitor after the peak disappears. This biases that stage momentarily back beyond cutoff and causes blocking. As the stage drifts back into its normal operating condition some distortion is evident before the amplifier resumes proper operation.

Another place where the trouble can occur, if the amplifier is "held up" right through to the grids of the output stage, is that the sudden removal of amplification due to clipping results in an excessive postive drive at the grids of the output stage. These are almost invariably resistance/capacitance coupled and consequently, immediately following the excessive peak, the output stage is momentarily over-biased so as to produce crossover distortion if not complete blocking for the moment.

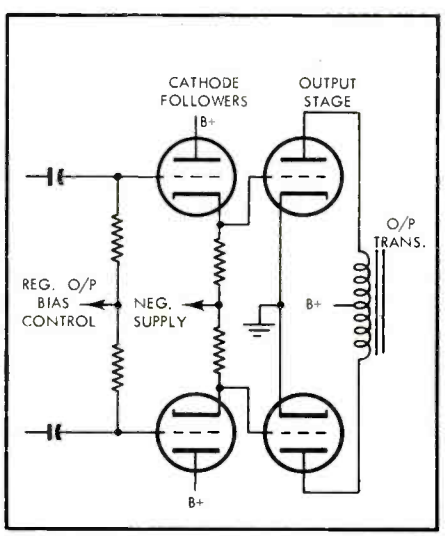


Fig. 3. One way to obviate output-stage blocking is to use direct-coupled cathode followers between drive and output, as shown here.

The Cures

There are two ways of obviating this. One is to use a cathode follower, direct coupled to the output stage with appropriate negative supply to enable the cathode follower to have an even more negative return than the necessary bias voltage for the output stage (*Fig.* 3).

The other is much simpler and almost as effective. It consists of interposing what at one time would have been called a grid-stopper resistor between each coupling capacitor and the output tube grids. It does not serve the one-time function of stopping parasitic oscillation in the grid circuit, but does prevent the large grid-current flow that momentarily occurs during the high peak condition and thus avoids the radical over-bias condition after the peak (*Fig.* 4).

These are some general measures to obviate the sudden overload troubles that beset high-feedback pentode-type amplifiers. But what about some of the other types of circuits, Ultra-Linear, unity-coupled, Circlotron, single-ended push-pull, and so on? "Which of these would you recommend as best?" is a not uncommon question. Here again it is not so much a question of choosing the best circuit as seeing that the one you do choose is correctly used.

In the case of Ultra-Linear the choice of the tube operation is virtually one between pentode and triode. The tappings on the transformer primary "split the difference" between connecting the screen to B + or directly to plates. The first is pentode, the second is triode. Connecting them to a tapping results in Ultra-Linear. This achieves practically the efficiency of a pentode while maintaining the linearity or low-order distortion of a triode.

This would seem to be ideal. The difficulty is that, to work perfectly, the transformer must maintain the correct tapping, both in voltage and phase, *at all audio frequencies.* This is not too difficult for the low-frequency end but, at the high-frequency end, stray leakage inductances between different parts of the winding, along with winding intercapacitances, can really play havoc with an Ultra-Linear circuit resulting in some quite weird waveforms at some specific frequencies.

The solution to this is to have a correctly designed Ultra-Linear transformer that avoids any spurious deviation from correct tapping up to a frequency beyond the audio range and also beyond the cutoff of the transformer as a primary-to-secondary transformer. This is not impossible, but only relatively few transformers manufactured under the name of Ultra-Linear achieve this objective.

The McIntosh version of the unity-coupled circuit relies on the famous bifilar-wound output transformer.[2] The fact that the high-voltage and ground-voltage primaries are wound with the wire actually side-by-side achieves a very intimate coupling between the winding connected to cathode and that connected to screen of the same tubes. To try and achieve this version of the unity-coupled circuit without a bifilar-wound transformer would be asking for trouble.

Of course, it is also necessary to use the various refinements developed with that circuit for avoiding the other kind of blocking we discussed earlier. In the case of the McIntosh circuit the output tubes are driven by cathode-follower direct-coupled stages.

[2] Norman H. Crowhurst, "Realistic engineering philosophy," AUDIO, Oct., 1959.

(*Continued on page 88*)

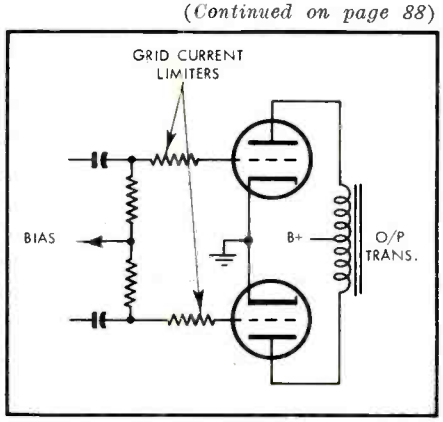


Fig. 4. A simpler method of at least reducing the effect is the use of grid-current-limiter resistors, shown here in the output-stage grids. They can also be used at any stage that causes blocking.

"The new Citation Kits represent for me the successful culmination of years of research and experimentation to achieve the ultimate in high fidelity design."

Stewart Hegeman, Director of Engineering, Citation Kit Division, Harman-Kardon, Inc.

THESE ARE STRONG WORDS from a conservative audio engineer. But the proof is overwhelming. All that's necessary is a look at the technical specifications of the new Citation I Stereophonic Preamplifier Control Center and Citation II 120 Watt Stereophonic Power Amplifier.(We'll gladly send them to you.)

Hegeman is recognized as one of the world's great audio engineers. His original designs for the famous Brociner amplifier and preamplifier, and the Hegeman-Lowther speakers, are still regarded as classics by audio engineers and audiophiles. In his capacity as head of the kit engineering group at Harman-Kardon, he has again created new classics.

Easily Assembled—Professional Performance

THERE ARE MANY exciting new concepts built into the Citation Kits. The engineering is so wonderfully precise that the instrument constructed by the kit builder will duplicate the precision of the finest factory-assembled products. Here are some of the remarkable new assembly features that distinguish the Citation Kits:

Military Type Construction: For ease of assembly and durability, rigid phenolic boards are used. *Special Cable Harness:* Unique harness template enables builder to make a professional cable harness to facilitate wiring and insure accuracy. *Special Aids:* Resistors and condensers are filed individually on special component cards so that they can be quickly identified. Wire strippers are supplied free with each kit to produce clean wire junctions.

The Citation I Stereophonic Preamplifier Control Center

HERE IS THE FIRST brilliant expression of the advanced design concepts which sparked the new Citation Kit Line: the incomparable Citation I, Stereophonic Preamplifier Control Center.

The Citation I consists essentially of a group of circuit blocks termed active and passive networks. Active networks incorporate the vacuum tubes and furnish amplification; passive networks consist of resistors and condensers and provide precise equalization. The active networks are treated as one- or two-stage amplification units, flat over an extremely wide frequency range, and each one of these networks is surrounded by a feedback loop. *This results in levels of distortion so low as to prove unmeasurable.* The passive networks are constructed of precision components and are designed for minimum phase shift.

PROFESSIONAL STEP-TYPE tone controls are used on the new Citation I. They overcome the limitations of continuously variable potentiometers; each position on a step control can be engineered to perform a specific function which is absolutely repeatable when necessary. The flat position of the controls by-passes all tone control circuitry, thereby eliminating transient distortion and phase shift.

Other features include: The new Citation Blend Control which introduces a continuously variable amount of cross-feed between the two channels to eliminate the "hole-in-the-middle" effect of many stereo records; DC heated preamplifier filaments; six silicon diode rectifiers to provide unexcelled B+ and filament regulation; separate turnover and rolloff controls to provide precise equalization.

The Citation I is available with an optional walnut hardwood enclosure which sets off its magnificent sculptured satin-gold escutcheon. The Citation I... $139.95; Factory Wired... $239.95; Walnut Enclosure, WW-I... $29.95.

The Citation II 120 Watt Stereophonic Power Amplifier

HERE IS ALL the power required from a stereophonic amplifier. Two 60 Watt Channels—with a combined peak power output of 260 Watts!

The Citation II reflects a dramatic new approach to amplifier design. Audio engineers have discovered that the characteristics of an amplifier in the non-audible range strongly influence sound quality in the audible range. This can be determined in critical listening tests where the program material for each amplifier is laboratory controlled.

Because of this vital consideration the Citation II is engineered to produce frequencies as low as 5 cycles virtually without phase shift. At the high end—the amplifier has a frequency response beyond 100,000 cycles without any evidence of ringing or instability.

AUDIO ENGINEERS have also found that the higher the degree of feedback—*and the consequent lower distortion*—the more apparent the improvement in sound quality and the greater the reduction in listener fatigue. In order to increase the degree of feedback in the Citation II, a "multiple loop" technique is used in contrast to conventional "single loop" techniques. This results in a 20/1 to 30/1 reduction in distortion compared with the 10/1 to 20/1 reduction in conventional amplifiers.

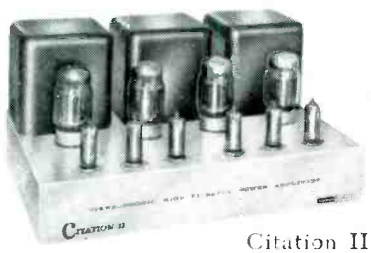
Other important Citation II features include: video output pentodes in all low level stages for exceptional wide frequency response and low distortion; power supply consisting of four silicon diode rectifiers, choke and heavy duty electrolytics with potted power transformer for superb regulation and long life; bias meter to adjust individually the plate current of each KT88 for balance and lowest distortion.

The Citation II is a handsomely styled brown and gold instrument with an optional Charcoal Brown protective cover. The Citation II... $159.95; Factory Wired ... $219.95; Charcoal Brown Enclosure, AC-2... $7.95.

All prices slightly higher in the West.

For a complete report on the new kits write to Harman-Kardon, Inc., Citation Kit Division, Dept A-11, Westbury, N. Y.

Citation I



Citation II

Build the Very Best CITATION KITS *by* harman kardon

press comment *on the*

AR-3

The American **RECORD GUIDE** *(Larry Zide)*

"Given a good stereo source, a pair of AR-3's comes as close to musical realism in the home, I believe, as the present state of the art permits . . . In sum, until someone comes out with something better that doesn't take up the entire house, the AR-3 is for me the reference standard."

high fidelity *(TITH report)*

"A major problem of tweeter design has been the beaming effect of very high frequencies . . . The "fried egg" **[nickname for the AR-3 tweeters]** appears to be a major step forward in the smooth dispersion of sound at extreme high frequencies."

HI-FI SYSTEMS

"In terms of bass response, these two speakers **[the acoustic suspension AR-1 and AR-2]** represent a phenomenal improvement in the state of the art.

"The complete AR-3 speaker system, in addition to containing a superb acoustic suspension woofer, which has enjoyed wide acceptance by professionals as well as audiophiles, constitutes, in our opinion, a mid and high frequency system which is in every way complementary to the bass quality. The new AR-3 rivals in overall quality the very best woofers and combinations."

The AR-3 is priced from $203 to $231, depending on cabinet finish ($216 in mahogany or birch). Literature is available for the asking.

ACOUSTIC RESEARCH, INC. **24 Thorndike St., Cambridge 41, Mass.**

Defense and the Hi-Fi Bachelors

C. H. MALMSTEDT*

Continuing the description of how the BOQ at the U. S. Navy Postgraduate School on the Monterey Peninsula was the scene of a unique growth of an outstanding hi-fi system.

In Two Parts—Part Two

UP TO THIS POINT, the system resulting from a joint interest in music among the young bachelors at the Navy's Postgraduate School had just arrived at a point where a third Ampex had been added to the installation—the latest addition being a second 601-2. By this time, the system consisted of fifteen major units, connected as shown in the block diagram.

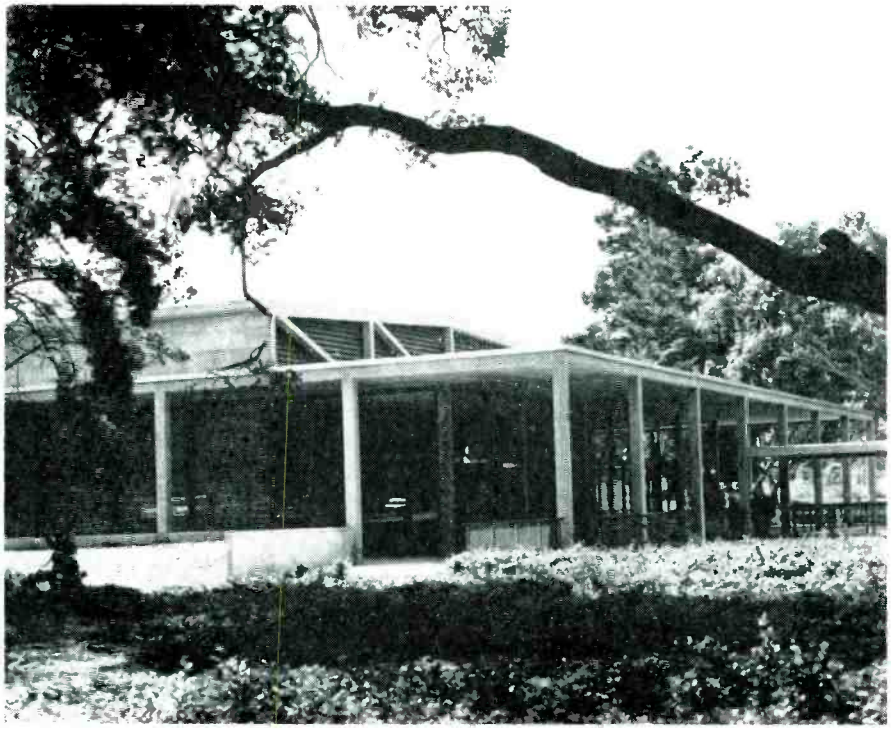
With the two tape recorders connected in "series" it may seem a disadvantage in that #2 must also be turned on when only #1 is being used, but it was decmed that the advantages more than outweigh this seeming disadvantage. For one thing, the arrangement permits the marking of two tape copies at parties —and by now this hi-fi room was a favorite meeting place for all and sundry, men and women, military and civilian—without the use of extraneous mixing or switching facilities. For another, recording from a multiple-mike setup was considerably simplified: with the output of recorder #1 fed into the Line input of recorder #2, a four-mike setup could be handled without external mixers. Another advantage, especially in an outside portable installation, was that both recorders could be fed from the preamplifiers with the use of only one set of plugs. Most conveniently of all, one machine could rewind while the other continued the playback program after the mere flipping of a couple of switches.

* *Carmel Valley, California.*

Expansion

With the system now in full swing stereophonically, it was not long before it ranged out beyond the confines of the BOQ. Although in some respects physically cumbersome, the system was still largely portable and experimental. So were the hi-fi ideas of its owners. Why confine their tape repertoire to AM-FM

King Hall, interior. Its acoustic treatment mainly of slatted varnished wood, modern sound reproduction capability is combined with the rustic motif so popular today. (Official photograph, U. S. Navy)

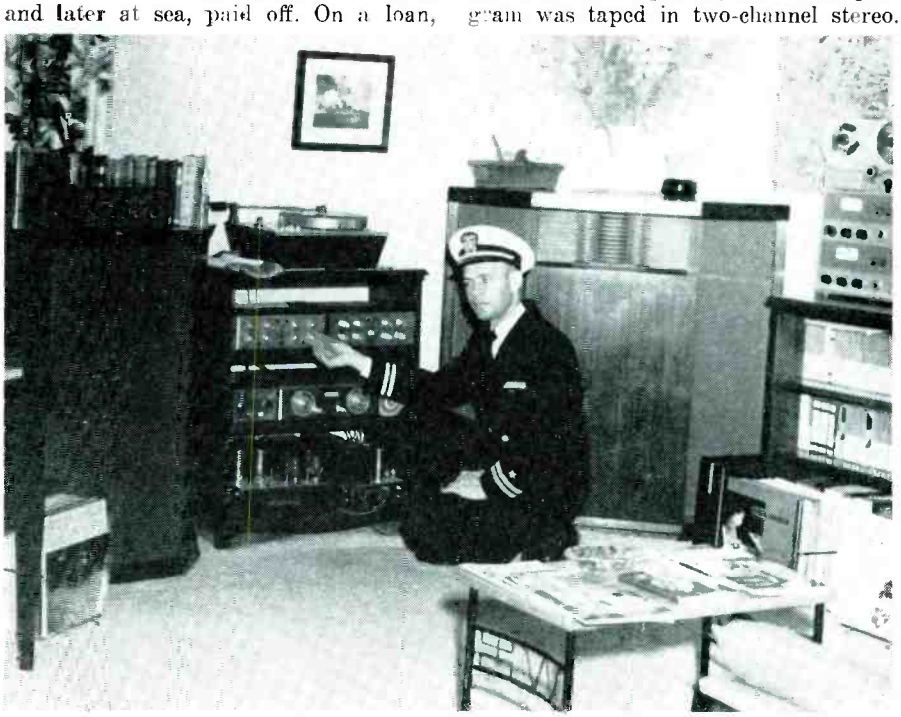


King Hall on the grounds of the U. S. Navy Postgraduate School. Low as a ranch house outside, the auditorium interior is as spacious as the amphitheaters of old—with acoustic design as modern as stereo. (Official photograph, U. S. Navy)

radio reception and to recordings taped from available discs? Weren't there local musical goings-on that could, without complications, be taped for noncommercial home use? There were, any number of them. But that meant one additional and expensive item in triplicate—microphones; and the present installation, with its almost 400 discs and 125 reels of recorded tape, was already worth in the neighborhood of $6000!

But again the community spirit on behalf of more and better music now, and later at sea, paid off. On a loan, in came three Altec M-20 systems utilizing Altec 21-D condenser mikes. They didn't have to wait long for an assignment. In Carmel, the St. Paul's Episcopal Church was presenting a Christmas program sponsored by the Monterey County Symphony Association. The performers were the Fort Ord Soldiers Chorus, the Carmel Womens Choir, a harpist, and the church organ. What could sound better in stereo!

Using one Ampex 601-2 and two of the M-20 mike systems, the entire program was taped in two-channel stereo.



Setting it "just so" on the left—channel preamplifier. (Official photograph, U. S. Navy)

Results were even better than had been expected. With excellent acoustics prevailing, a close-on-mike pick-up of the choral groups gave the tapes not only definition but as well a rich and mellow perspective—beauty that has since then often filled the BOQ room and its environs, successfully competing with the finest commercial recordings available.

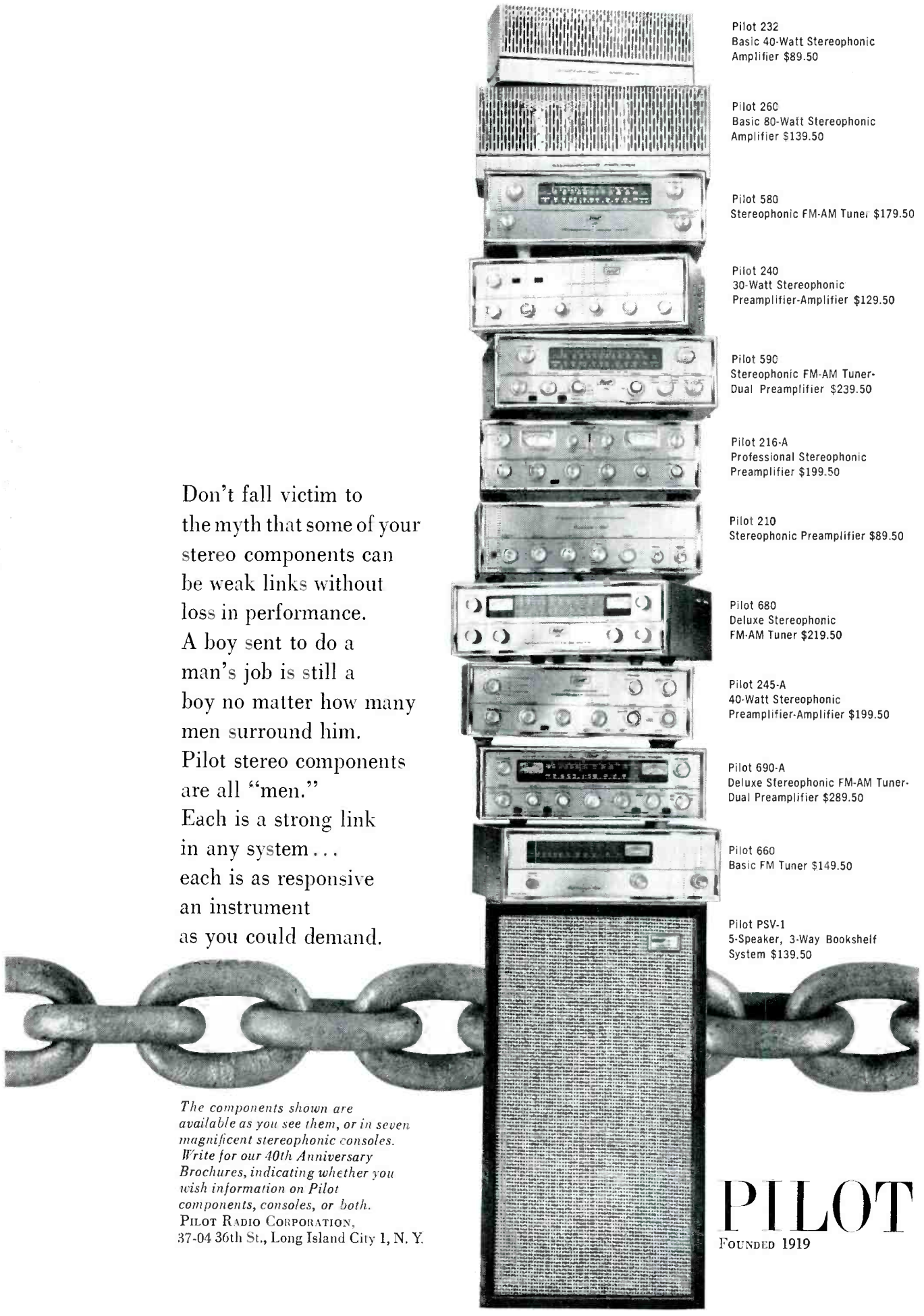
But a real test of this superb hi-fi installation was still to come, in both recording and playback. Meanwhile, it had already inspired into being some 14 or 16 other hi-fi installations, disc and tape, within the naval facility and outside it, among both men and women. Foreign students returning to their homelands carried with them not only the results of their official academic and practical training but as well a rich memory-accumulation of the world's finest music, perhaps all the more precious because of the friendly extracurricular manner in which it had been acquired. Many carried, in addition, hi-fi equipment carefully selected after consultation with Lt. St. Ville and such colleagues and hi-fi participants as lieutenants John Coiner and Richard Avrit, each of whom had contributed much in time and equipment to the large installation even while having smaller ones in their own rooms; and two of whom had been prime movers on the Sound Committee of the highly successful Monterey Jazz Festival of 1958.

The Proving Ground

The ultimate test of the big installation came at King Hall, where, upon the invitation of Rear Admiral E. E. Yeomans, superintendent of the Postgraduate School, an all-Brahms concert was given by the Monterey County Symphony Orchestra, Gregory Millar conductor. Featuring such Brahms numbers as *The Song of Destiny for Chorus and Orchestra,* opus 54; *Double Concerto for Violin, Cello, and Orchestra,* opus 102; *Rhapsody for Contralto, Male Chorus, and Orchestra,* opus 53; and the *Academic Festival Overture,* opus 80, the challenge to hi-fi reproduction was a great one. There was also another challenge: King Hall, built in 1955 on the grounds of the naval facility, embodied in combination the best of the old and the new. Sloping deep into the ground toward the stage in the manner of the amphitheaters of old Greece, the auditorium design and construction also incorporated the very latest achievements in the science of acoustics. The added challenge, then, was this: since the concert was not only to be recorded in its entirety but would as well be played back as a stereo demonstration to the audience after the concert—would even this fine hi-fi installation produce

(*Continued on page 103*)

Don't fall victim to
the myth that some of your
stereo components can
be weak links without
loss in performance.
A boy sent to do a
man's job is still a
boy no matter how many
men surround him.
Pilot stereo components
are all "men."
Each is a strong link
in any system...
each is as responsive
an instrument
as you could demand.



Pilot 232
Basic 40-Watt Stereophonic
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Pilot 260
Basic 80-Watt Stereophonic
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Pilot 580
Stereophonic FM-AM Tuner $179.50

Pilot 240
30-Watt Stereophonic
Preamplifier-Amplifier $129.50

Pilot 590
Stereophonic FM-AM Tuner-
Dual Preamplifier $239.50

Pilot 216-A
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Pilot 210
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Pilot 680
Deluxe Stereophonic
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Pilot 245-A
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The components shown are available as you see them, or in seven magnificent stereophonic consoles. Write for our 40th Anniversary Brochures, indicating whether you wish information on Pilot components, consoles, or both.
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PILOT
FOUNDED 1919

The Tape Guide

Tape Recorder Accessories

HERMAN BURSTEIN*

While you can dig a post hole with a tablespoon, you can do it much easier with the proper tool; similarly, these accessories become the desirable "tools" to the recordist, making his work much easier.

TAPE RECORDER ACCESSORIES are considerable in number. As to their usefulness, an anology with automobile accessories may be in order. Some are a virtual necessity (like a heater if you live in the northern part of the country). Some are highly desirable (like a radio or power steering). And some are a matter of convenience (like the gadget that squirts water on your windshield); nice to have but not indispensable.

It is impractical to attempt to sort the various accessories into these three categories of usefulness. What is merely a convenience to one tape recordist may be a necessity to another because of the manner or extent of use of his tape recorder. Therefore it should be clearly understood that the order in which accessories are discussed below constitutes only an extremely loose approximation to their relative importance. And this order of importance is purely the subjective view of one person—the writer.

Tape Splicer

One of the accessories most likely to fall into the category of necessities is the tape splicer. Whether or not you plan to go in for an appreciable amount of tape editing, which involves the excision of undesired portions and the joining of desired portions, you will still find a tape splicer handy for the accidental break that will inevitably occur. True, you can use a scissors for the job, but it is rather difficult to do a precise, neat job, which means bringing the two sections of tape together in exact alignment so as to avoid a thump when the spliced portion passes the playback head.

* *280 Twin Lane E., Wantagh, N.Y.*

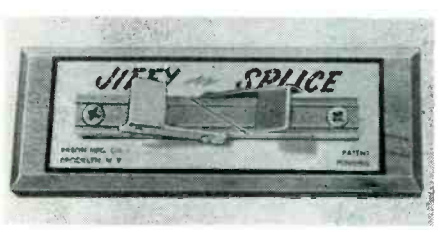


Fig. 1. A low-priced tape splicer—"Jiffy-Splice," by Rason Mfg. Co.

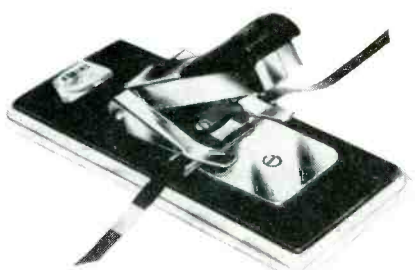


Fig. 2. Robins Industries Corp's. medium-priced splicer—Model TS4A-STD.

Tape splicers come in a great variety of types and prices, ranging from as little as approximately $1.50 to as high as $50 or more. *Figures* 1, 2, and 3 show three models, which are respectively low-, medium-, and high-priced units. The expensive ones are more rugged, have a greater degree of automaticity, and operate more quickly. Yet one can do a perfectly adequate job of tape splicing with the least expensive units.

If your only need for a tape splicer arises from an occasional accidental break, then a low-priced unit may be your best purchase. But if you plan to do a fair or substantial amount of editing, it is wise to investigate the more sophisticated models as most suited to your needs. One of the factors to be taken into consideration is the fact that some splicers are sufficiently compact so that with the aid of an adhesive they can be mounted directly on the tape machine, where they are always conveniently at hand.

It is vital that one use a splicing tape specifically made for this purpose rather than conventional cellophane tape. If the latter is used, the adhesive is apt to ooze out under the pressure exerted by the capstan and pressure roller, and will be deposited upon these and other parts, causing wow and flutter and otherwise impairing operation of the machine.

As a further precaution against fouling of the mechanism by the splicing material, it is desirable to cut the tape so that it narrows slightly in the area where the splice occurs. A number of splicers make such a cut, as do those in *Figs.* 2 and 3, which produce what their manufacturer calls a "Gibson Girl" cut.

In the event you rely upon a scissors rather than a tape splicer, be sure to make the cut at an angle of about 30 to 45 deg. rather than 90 deg. A cut of right angles to the length of the tape will result in a thump as the tape passes the playback head.

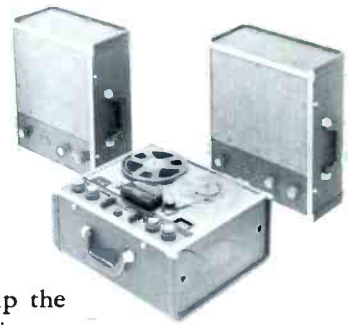
Fig. 3. A high-priced splicer,—Robins' Model TS-250-1000.

AMPEX 960

STEREOPHONIC RECORDER/ REPRODUCER

ABOVE--960 PORTABLE STEREO RECORDER/REPRODUCER

BELOW--MODEL 2560 PORTABLE STEREO SYSTEM CONSISTING OF 960 AND PAIR OF 2010 AMPLIFIER-SPEAKERS



Stereo Portable PLUS!

Guiding the Ampex engineers who created the 960 was a dual objective—that of building a machine which was not only a superb example of engineering skill, but one which would also offer its user a range of capabilities far exceeding that of any other recorder made today. The result was not merely an improved stereo recorder, but *an entirely new concept* in home entertainment.

The STEREO 960 fits into family life in literally dozens of ways, contributing many tangible benefits in musical, educational and recreational fun. You'll use it to keep up the family correspondence by sending "letters in sound", to tape stereo programs off the air, to preserve your best monaural and stereo discs on tape, and to acquire new musical and language skills. You'll have endless fun exploring the 960's many fascinating recording capabilities, including sound-on-sound, echo chamber effects, and other advanced techniques.

AMPEX STEREO SIGNATURE OF PERFECTION IN SOUND

RECORDER/REPRODUCER

SPECIFICATIONS

The true values of a recorder are best assessed through careful evaluation of its performance specifications and operating features. It is worthwhile noting here that these specifications are based not on theoretical design parameters but on actual performance tests. They are specifications which the recorder not only meets or exceeds today, but which years from now will still hold true.

The Ampex Model 960 Stereophonic Recorder/Reproducer is capable of essentially distortionless frequency response from 30 to 20,000 cycles per second at the operating speed of 7½ inches per second, and from 30 to 15,000 cycles per second at 3¾ inches per second. Its precision-engineered timing accuracy is such that it offers perfection of pitch held to tolerances of less than one-third of a half-tone. Playing times, using standard (.002"), long play (.0015"), and extra-long play (.001") tapes are as follows:

	(a) 4-Track Stereo Tapes	(b) 2-Track Stereo Tapes	(c) Monaural Tapes, half-track
1200 foot reel	3¾ ips - 2 hrs. 8 min. 7½ ips - 1 hr 4 min.	3¾ ips - 1 hr. 4 min. 7½ ips - 32 minutes	3¾ ips - 2 hrs. 8 min. 7½ ips - 1 hr 4 min.
1800 foot reel	3¾ ips - 3 hrs. 12 min. 7½ ips - 1 hr 36 min.	3¾ ips - 1 hr. 36 min. 7½ ips - 48 minutes	3¾ ips - 3 hrs. 12 min. 7½ ips - 1 hr 36 min.
2400 foot reel	3¾ ips - 4 hrs. 16 min. 7½ ips - 2 hrs. 8 min.	3¾ ips - 2 hrs. 8 min. 7½ ips - 1 hr. 4 min.	3¾ ips - 4 hrs. 16 min. 7½ ips - 2 hrs. 8 min.

RECORD INPUTS: High impedance line inputs (radio/TV/phono/auxiliary) 0.3V rms for program level; high impedance microphone inputs

PLAYBACK OUTPUTS: Approximately 0.5V rms from cathode follower when playing program level tapes

PLAYBACK FREQUENCY RESPONSE: 30-20,000 cps at 7½ ips; 30-15,000 cps at 3¾ ips
Within ±2 db 50-15,000 cps at 7½ ips, 55 db dynamic range
Within ±2 db 50-10,000 cps at 3¾ ips, 50 db dynamic range

FLUTTER AND WOW: Under 0.2% rms at 7½ ips; under 0.25% rms at 3¾ ips

HEADS: Manufactured to the same standards of precision that exist in Ampex broadcast and recording studio equipment. Surfaces are lapped to an optical flatness so precise that they reflect specified wavelengths of light, resulting in uniform performance characteristics and greatly minimizing the effects of head wear. Azimuth alignment of stereo head gaps in the same stack is held within 20 seconds of arc, equivalent to less than 10 millionths of an inch — a degree of precision achieved through use of a unique process involving micro-accurate optical measurements within a controlled environment. Head gap width is 90 millionths of an inch ±5 millionths of an inch.

KEY TO THE EXCITING FUN FEATURES OF THE 960 --

THE AMPEX STEREO-GRAPH

Here's the simplest, quickest answer to almost every question about how to perform the operations illustrated at right and numerous other recording functions. The Ampex Stereo-Graph shows you, quickly and clearly, the proper dial settings to make for more than a dozen of the most popular uses for the 960 . . . including sound-on-sound, language and music instruction,

and other special effects. A convenient tape footage/playing time indicator is included on the reverse side.

MODEL 2010

MATCHING AMPLIFIER-SPEAKER

The Ampex Model 2010's ten-watt (20 watts peak) amplifier section provides operating characteristics (unequalized) flat within ±0.1 db, with total harmonic distortion less than 0.5 of 1%, throughout the maximum range of human hearing ability, at rated output. Noise and hum are 80 db below rated output, and input sensitivity is 0.18V to develop rated power.

The specially designed 8" speaker provides smooth, peak-free response throughout a remarkably wide audio range. Such superior design features as its massive die-cast frame and edgewise-wound ribbon coil contribute effectively to higher levels of performance than ever before achieved with a speaker this size.

MODEL 960 DIMENSIONS: Portable cases 9" x 15" x 17½". Unmounted recorder 13" x 15" x 6⅛" depth below top plate, 1⅜" above. Recorder weight 36 lbs., speaker amplifier 31 lbs.

AMPEX AUDIO, INC. • SUNNYVALE, CALIFORNIA 9004

Relax and enjoy the show—let your Ampex do the narration! With the commentary on tape, your color slide shows are more professional, more complete, and more fun!

Your favorite LP's and Stereo Discs are at their exciting best while they're new and unscratched. That's when to tape them on your Ampex, and preserve their original quality for keeps!

When you tape it "off the air" your only cost is for blank tape. Yet your musical repertoire can soon equal that of all the stations you hear.

There's a real future in family fun like this—with your Ampex you can live such happy moments over and over again, with a quality so lifelike you're almost literally carried back.

In the Ampex "Speech Testing Game" you pit your wits against the trigger-quick memory of the Ampex recorder/reproducer. You can't win, but it's fun trying.

Letter-writing is no longer a problem, with an Ampex in the house . . . now it's a family project. And even more fun than sending letters in sound is receiving them!

For "letters in sound", the 7" tape reel holds as much as a 90-page letter, mails first class anywhere in the United States for 8c.

A command performance, exclusively for you! Whether you prefer jazz, pops or classical, the privacy of headphone listening is a unique pleasure. You don't disturb the rest of the family, and they don't disturb you!

The Ampex, in private rehearsal, can be a wonderful confidence-builder for people who normally develop rubber knees when faced with the prospect of speaking before a group.

Learning to speak a new language is made immeasurably easier on the Ampex; you can record your own phrases side-by-side with those of the instructor, and play them back for comparison at any time.

When you strike up the band in stereo, you don't need professional musicians to make a professional record. Advanced techniques are amazingly easy on the Ampex.

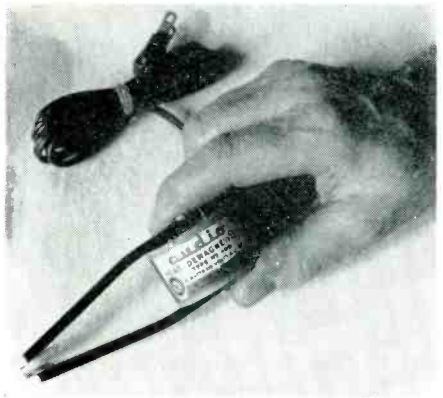


Fig. 4. Recording head demagnetizer—Audio Devices, Inc., Type 400.

Head Demagnetizer

The record and playback heads tend to become magnetized gradually as the result of the asymmetrical wave-forms contained in speech and music; this asymmetry is in effect a d.c. component producing magnetization. The heads may also become magnetized due to surges of current as the machine is turned on or off. A magnetized head is a source of noise; magnetized record and playback heads inscribe noise on the tape, while a magnetized playback head also produces noise directly. Moreover, such heads may erase the higher frequencies.

Therefore the individual wishing to preserve his valued tapes in the best possible condition should demagnetize the heads on his machine at frequent, regular intervals. About every 8 to 10 hours of use is a suitable period.

Figures 4 and 5 show several makes of head demagnetizers. They operate from house current and apply an alternating magnetic field of decreasing intensity to the head, accomplished by bringing the pole pieces of the demagnetizer in contact with the head and then slowly removing them. The unit in *Fig.* 5 comes with three sets of removable pole pieces, each shaped differently to permit access to heads in various types of housing.

If you are slightly handy and happen to have an old, inexpensive, two-pole motor, such as is commonly found in a cheap phonograph of the $20 variety, you can construct your own head demagnetizer, as shown in *Fig.* 6. First, remove the armature, so that only the field of the motor is left. Next, remove portions A and B, which are respectively a metal bar serving as a magnetic link for the motor and a heavy copper wire used as a short-circuiting ring. Attach a strip of iron—a silicon steel strip from the core of a junked transformer is fine—as shown, and you will find there is sufficient magnetic field at the end of this bar to demagnetize the heads. The bar is attached by one of the screws holding the field laminations together.

Cleaner for the Heads and Other Parts

As important as the demagnetizer is head cleaner, frequently suitable for cleaning other parts as well. Due to friction, a layer of tape oxide builds up on the heads, capstan, pressure roller, and guides. These and other components may also become contaminated with oil. As a general rule, a cotton swab dipped in alcohol will serve effectively as a head cleaner. Whether it serves effectively for other parts depends upon the nature of the contamination.

One can purchase fluids specifically intended for removal of tape oxide from heads and other parts, such as HC-2,

Fig. 5. Head demagnetizer with interchangeable pole pieces—Lafayette Radio's Model PK-238.

made by Robins Industries. Or one can obtain an all-purpose cleaner, such as Long Life, made by Electrical Chemical Specialty Company. The latter consists of four different kinds of solvents, one for oxide, the second for grease, the third a general cleaner, and the fourth a diluting agency to limit the potency of the active solvents.

The accumulation of tape oxide on the heads prevents intimate contact between them and the tape, resulting in high-frequency losses. Extremely minute accumulations can produce significant losses. Accumulation of oil and other materials on the guides, capstan, pressure roller, and soon tends to produce speed irregularities, manifest as wow and flutter. Also, they can cause deviation from correct speed.

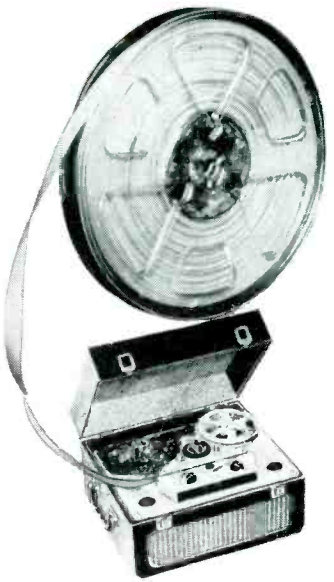


Fig. 7. Walsco "Kleen-Tape," designed for cleaning heads.

Another form of head cleaner is that shown in *Fig.* 7, namely a tape which bears not the usual magnetic coating, but instead a special material that cleans and polishes the tape. This comes in a 100-foot length on a conventional reel and is operated past the heads in the same manner as a regular tape.

Tape Conditioner

Some tapes, particularly after long use, develop increasing friction as they pass the heads, resulting in audible squeal and distortion. Several compa-

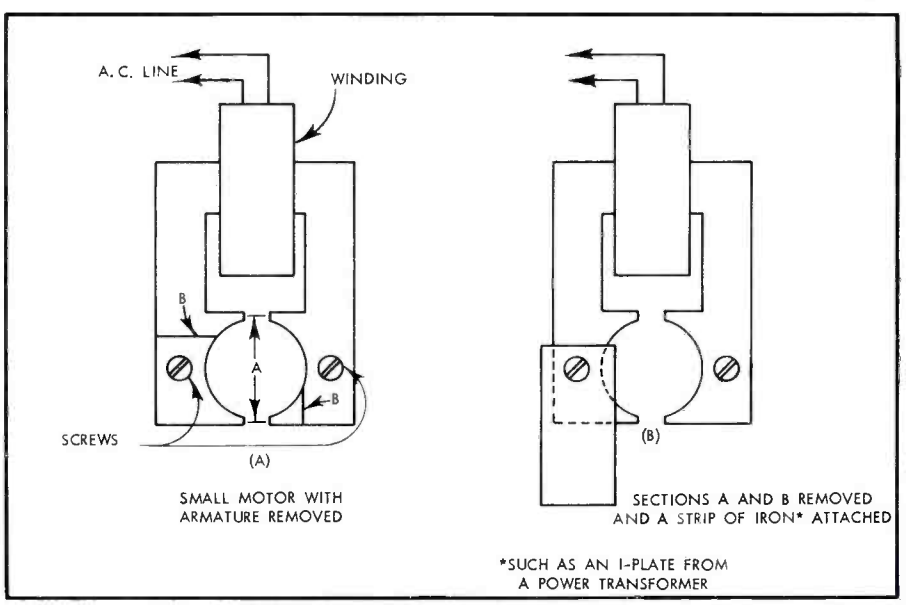


Fig. 6. Construction details for a head demagnetizer.

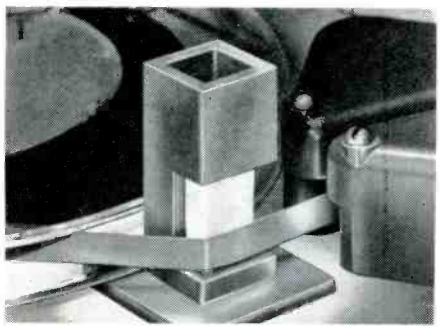


Fig. 8. Applicator used to apply Long Life Conditioner to the tape.

nies have therefore brought out products to lubricate and clean the tape. One is the Long Life Tape Conditioner, made by the same company that manufactures the Long Life Cleaner previously described. A special applicator, as shown in *Fig.* 8, is used to make contact with the tape as it is run from reel to reel. Robins Industries produces what is calls a Jockey Cloth, which is held in contact with the moving tape and serves to clean as well as lubricate the tape.

Head and Guide Lubricator

For minimum wow and flutter, minimum distortion due to erratic tape movement, and elimination of tape squeal, it is desirable to lubricate the heads and guides. One of the products designed for this purpose is Long Life Lubricant (the third of a trio of companion products), which contains silicone. An important caution is in order here. Be sure that the lubricant does not get on the capstan or pressure roller, as this will cause tape slippage.

Bulk Eraser

A bulk eraser is a powerful electromagnet that can completely erase a reel of tape in a matter of seconds and a good deal more effectively than the erase head does. The entire reel of tape is brought into contact with the bulk eraser and then slowly removed, meanwhile describing a circular motion so that the magnetic field cuts all parts of the tape. In some cases, the bulk eraser has a handle, so that it rather than the reel of tape may be moved.

The bulk eraser is useful when dealing with a tape that has been heavily over-recorded, because it is then difficult or impossible for the erase head to completely remove the signal, at least on the first pass. The noise level on the tape may be brought to a minimum by subjecting the tape to a bulk eraser prior to recording. The bulk eraser can prove a necessity rather than a mere convenience in the event the tape recorder contains no erase head, which occurs in some instances where the erase head has been removed to make room for another head, such as a separate record head, a four-track stereo head, etc.

A major disadvantage of the bulk eraser is that it erases the entire tape, not just the one or two tracks that one wishes to eliminate. Another disadvantage is that one cannot confine erasure to a given length of the tape with the same precision as when using an erase head.

(As an incidental note, a bulk eraser can be useful in other ways than in connection with tape recording. Thus it can be employed to magnetize or demagnetize tools, to demagnetize tubes, to demagnetize tube shields, and so on.)

One should not attempt to bulk erase a reel of tape as it lies on the tape machine, particularly if the machine employs a meter as a record level indicator. Bringing the bulk eraser into the vicinity of the meter is apt to upset its calibration or perform even greater injury.

Bulk erasers, several of which are shown in *Fig.* 9, are a relatively expensive accessory, generally costing between $20 and $40. However, it is not difficult for the recordist to make his own at a very little cost. This assumes he can obtain an old power transformer, such as is found in a power amplifier, TV set, or transformer-operated radio; these are often to he had in a surplus radio parts store for a few dollars. The procedure then is as follows. Disassemble the transformer by removing the nuts

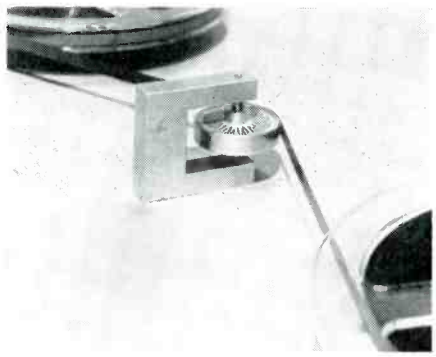


Fig. 10. The Tape Strobe, a product of Scott Instrument Labs.

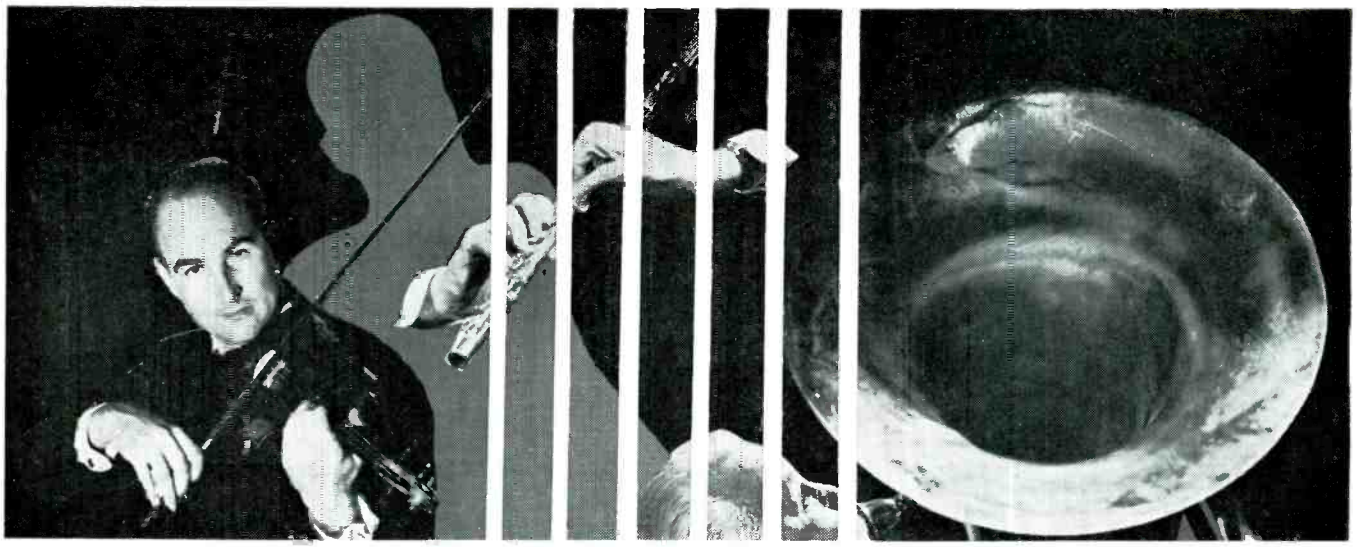
and screws that hold the casing and laminations together. Remove the E-shaped and I-shaped plates from the transformer core. Reinsert the E-plates so they all face in the same direction; put the I-plates aside (you can use one of these as the metal strip for a head demagnetizer, as previously described). Bolt the E-plates together, using the screws and nuts previously removed; do not replace the casing. Attach lamp cord and a plug that mates with the house socket to the leads of the primary winding. Be sure that you know which are the leads of the primary winding before you start on this job. Snip all other windings and tape them so they will not make contact with each other. Wind the bulk eraser with rubber tape to protect the core and windings. Insert the plug into the house socket, and you have a powerful electromagnet that can erase a tape in seconds.

Do not leave this bulk eraser connected to the house line for more than about one minute at a time, because it heats up fairly quickly. However, in one minute you can erase several reels of tape. If your needs call for the bulk eraser to be operated an appreciable length of time, you should consider the purchase of a commercial unit.

Test Tapes

Test tapes will be discussed in detail in a later article concerned with the testing, alignment, and adjustment of tape machines. It may be briefly stated here that it is desirable to have one or more

Fig. 9. Various types of bulk erasers—left to right, Lafayette Radio ML-120, Rason Mfg. Co. "Jiffy-Rase," and Robins Industries' Model ME-99.



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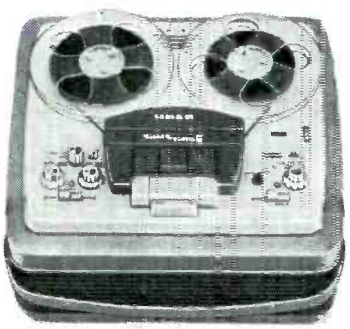

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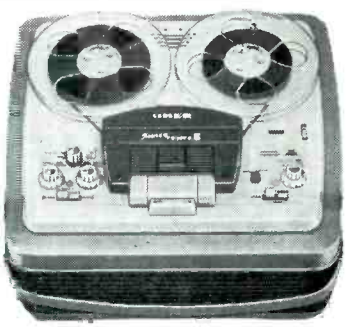

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Fig. 11. Orr Industries' Stroboscopic Tape Disc.

test tapes that provide test tones to check the following:

1. Azimuth (a tone of about 10,000 cps is desirable).
2. Frequency response (tones covering the range of 50 to 15,000 cps).
3. Wow and flutter (a tone of about 3000 cps, at which frequency wow and flutter tend to be most noticeable).
4. Correspondence of the record level indicator with the maximum permissible recording level. (The test tape should have a test tone at a frequency between 250 and 500 cps, recorded at a level resulting in 1, 2, or 3 per cent harmonic distortion.)

Tape Stroboscope

It is desirable to have a means of checking whether the tape is running at reasonably accurate speed. Of course, what is "reasonably accurate" depends upon one's acuity in detecting departures from true pitch. In the case of semi-professional and professional users, accuracy in timing programs also becomes important. To most human ears, a speed error not greater than 1 per cent will be unnoticeable; in fact, many persons can tolerate errors as great as 5 and even 10 per cent. Thus the 1-per cent criterion will be acceptable in the majority of instances. On the other hand, professional practice calls for speed error to be kept within limits of ± 0.3 per cent. Thus the deviation in a half-hour program would be no more than 3.6 seconds.

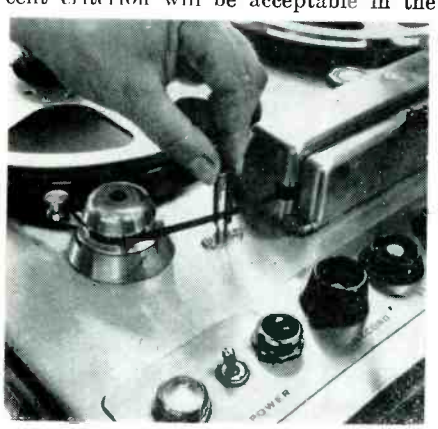

Fig. 12. Audio Devices' "Echoraser."

At least two stroboscopic devices are now on the market. One is the TapeStrobe made by Scott Instrument Labs, shown in *Fig.* 10. The device is placed on a convenient part of the tape deck and pressed slightly against the moving tape, causing the strobe to turn. The TapeStrobe has sufficient weight so that it will remain in the position where it is placed. The strobe markings are viewed under the light of a bulb operating on 60-cycle current. This may be an ordinary light bulb; to obtain a sharply defined strobe image, however, a neon or fluorescent lamp is preferable. If the pattern appears stationary, speed is correct. If it appears to be moving forward, that is, in the same direction as the tape, speed is fast. If the pattern appears to be moving backward, the speed is slow. To judge the degree of speed inaccuracy, count the number of bars that appear to be passing a fixed point during one minute (hold a pencil point over a fixed spot on the strobe). If the number of bars is 72, speed error is 1 per cent. A greater or smaller number of bars denotes a proportional error. To illustrate, 36 bars would signify a speed error of 0.5 per cent; 144 bars would signify an error of 2 per cent, and so on. This holds true for all speeds.

Another stroboscopic device is the Stroboscopic Tape Disc made by Orradio Industries, Inc., shown in *Fig.* 11. This operates in exactly the same fashion, except that it is held by hand against the moving tape instead of being positioned on the tape deck.

Print-Through Remover

When a tape has been heavily recorded and/or stored for a considerable length of time, the phenomenon known as print-through tends to occur, namely the transfer of the signal on one layer of tape to the adjacent layers. Hence one may hear what is known as "pre-echo" and "post-echo." This effect is more severe for the long-playing and extra-long-playing tapes than for the standard tape, because the former are thinner and therefore present less of a barrier to signal transfer.

Of quite recent vintage is a device known as the Echoraser, developed by Audio Devices, Inc., that can remove print-through from a tape without substantially affecting the original audio signal. As shown in *Fig.* 12, it is designed to be slipped onto pins that are permanently attached to the tape deck. The tape contacts the Echoraser, and as the tape passes through the magnetic field of this device the print-through is reduced by various amounts, depending upon the age of the recording, the magnetic properties of the tape, conditions under which the tape has been stored, and the signal frequencies.

Echorasers are supplied in two strengths. One strength, according to the manufacturer, achieves up to 9 db removal of print-through without significantly affecting high frequency response. The other strength, intended for the most serious cases of print-through, achieves up to 18 db removal and involves losses of about 2 to 3 db at high frequencies.

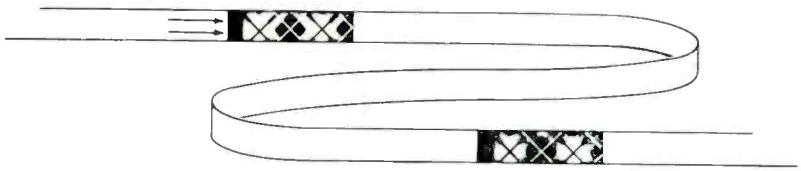

Fig. 13. Typical leader tape, Minnesota Mining and Manufacturing Co.

Other Accessories

There are a number of other tape recorder accessories which require a minimum of comment. These include the following.

1. Write-on labels for identifying the contents of a recorded reel of tape. These come on a dispenser in the same fashion as cellophane tape.

2. Leader tape (*Fig.* 13), which may be attached to the beginning, end, or intermediate portions of the reel of tape. This can serve at least three important purposes: (1) it can protect the ends of the tape from wear and tear. (2) It permits one to write in the contents of a reel of tape. Although the reel may bear a label, it is quite possible that one may neglect to rewind the tape back onto this reel after it has been played, particularly in the case of a one-way stereo tape. Such neglect may lead to accidental erasure of a valued tape, unless one takes the precaution identifying the contents on a strip of leader tape. (3) The leader can be used to separate various portions of a tape, permitting quick and accurate location of desired sections.

3. Tape clips (*Fig.* 14), which prevent the end of the tape from unraveling off the reel.

(*Continued on page 107*)

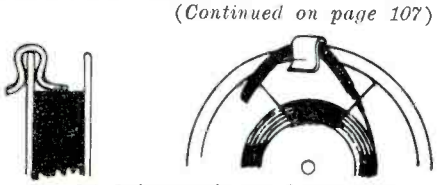

Fig. 14. Robins Industries' Tape Clip.

A Figure of Merit for Output Tubes

ROBERT M. MITCHELL*

The right approach in making any selection of anything is to have all the information about it. Then, if you weight the information correctly, you will come out with the correct decision. The author tells you how to go about the weighing.

EVERY AUDIO DESIGNER has been faced at one time or another with the problem of choosing tube types for a design. Since the design of an audio amplifier normally commences with the power stage, the audio output tubes are usually the first to be investigated. If the designer had available a method which helped him to select invariably the best tubes, it would reward him in both performance and pride, not to mention time and effort. How such selection may be readily done is described below.

The usual procedure of choosing a tube is to consult the manuals, and compare data by glancing back and forth among the specification sheets, perhaps making an occasional note. The information thus gleaned is combined with the designer's personal knowledge of how some of these tubes have behaved in certain equipment. On the basis of this information a choice is made. In many cases the choice thus made is a good one. In other instances, however, events prove that the second-best tube has been chosen. In such cases the wrong tube was chosen, not because the data sheet of a better one was unavailable, but because the data on the available tubes was not properly evaluated.

It is therefore of considerable interest to the designer to have available a method of systematically evaluating the characteristics of various tubes, so that an intelligent choice can be made.

The method discussed here consists of grouping the various tube characteristics so that substitution of proper values gives a result which can be compared numerically with that of any other tube. Such an expression is called a Figure of Merit, since it indicates the relative value of the tube *for a given application*. The phrase italicized is an important qualification. A tube which may have a fine Figure of Merit for audio output service, may have a very poor one for class C oscillator service, for example.

A Figure of Merit must adequately reflect the variations of its make-up factors so that significant differences can be seen. In order to achieve this, it may sometimes be necessary to "weight" some of the factors—that is, to assign them arbitrarily a multiplying factor which increases their relative value. This point will be discussed later in greater detail. Specifically, a Figure of Merit for audio output tubes should be so arranged that it indicates relative worth not only when tubes operate under "tube manual" conditions, but also under other practical and likely conditions. For example, if we put tubes in parallel, or apply feedback around the tubes, our Figure of Merit formula should still be valid. We may then determine the relative value of different tubes in parallel, or the relative value of different tubes with the same amount of feedback around each. We may also, of course, compare two tubes of type A without feedback with two tubes of type B with feedback, and so forth.

In deriving any Figure of Merit it must be understood that the cost of the

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TABLE I

INVENTORY OF TUBE CHARACTERISTICS

DESIRABLE	UNDESIRABLE	
Damping factor	Distortion	QUALITY
Power output Efficiency Max. grid resistance	Driving voltage Heater power Cost	QUANTITY

TABLE II

BASIC FIGURE OF MERIT

All tubes in Class AB, with 400 volts or less on plates

TYPE	*	BIAS	E_b	P	E_{gg} (rms)	P/E_{gg}	D	H	F
6V6	B	FIXED	285	14	25.9	0.54	0.072	3.5	11.1
EL84	P	FIXED	300	17	20	0.85	0.11	4	23.4
6L6	B	SELF	360	24.5	28.7	0.85	0.19	4	40.4
6L6	B	FIXED	360	26.5	31.9	0.83	0.14	2	58.0
5881	B	FIXED	360	26.5	31.8	0.83	0.14	2	58.0
KT66	B	SELF	390	30	49.5	0.605	0.175	6	17.7
EL37	P	SELF	325	35	43	0.815	0.14	4.4	26.0
EL37	P	FIXED	400	69	49	1.41	0.10	2.5	56.5
EL34	P	SELF	325	35	42	0.83	0.095	5	15.7
EL34	P	FIXED	400	55	54	1.02	0.095	5	19.3
6550	B	SELF	400	41	37.5	1.09	0.07	4	19.0
6550	B	FIXED	400	55	32.5	1.69	0.09	3	50.7
2A3	T	SELF	300	10	110.0	0.09	3.1	5	56.5
2A3	T	FIXED	300	15	88	0.17	1.87	2.5	127.0
6CZ5	B	FIXED	350	21.5	33	0.65	0.1	1	65.0

* B = BEAM POWER P = PENTODE T = TRIODE

tube is a parameter of primary interest, even to the quality-minded purist. This is so because almost any Figure of Merit will include the power sensitivity (watts out per volt in) as one term, and it is obvious that the power sensitivity can be increased *ad infinitum* merely by putting more tubes in parallel with the initial set. However, since this cost factor can be evaluated *only* by the user we will not explicitly consider it. We will find, though, that it tends to enter indirectly in some of the other terms of the expression.

Important Factors

To formulate our Figure of Merit we first take inventory of the various factors which we wish to consider. Among these may be power output, driving voltage, distortion at rated output, damping factor (ratio of load impedance to source impedance), efficiency, maximum grid circuit resistance, cost, size, and so on. These may then be sorted quite arbitrarily into two groups: desirable and undesirable. The figure will be designed so that a large desirable term makes a better figure and a large undesirable one makes the figure poorer. This will mean our figure is a fraction with the desirable factors in the numerator and the undesirable ones in the denominator. See Table I.

In looking over this inventory of factors we may find terms which actually affect the merit-figure of the driver tube more than the output tube. Driving voltage and maximum grid circuit resistance are two such terms. Low driving voltage is desirable because it means lower distortion in the driver stage, or possibly lower voltage for a given distortion. A high permissible grid circuit resistance is desirable because it means that awkward coupling methods, such as transformers, are not necessary, or that the loading on the preceding tube can be made less, or that the size of a coupling capacitor can be made smaller for the same low-frequency time constant.

The terms of the figure might be grouped, if we desire, in terms of quality and terms of quantity. The distinction however, is not clear-cut and there is overlapping of the groups. It is this overlapping that the element of cost invariably creeps into, whether we want it or not. If this cost element is neglected to the greatest possible extent we can make up a simple figure which is predominantly a quality figure and therefore very suitable for home constructors or experimenters.

A basic Figure of Merit is the following:

$$Figure\ of\ Merit = F = \frac{PD}{EH}$$

where P = power output—a "quantity" factor

D = Damping factor (load Z/ Source Z),—a "quality" factor

E = Input voltage required to produce P—a "quantity" factor

H = Harmonic distortion at power P—a "quality" factor

Damping factor is a quality factor for three reasons. Not only does it indicate a measure of the transient response of the loudspeaker system, but it also indicates frequency response, since a low source impedance relative to the reflected load means a wider response from a given output transformer or (to let the factor of cost creep in) a cheaper output transformer for the same frequency response. Low source impedance also means less distortion due to the transformer itself.

The other terms are relatively self-evident. Power is wanted, but we want to get it at no expense to the preceding stage, that is, with as little driving voltage as possible. Our quantity terms are therefore:

$$\frac{power\ out}{driving\ voltage} = power\ sensitivity$$

The distortion term needs no explanation. If, because of the magnitudes of the various terms, our figure ends up as a decimal, we may multiply the result by some arbitrary number. In this case final results have been multiplied by 1000.

Effect of Feedback

Let's see how feedback affects this figure. If enough voltage feedback (6 db) is applied (around the output tubes only) to increase the required driving voltage by a factor of two, our quantity term in the expression is reduced by two, making the figure only one-half as good as before. Our quality term has been increased by more than two, however. The distortion has been cut in half (for the same power output, of course), and this alone has brought the total figure back to its original value. The change in the damping factor, however, is considerably more than two to one, typical values for a triode being about two, and for a beam power tube about 10. This is because the plate resistance variation due to voltage feedback is dependent on the amplification factor, μ, of the tube and not just on the stage gain. Whether we agree that the merit of our system has gone up by a factor of two (or ten) is a question of how much weight we give the damping factor term. The problem of what weights should be assigned to any of the terms is one which the designer must decide on in advance.

With this basic Figure of Merit at hand, let us see how some of the well-known power tubes fare.

Determining the F

Table II lists not only the final Figure of Merit but also the component terms which go to make up that figure. The ratio of the first factors is also given separately as the power sensitivity (column headed P/E), a sort of sub-figure-of-merit.

Type 2A3, an obsolescent filamentary type triode, has been deliberately included in Table I since it helps demonstrate a particular point. The point is that the value of a Figure of Merit depends on how important the designer feels the individual factors are. The 2A3 has the highest Figure of Merit according to Table II. There are many designers who would not agree at all with this rating. They would point out that the 2A3 achieved top rating almost solely on the basis of its damping factor, and that conversely the 2A3 is by far the hardest tube of the group to drive.

A glance at the columns for Power Sensitivity P/E and Damping Factor will show that, in these two respects, they are right. It takes 88 volts rms or 125 volts peak to drive a pair of 2A3's in fixed bias. This is quite a large voltage to achieve without distortion. It is therefore quite possible that the distortion in the driver stage will exceed the distortion in the output stage. There is no disputing the fact that the 2A3 has a high damping factor. Is the damping factor, however as important as we have made it appear?

Let us compare the 6V6 tabulation for a moment. The 6V6 gives about the same power output as the 2A3 at almost the same d.c. supply voltage. It is therefore a tube that may be fairly compared with the 2A3. Let us suppose that we have available a driver tube that can supply 88 volts rms with low distortion, say one per cent. Are we justified in using 2A3's in the output, or could we do better with 6V6's and how?

The 6V6 requires 26 volts drive. Let us apply negative voltage feedback around the 6V6 until it requires 88 volts drive. Its power sensitivity will then be equal to that of the 2A3. This requires a feedback of 3.4 or 10.6 db. This application of feedback will reduce the dis-

(*Continued on page 99*)

TABLE III
COMPLETE FIGURE OF MERIT

TYPE	BIAS	F_1	EFFICIENCY x R_g (Megs)	F_2	COST (Relative to 6V6)	F_3
6V6	FIXED	11.1	.039	0.434	1.00	0.434
EL84	FIXED	23.4	.116	2.72	1.50 1.11	1.81 2.45
6L6	SELF	40.4	.236	9.55	2.00	4.77
6L6	FIXED	58.0	.042	2.44	2.00	1.22
5881	FIXED	58.0	.042	2.44	3.50	0.7
KT66	SELF	17.7	.215	3.8	3.50	1.08
EL34	SELF	15.7	.274	4.3	3.50	1.22
EL34	FIXED	19.0	.203	3.85	3.50	1.10
6550	SELF	19.0	.092	1.75	5.50	0.32
6550	FIXED	50.7	.019	0.98	5.50	0.18
2A3	SELF	56.5	.1375	7.77	2.55	3.05
2A3	FIXED	127.0	.015	1.9	2.55	0.75
6CZ5	FIXED	65.0	.0475	3.1	1.27	2.45

TABLE IV
ADDITIONAL CHARACTERISTICS FOR TABLE III

TYPE	BIAS	P_o	P_{in}	PLATE EFF.	R_g	P_H	OVERALL EFF.
2A3	FIXED	15	44	.34	50 K	6.25	.30
2A3	SELF	10	30	.33	500 K	6.25	.275
6V6	FIXED	14	30	.467	100 K	5.65	.393
6L6	SELF	24.5	40.6	.604	500 K	11.3	.473
5881	SELF	24.5	40.6	.604	500 K	11.3	.473
6L6	FIXED	26.5	51.55	.514	100 K	11.3	.422
5881	FIXED	26.5	51.55	.514	100 K	11.3	.422
KT66	SELF	30	53.7	.56	500 K	16.0	.43
6550	FIXED	55	120.0	.46	50 K	22.6	.386
6550	SELF	41	88	.465	250 K	22.6	.370
EL34	SELF	35	71	.495	700 K	18.9	.390
EL34	FIXED	55	116.0	.475	500 K	18.9	.407
EL84	SELF	17	34.2	.497	1000 K	9.6	.388
EL84	FIXED	17	34.2	.497	300 K	9.6	.388
6CZ5	FIXED	21.5	39.6	.543	100 K	5.65	.475

from McIntosh...

PERFECTION in Stereo Control

Industrial design by George H. Kress Associates. • $225 less cabinet

The C 20 COMPENSATOR FOR STEREO

Simplicity, flexibility, and beauty have been integrated by careful engineering and design in the McIntosh C-20 Stereo Compensator. The greatest listening pleasure in stereo or monophonic reproduction is assured as a result of over a year of careful and diligent research in the requirements of a new preamplifier designed for stereo. Full stereo flexibility has been provided plus built in protection for your investment in monophonic records. McIntosh has designed in the C-20 Stereo Compensator the necessary features required to give the finest monophonic reproduction the keenest listener may require.

Complete satisfaction is yours in monophonic and stereophonic with the McIntosh C-20 Stereo Compensator.

McIntosh... *the Mark of Excellence*

FACILITIES

Mode Selector: 6 positions including Stereo, Stereo Reverse, Left channel on left speaker only, Right channel on right speaker only. Left channel on both speakers, or Right channel on both speakers.

Monophonic: Internally parallels and decouples a stereo phono cartridge to offer best quality reproduction from monophonic records.

Tone Controls: Treble: boost 13 db at 20 KC
attenuate 18 db at 20 KC
Bass: boost 16 db at 20 cycles
attenuate 20 db at 20 cycles

Trim Controls: Separate channel back panel controls to balance the frequency response of the system independent of front panel controls.

Equalization: Separate bass and treble 6 position switches, including NAB tape and flat for any low level flat source.

Aural Compensator: Fletcher-Munsen compensation, continuously variable.

Rumble Filter: Rolloff to reject low frequency disturbances such as rumble.

High Frequency Cutoff: Two positions, 9 KC and 5 KC to suppress hiss and noise.

Phase: 180° phase reversal to phase speakers or source material.

Balance: Attenuates alternate sides of center 40 db each channel to balance for unequal source material.

Tape: Front panel jacks, push button controlled, to permit the use of a portable tape recorder without disrupting permanently installed equipment.

Tape Monitor: To permit instantaneous monitoring of tape while recording.

SPECIFICATIONS

Power Requirements: 117 VAC; 35 watts

Input Sensitivity and Impedance: Auxiliary, Tape, and 2 Tuner 0.25 V at 470K
2 Phono, Low: 2.5 MV at 47K
High: 12.5 MV at 47K
XTal: 0.1 V, very high
2 Tape Head, Low: 1.25 MV at 47K
High: 6.25 MV at 270K
Tape Monitor: 0.25 V at 130K

Frequency Response: ±0.5 db 20 to 20,000 cycles

Distortion: Less than 0.2% at rated output, 20 to 20,000 cycles

Hum and Noise: High level inputs: 85 db below rated output
Low level inputs: less than 2 microvolts at input terminals (—115 dbm)

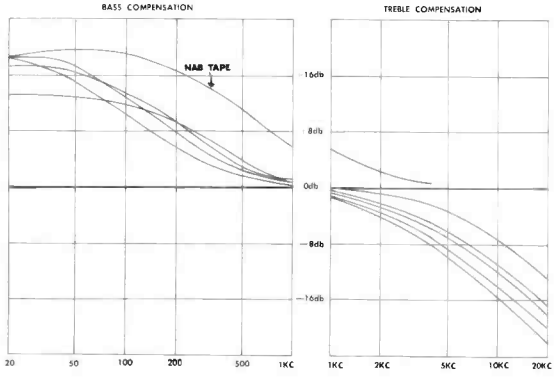
Outputs: Main: 2.5 V with rated input
Tape: 0.25 V with rated input

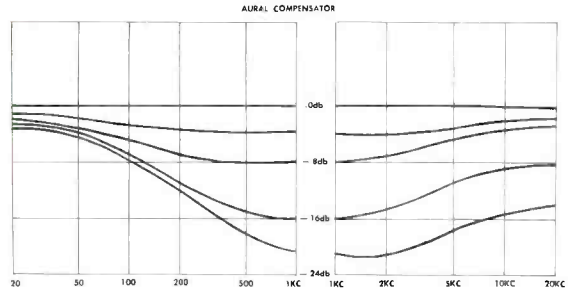
Gain: Low level inputs: 1000-1 Main Output
Low level inputs: 100-1 Tape Output
High level inputs: 10-1 Main Output
High level inputs: 1-1 Tape Output

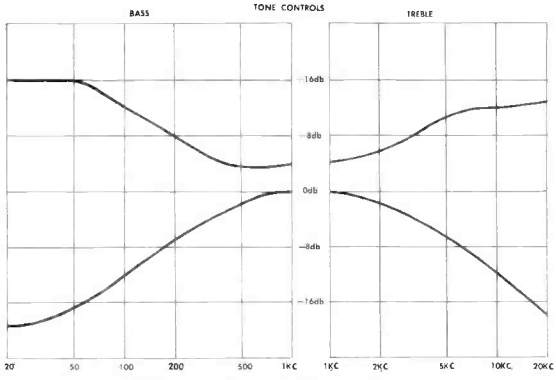
A.C. Aux. Outlets: 1 unswitched for tape machine or turntable and 3 switched

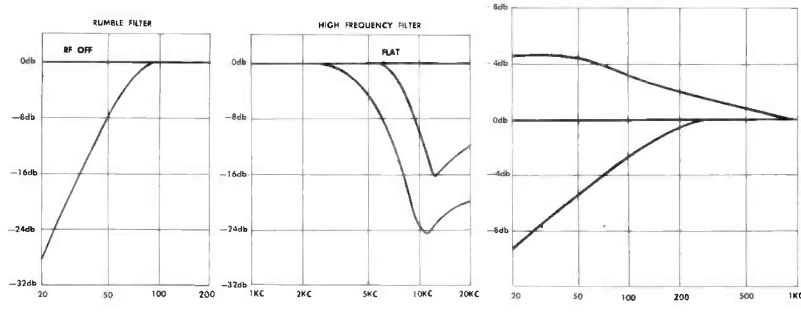
Size: Chassis: 14½ inches wide; 4¼ inches high; 12 inches deep
Front panel: 14¾ inches wide; 4¼ inches high

Weight: 17 pounds









McIntosh LABORATORY INC., 4 Chambers St., Binghamton, N. Y.

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Visual Stereo Monitoring

BURWELL GRAHAM and GEORGE L. FOSTER*

The oscilloscope can be used to tell you more about a stereo recording than ears and meters will, provided you know how to interpret the indications. The author tells you what to look for and what it all means.

WHEN A WELL-ESTABLISHED INDUSTRY is faced with a basic change in its product as a result of a new idea or by modification of some old one, many problems are bound to arise.

The recording and associated industries, faced this in the middle 1940's with the introduction of the LP and 45 rpm records. A number of years were required before the manufacturers of both the records and the playing equipment were able to gain full advantage of these developments.

At present, we face a similar situation with regard to stereo. Stereophonic sound is not new; it has been used on film and tape for many years. However, the equipment used was somewhat limited. Manufacturing, installing, and adjusting of such equipment was more or less on a custom-made scale and with experienced personnel.

Stereo records, on the other hand, enabled the art to be placed on a general usage level requiring the availability of playing equipment in all price ranges. It also resulted in the production, on a quantity basis, of stereo records by all major companies.

Many of the persons involved in the retail hi-fi business have only a limited knowledge of the art. Judging from many demonstrations and discussions, there is little general agreement as to the sound of good stereo. Normal monitoring equipment also fails as a guage to judge a stereo program, or as a means to judge good stereo.

To the average listener, so-called stereo is usually demonstrated by having a program broken into two distinct channels, each playing into a separate speaker system, the two being some distance apart. In many demonstrations, the speakers are located as much as 20 feet apart. The program chosen usually shows the two-channel effect, such as a group of performers, where some are heard on one channel only, some on the other. This is easy to demonstrate. The effect is something like watching a tennis match. The demonstration shows only that it is possible to put two channels of monophonic information on one phonograph record and get both of them with one stylus, but it is not stereo.

* *Spartan Of Canada, London, Ontario.*

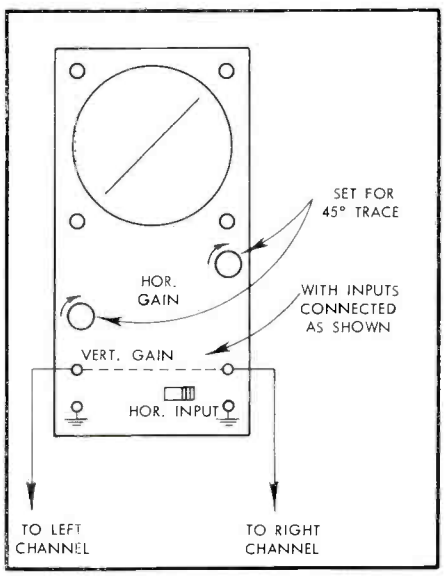


Fig. 1. Arrangement of connections to "scope."

Other exhibitions are more polite, only one channel speaks at a time.

True stereo should result from an infinite number of sound sources, not just two. With our present two-channel stereo we can actually point at five sound sources.

Five Sources of Sound

First, we have that resulting from monophonic, in-phase (lateral cutting) recording. This is one sound voice. We have been listening to this for years. If we reverse the phase of one speaker in a two-speaker monophonic system, the sound now appears to come from two points, one on each side of the pair of speakers, or two sound sources. This same effect can be heard on a stereo system, two signals equal and out of phase.

Then there is sound from the left channel and sound from the right channel, five apparent sound sources. But only five? Remember the "center" sound was produced by combining the two signals in phase: the "outside" sounds by combining signals out of phase by 180 deg. Other signals with varying phase difference are present as well resulting in a range of sound source. This gives the true stereo effect where the music appears to have depth and dimension, rather than a single source.

The effect can be noted much better at home, in a quiet place free from disturbance and technical problems. Each person gets a slightly different effect due to his own particular hearing. With some programs the phasing is very difficult to detect, particularly with instrumental music. What is needed is a visual device with which we can monitor programs, and check equipment.

Use of the Oscilloscope

While designing some playing equipment, a solution was found to this problem. The cathode ray oscilloscope was originally developed as a sensitive measuring device to measure position and phase. Based on the old principle of producing Lissajous figures, it can be adapted to show all the information necessary to judge stereo equipment and programming and thus serve as a window into the somewhat obscure stereo picture.

The application is simple; any reasonable 'scope can be used provided it has adjustable amplifiers on both the X and Y axes and access to each of them. We have used a 5-in. Heathkit model with quite satisfactory results, as well as several more elaborate types.

The first step is to equalize the vertical and horizontal gain of the X and Y channels on the scope. Set the horizontal control to horizontal input (or external), connect ground terminals of both horizontal and vertical to ground if required (on some 'scopes the lower terminals are grounded on the front panel). Connect the two upper terminals together and apply a signal, either from an audio oscillator, or from one output channel on a stereo amplifier. *Figure* 1 shows how to connect the 'scope. Now, play a record of any type having a more or less steady volume.

Adjust the vertical and horizontal amplifier gain controls to give a trace at 45 deg. on the 'scope. To be of any use, the 'scope should adjust to this position. Allow the 'scope to warm up and stabilize when this adjustment is made. After the 'scope is stable, again check the angle of the trace, readjust if necessary to the 45 deg. When the gain-control setting has been established do not touch these controls without again paralleling the two inputs and rechecking.

Remove the jumper from the two in-

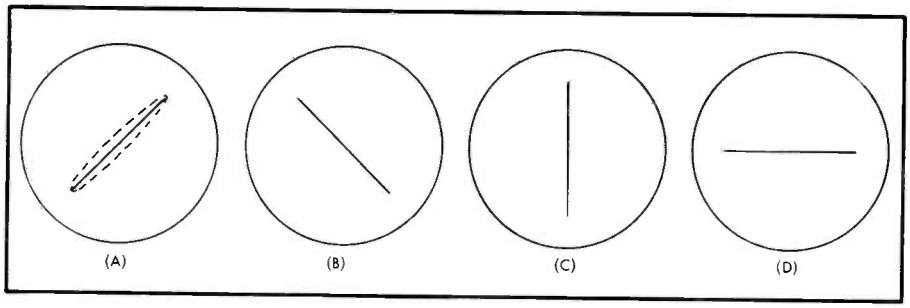


Fig. 2. 'Scope patterns: (A) 45-deg. trace which should appear when amplifier inputs are paralleled and the gains are equal. A monophonic disc will also give the same trace when played on a stereo system, although pattern may appear more like (C) in Fig. 3 because of pinch effect, which is actually vertical modulation. (B) 315-deg. trace, obtained by playing a vertical-cut record. It will sound like a monophonic record with one speaker out of phase. (C) 0-deg. trace, left channel only. (D) 90-deg. trace, right channel only.

puts and connect each input to one channel of the stereo system. The best point in the amplifier is on the output transformer secondary of each amplifier. The voice coils could be used but on some speaker systems there are dividing networks ahead of the voice coils. We require the full range output of each amplifier.

The next step is to balance the gain of the two amplifiers. Play a lateral recording (a frequency record is preferred). For tape equipment, parallel the inputs as before and play monophonic tape. Turn the amplifier input to monophonic or standard. This should give the same trace as when the 'scope was set as above. If the trace is not at 45 deg. adjust the gain of the individual amplifiers to make it as at (A) in *Fig.* 2. If the trace is not a thin line but instead is a wide pattern (dotted line), there are some non-uniform phase shifts in the amplifiers. Stereo amplifiers should be identical. Note particularly the grid, plate, and cathode resistors and the coupling capacitors. Any wide divergence between amplifiers results in a non-uniform phase shift. This is very important when the amplifier is compensated with negative feedback from the audio transformer secondaries. Amplifiers having resistance-capacitance feedback networks can have considerable phase differences. It is important that the amplifiers are so corrected and adjusted to give a thin 45-deg trace on the 'scope with the amplifier inputs paralleled. True stereo gives an elliptical or circular trace. Any non-uniform phase shifts in the amplifiers can cause cancellation or distortion of the stereo effect. Each amplifier in a stereo system should have a gain-setting control.

Turn the input switch on the amplifiers to stereo still playing the lateral or monophonic recording. If the pickup and record are perfect, no change should be noticed. Usually, however, many changes occur. Hum and rumble will cause a widening of the trace. If your amplifier has a bass reduction control, cut down the low response. The trace should narrow if the widening is due to hum or rumble. If it does, turn up the bass control and lift the pickup from record. Hum usually remains, but the rumble should disappear. It may take some intensive work to reduce the hum and rumble to practical limits.

Use with Test Records

If you have the two Westrex stereo test records, these can now be used to check the system. Play the lateral side, #714. This should give the characteristic 45-deg. monophonic trace. Play the vertical side, #713, which will give a trace at 315 deg. The left channel, #715, will give a horizontal trace. The right channel, #716, will give a vertical trace. Poor separation in the pickup will result in a wide pattern on either or both vertical and horizontal traces.

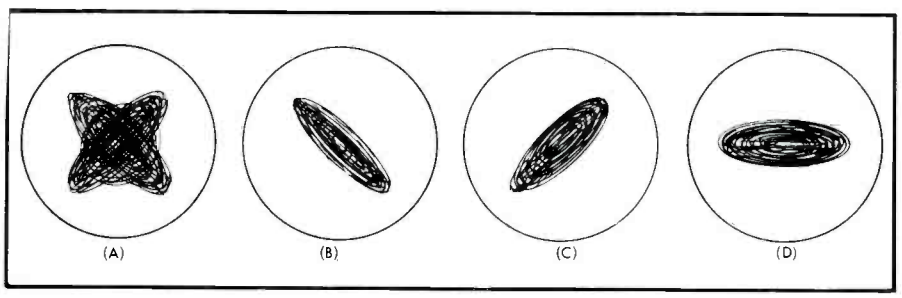


Fig. 3. (A) Sunburst effect, good stereo, with many sound sources. (B) Mostly vertical; program might sound "thin." (C) Mostly lateral or monophonic; sound source should appear to be midway between speakers. (D) One channel only; can be caused by magnetic pickup with stylus off center. Trace may appear at 0 deg. instead.

Magnetic pickups very often deteriorate in quality due to dirt becoming lodged in the pole pieces. Very small magnetic particles can so effect magnetic pickups that there is no difference between vertical and lateral, that is, zero separation.

To check recording equipment, studio amplifiers, and microphones, the above tests should be made using a small directional sound source. This can be positioned at five places representing each side, the center, and the intermediate within the range of the microphone used.

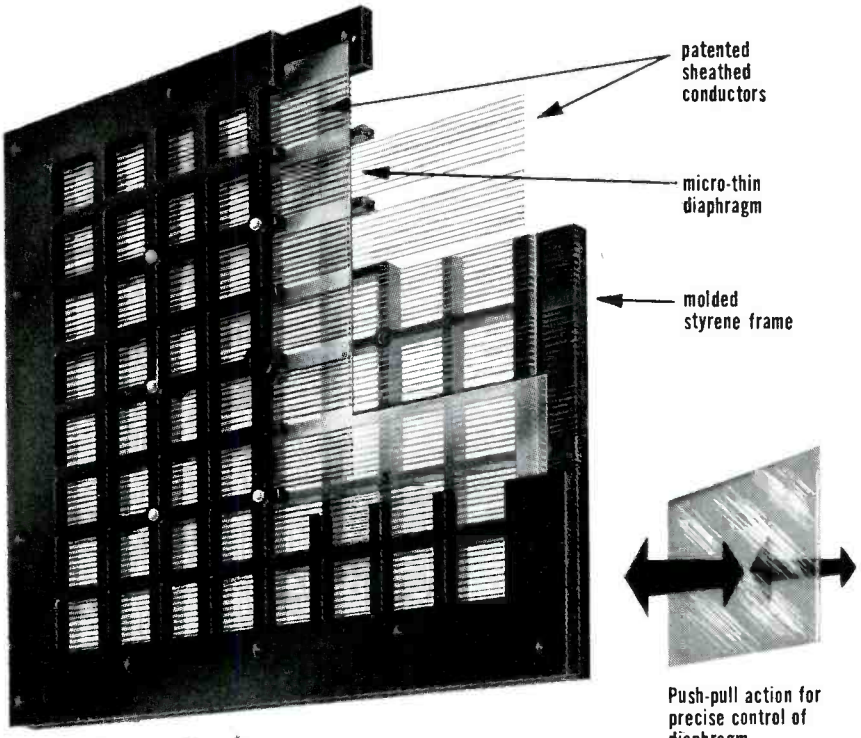
Going through these stages will, no doubt, show numerous problems with the equipment. When the equipment has been corrected, you have an excellent device with which to monitor stereo recordings.

As mentioned earlier, true stereo results from audio information with all phase differences. In other words, a circular trace on the 'scope! This is only occasionally seen. More generally, however, the display is a sunburst effect, as at (A) in *Fig.* 3, fairly uniform in shape. "Directional" stereo shows up as a pattern in the vertical or horizontal. This is desirable in some programs but listening becomes boring when the selection always appears this way.

Too little stereo shows as a 45-deg. pattern (the same as monophonic) while too much out-of-phase information gives a 315-deg. pattern. This generally results in apparent loss of lows and, if the trace in this plane is too long, shows a recording with too much vertical cutting. Indeed by watching the 'scope as well as listening to the speakers, one can monitor the cutting and achieve a better balanced recording.

With a little experience, one can get a vast amount of information from the trace pattern on the 'scope. By listening and watching the 'scope at the same time, good stereo can be recognized more easily than by listening alone.

This system can be used as a continual visual monitor of the program material during recording and particularly during cutting. Too long a trace at 315 deg. indicates too much vertical component with the damage of overcutting. When making stereo recordings, it is advisable to keep the program balanced for at least 75 per cent of the time. This shows up as a "sunburst" type trace. This is an important feature when the recording is played on low-priced equipment. Many of the small stereo record players have only limited output on any one channel and thus need program material on both channels for full volume. The conventional monitor which uses two db or VU meters only shows the output from each channel and will not show sum and difference values which result from vertical and lateral cutting. Æ



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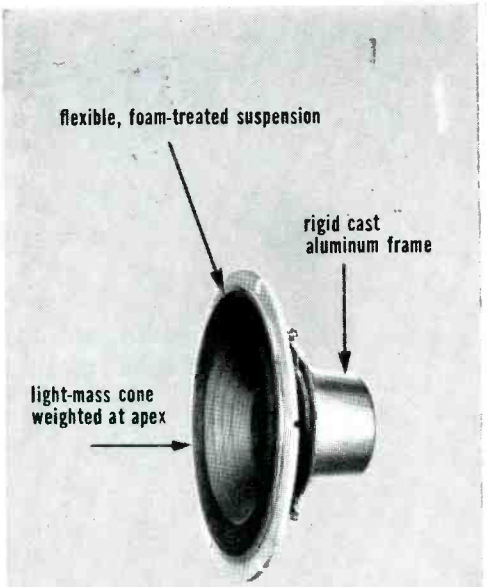
Push-pull action for precise control of diaphragm



Cone Woofer for the lows

The Model 350 woofer is specifically designed to match the efficiency, low distortion, and excellent transient characteristics of push-pull electrostatics.

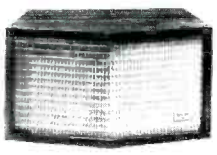
worth KNOWING the difference... worth HEARING the difference

The Z-300 console and the new Z-400 shelf speaker systems are definitely not for those who've been listening to shrilling trebles and booming basses for so long they've forgotten what "live" music is really like.

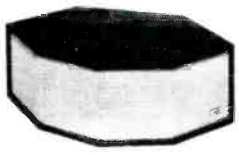
For whatever the program—velvety strings, the human voice, percussion, full organ—the Z-300 and Z-400 reproduce with measurable precision the full audio spectrum from 30 to 30,000 cycles. Nothing escapes them . . . nothing is added by them to mar the clarity of the original recording or broadcast.

The secret is the sonic mating of the remarkable JansZen Electrostatic mid-high range speaker with the Model 350 cone woofer — the low frequency speaker designed *specifically* to match the efficiency, low distortion, and excellent transient characteristics of an electrostatic.

Listen to these compact integrated speaker systems . . . singly, or in pairs for stereo . . . at leading high fidelity dealers.



Model 65 Electrostatic Two-element Mid/High Range Tweeter gives absolutely clean response to 30,000 cycles.



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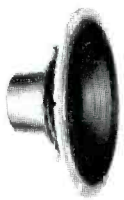
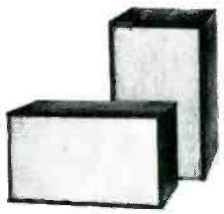
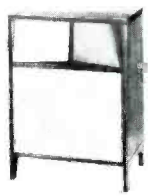


Model 350 Cone Woofer designed specifically for small enclosures . . . undistorted bass to 30 cycles.



Model Z-400 Shelf Speaker System combines Model 65 electrostatic with Model 350 woofer . . . ideal for stereo . . . vertical or horizontal placement on shelf or floor.



Model Z-300 Console Speaker System combines Model 65 electrostatic with Model 350 woofer . . . exceptionally compact . . . uniform response from 30 to 30,000 cycles.

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Series-Tuned Push-Pull Oscillator

A description of a novel push-pull oscillator using a series-tuned circuit as the frequency determining element.

E. J. CUDDY*

THE SERIES-TUNED CIRCUIT as a frequency-determining element in an oscillator has been used from time to time and found to have certain advantages. In most cases, it is in the form of a piezo-electric crystal and requires an additional parallel-tuned tank. Other applications are restricted to frequencies close to the self-resonant frequency of the tube used; still others are actually as a variable element in a parallel-tuned circuit. It would appear that something more flexible such as the arrangement shown in *Fig.* 1 would be welcome addition to those now in use.

The equivalent circuit, *Fig.* 2, shows more clearly that the T_1 has, as a load, the cathode resistor (R_{k2}) of tube T_2 plus the series resonant circuit represented by r; and that tube T_2 has R_{k1} and r for a load. Going to *Fig.* 1, it can be seen that due to the method of connecting the grids, a slight rise in the voltage at the grid of T_1, will cause a current flow through R_{k2} in such a direction as to drive the grid of T_2 negative. This negative swing of the grid of T_2 will in turn drive R_{k1} so as to make the grid of T_1 more positive. Hence, we have a build up in one direction until saturation in one tube or cut-off in the other causes a reversal of the action and a build up in the other direction. Since the series circuit is common to the outputs of both the tubes, it will determine the frequency of operation, yet remain fairly independent of the phase shift between the grid and plate of each tube.

* *Romig Associates, 11 Bainton St., Yonkers, N.Y.*

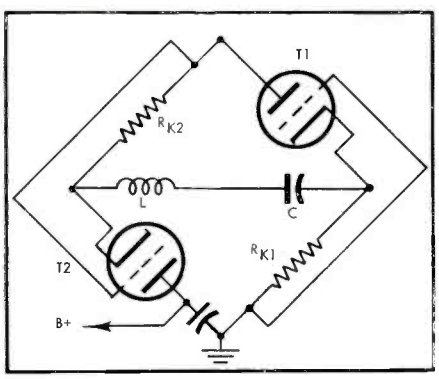

Fig 1. Basic circuit of the series-tuned oscillator, which may be used for audio as well as radio frequencies.

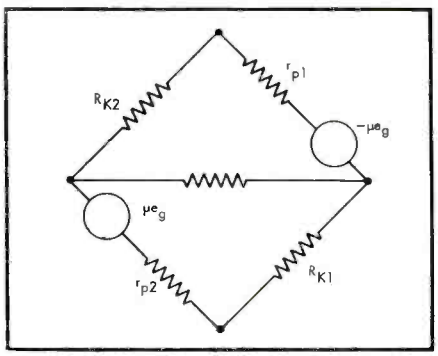

Fig. 2. Equivalent circuit of the schematic of Fig. 1.

In addition to the fact that the series resonant circuit is not as much affected by a change in shunt capacitance as is a parallel circuit, *Fig.* 3 shows that a balancing action takes place in this oscillator. Since the grid-to-cathode capacitance of each tube is in series with the plate-to-cathode capacitance of the other, a cancellation takes place in each half of the bridge and any remaining unbalances will be canceled because the capacitance variation in each half will oppose that of the other.

Practical Circuit

As in other oscillators, a high-Q tuned circuit gives best frequency stability and also seems to improve wave shape. In addition, it is desirable to operate the tubes under Class A conditions for best frequency stability so R_{k1} and R_{k2} should be approximately the value recommended by tube manufacturers for such operation. The proper plate voltage is important in this regard and some means of varying it should be provided until the tube giving the most stability is ascertained.

Output signal can be taken across R_{k1} with little effect on the circuit as long as it is fed into a high impedance through a capacitor, or the output may be taken off at the junction of R_{k2} and T_1 and about twice as much voltage obtained. Almost any pair of triodes may be used, except at the higher frequencies where tubes designed for this use and in separate envelopes will be found superior.

Applications

It seems likely that this type of oscillator will be found more useful when used with a crystal as the series-tuned circuit. As it stands (*Fig.* 1) it is inconvenient to use an ordinary grounded tuning capacitor and permeability tuning is indicated. However, where a separate oscillator power supply is used, the cathode of T_1 may be grounded so that a regular capacitor with its grounded plates connected to this point will do for tuning. Of course, in this case, the negative lead of the supply is returned to the bottom of R_{k1}.

While these factors (plus the fact that two tubes, or a duo-triode, are required) tend to restrict the use of this circuit, it should prove valuable where frequency stability is the prime consideration. Æ

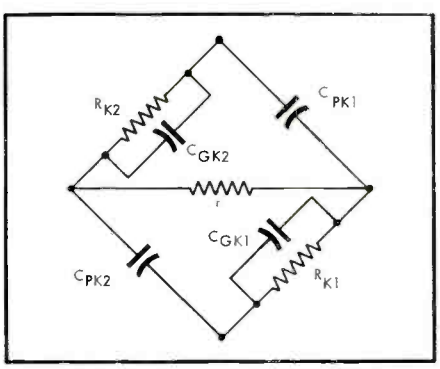

Fig. 3. Presentation of the circuit in bridge form.

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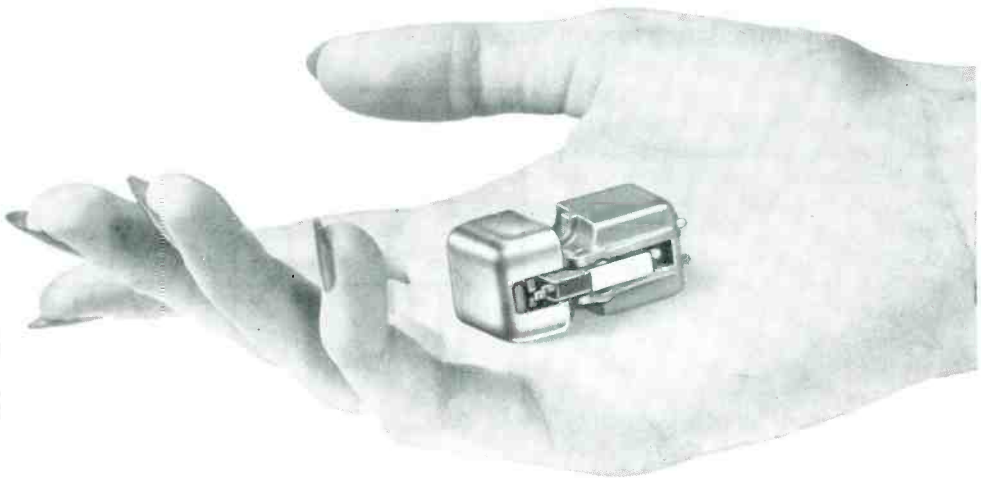

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We believe that once you hear General Electric's all-new VR-22 in the privacy of your own home, on your own equipment, you'll want to have this superb stereo cartridge for your very own.

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The VR-22 is outstanding in all four critical areas of stereo cartridge performance: *Channel separation—Response—Freedom from hum—Compliance.*

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*Manufacturer's suggested resale prices.

Acclaimed by the experts!

Oliver P. Ferrell
Editor
Hi-Fi Review
as quoted in issue of Aug. 1959

". . . the VR-227 is a top performer. The frequency response is as flat as any cartridge tested to date. Channel-to-channel separation in the vital area between 700 cycles and 8000 cycles was equal to the very best stereo cartridges now offered the public."

Wm. A. Stocklin
Editor
Electronics World
as quoted in issue of Sept. 1959

". . . listening tests did not show up any flaws. Frequency response from 30 to 15,000 cps (limits of our test) was within 2.25 db of flat. Provides about the best channel separation available of any checked with the exception of [cartridge selling for $65.00] in the frequency range from about 5000 to 9000 cps."

C. G. McProud
Editor
Audio
as quoted in issue of Sept. 1959

". . . is even better than its predecessor with respect to output, channel separation and extended frequency response and the two channels balance within ±2 db to 15,000 cycles. The shielding has been improved and the grounding of the shield and the method of shorting the two 'ground' terminals are well thought out."

GENERAL ELECTRIC

Transistorized Microphone Preamplifier

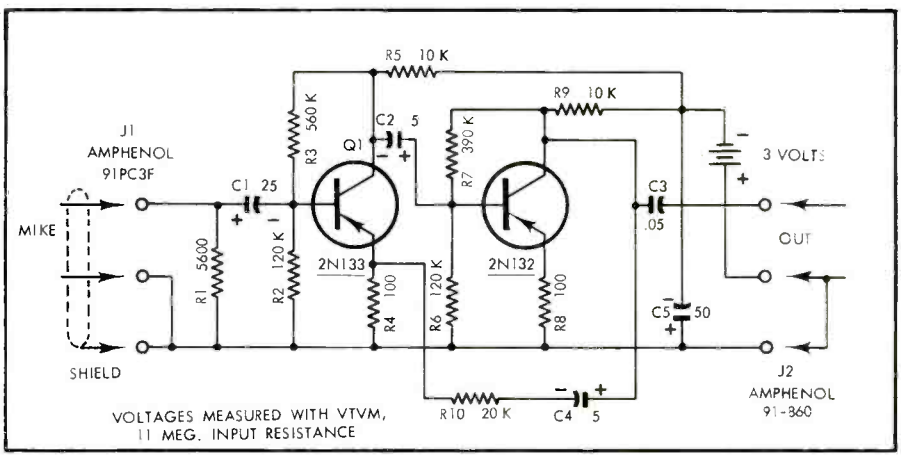
HORACE E. WEST*

This simple, easily constructed preamp will make it possible to use a high-quality low-impedance microphone with typical high-impedance inputs on tape recorders.

THE WRITER has a good home-type tape recorder, which came complete with a sensitive variable-reluctance, high-impedance microphone. With the recorder it is possible to make copies of long-play records of such quality that when the tapes and records are played back through a hi-fi set, it is impossible to tell which is being played. But when recordings were made with the low-priced microphone, the quality was quite inferior. To make it possible to make original recording of good quality, a good microphone was bought, and so as to provide flexibility in placing the equipment, a low-impedance microphone and good-quality microphone transformer were chosen. It now became possible to make quality recordings, and to place the microphone at any convenient distance from the recorder. However, a new problem was encountered—the professional style microphone was so much less sensitive than the one supplied with the recorder that for soft music or voices the volume control had to be turned all the way on, or the microphone placed too close to the source of sound for comfort.

A logical solution seemed to be a microphone preamplifier to step up the output of the microphone and to match the high-impedance input of the recorder. In the interests of portability a transistor amplifier seemed desirable. Other features indicated were:

1. Quality as good as that obtained with a good microphone transformer.
2. A noise level sufficiently low so as not to be noticeable.
3. Output equal to that obtained from variable-reluctance or crystal microphones.
4. Weight no greater than the microphone transformer previously used between the end of the shielded cable and the input jack on the recorder. All this was achieved in the preamp developed, and shown in the schematic, *Fig.* 1. It is housed in an aluminum box $5 \times 3 \times 1\frac{1}{2}$ in., and weighs less than the transformer. Powered by two pen-light batteries it has more output than the original cheap microphone, and this output



can be increased another fifty per cent by merely adding another pen-light battery to the two suggested. Current consumed is only 0.25 milliamps, so the batteries should last their normal shelf life. Instead of a switch to turn the batteries on, a three contact female chassis receptacle was used for the output connection, and when the corresponding plug is inserted, it closes the battery circuit as well as making the output connections.

All in all, the preamp described has greatly increased the usefulness of the recorder, and should be of help to many amateurs wishing to make better recordings. Because of being battery powered, no hum is introduced, and the unit is completely free from all microphonics.

Construction Details

Construction was simple, with no complications. A low-noise transistor was used in the first stage. All resistors were half-watt. Miniature electrolytic capacitors were used in the interests of compactness. A piece of bakelite, approximately 3×5 in., was used as the base-board. The pen-light holders were placed along the top edge. Most of the resistors and capacitors were put in a single row, parallel to the short edges of the bakelite, in the order they are numbered: R_1, C_1, R_2, Q_1, R_3, R_4, R_5, C_2, C_3, R_6, R_7, R_8, Q_2, R_9, C_5; the components of the feed-back circuit, C_4 and R_{10}, are placed in an end-to-end position along the bottom edge of the bakelite sheet. The units were mounted by drilling a 1/16-in. hole at each end of each resistor or capacitor, and pushing the leads through. As the units are placed in the order the signal reaches them, wiring is at a minimum—the only wires used were the component leads themselves. On the underside of the board these were cut to the right lengths, and soldered together. Three short flexible leads were left at the input, and they were soldered to the input connector after the circuit board was screwed to the bottom of the aluminum box—with spacing washers holding the board far enough from the actual bottom to prevent a short of any wiring to the metal box. In the same way, three other flexible leads were left to be soldered to the output connector. A length of shielded microphone cable, with a three-prong matching connector on one end, and a 'phone plug on the other, connects the preamp to the microphone jack on the recorder. Æ

PARTS LIST

C_1	25 µf, 6-volt, Sprague Little-Lytic
C_2, C_4	5 µf, 6-volt, Sprague Little-Lytic
C_3	.05 µf, paper, midget type
C_5	50 µf, 6-volt, Sprague Little-Lytic
J_1	Microphone connector, Amphenol 91PC3F

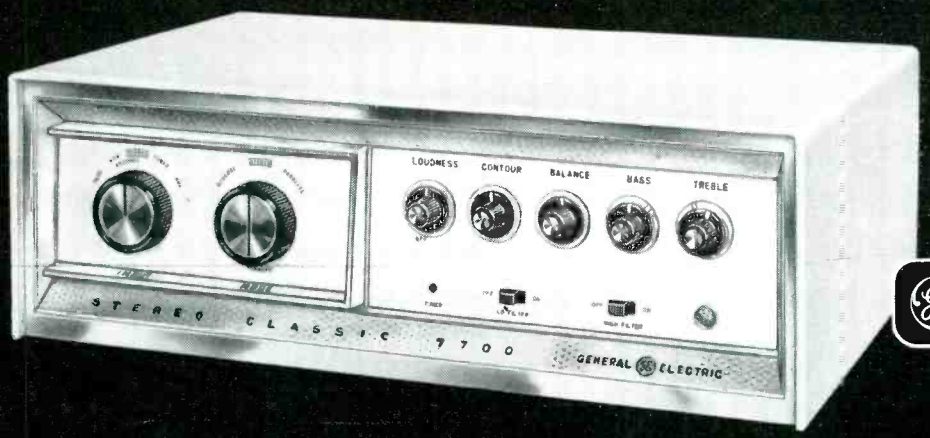
(*Continued on page 88*)

* *8487 Adera St., Vancouver 14, B.C.*

new General Electric stereo amplifier

Power: 56 watts (28 watts per channel) music power. More than enough to drive even low efficiency speakers. Response flat (±0.5 db) from 20 to 20,000 cycles, with less than 1% distortion. Channel separation 40 db.

Soundly engineered: Power tubes at the extreme back for more ventilation, cooler operation. Scratch and rumble filters. Advanced circuitry for easy servicing, stable performance. Speaker phasing switch at rear.



Inputs and outputs: Controlled quickly and functionally with two multi-purpose controls. For stereo and monaural cartridges (magnetic and ceramic), tape heads, tape machines and tuners. Gives you flexible command of inputs and complete selection of speaker combinations.

Sensitive music controls: Loudness: combined with power on-off. Contour: for automatic bass boost at low volume. Balance: continuously variable to "off" on either channel. Boss and treble: dual concentric type adjusts channels together or separately for non-matching speakers.

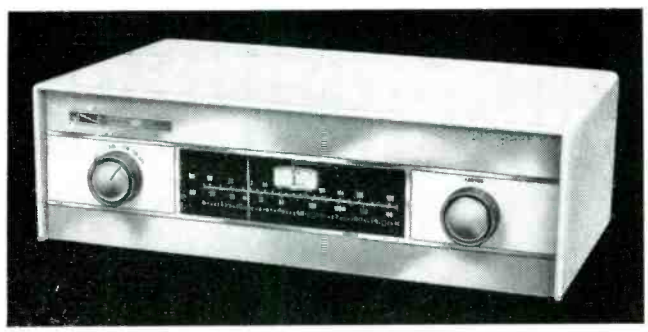
*56 watts of power, soundly engineered, a versatile beauty. From front to back, a remarkable achievement at $189.95**

Designed for beauty and value: Featuring a recessed front panel, the G-7700 comes complete in a beige vinyl case, the G-7710 in a white vinyl case. The price is a modest **$189.95***, including case. (The G-7600 delivers 40 watts, 20 watts per channel, **$139.95***.) Other General Electric stereo amplifiers from $119.95, including case.

FM-AM Tuner, Series FA-10. Receives even weak signals with unusually low distortion, hum and noise level. Drift-free. Visual meter for pinpoint FM center channel tuning and optimum AM signal tuning. RF amplifier stage in both FM and AM increases sensitivity. FM multiplex jack for stereo adaptor. Built-in AM antenna; FM dipole included. **$129.95***.

Colors match all General Electric amplifiers: Saddle Brown FA-10 matches MS-4010; Willow Gray FA-12 matches MS-4000A, MS-2000A; Beige FA-15 matches G-7700; White FA-16 matches G-7710; Saddle Brown FA-17 matches G-7600.

* Manufacturer's suggested resale prices. Slightly higher in the West.



See and hear General Electric Amplifiers and Tuners at your Hi-Fi dealer now.
Audio Components Section, Auburn, N. Y.

GENERAL ELECTRIC

Speaker System for Perfectionists

JAMES A. MITCHELL*

Attention to detail and a thorough search for the slightest element which might detract from the quality of performance makes this unit worthy of duplication by anyone who wants good reproduction.

THE MOST SIGNIFICANT trend in speaker system design in the past few years has been efforts to achieve realism or naturalness in sound. This may sound like a puzzling statement to the average audio fan since it might be logically assumed that all speaker systems attempted to sound "real." Actually most speaker systems built in the last twenty years have intentionally deviated from theoretical perfect response to produce the most popular and pleasing tone from the sound sources available at the time. Distortions in records and radio have encouraged the popularity of speakers with juggled response curves and with "enhancing" resonances. And there have been fads in brilliance, juke box bass, and overemphasized presence.

The first wide-range coaxial speaker had a built in high frequency roll-off switch so that when playing most of the shellac records of that day the noise and high-frequency distortion could be cut down to tolerable levels. As better records were made the range of speakers was extended to reveal more highs. High frequencies became the object of high fidelity and excessive brilliance became a fad in the design of many speakers. Peaks is the response curve in the six- to ten-thousand-cps range were easy to achieve and when followed by a rapid roll-off above this frequency gave the impression of tremendous highs without distortion in the very high frequency range.

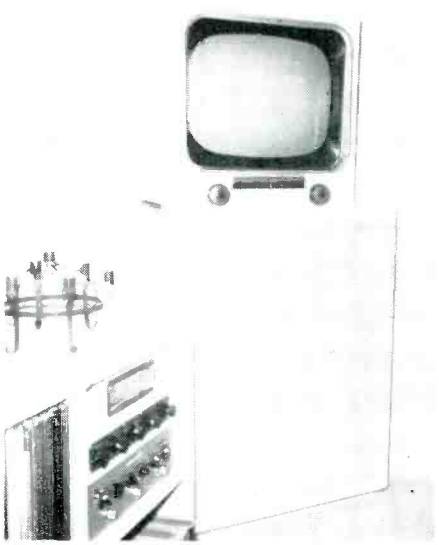
The bass end too has been boosted, rolled-off, and resonated in all sorts of ways to give the impression of big bass. The open backed vibrant speaker cabinets which would whoomp on every loud note gave the first hi-fi thrills. True extended range bass has been achieved only with great effort and until recently, large size. There has remained a tendency to use resonance to extend the bass response of many systems.

The latest advances in the recording art have encouraged many speaker designers to try to produce speaker systems with a much more truly "flat" response and free from the resonance and "color" of earlier speakers.

What are the sound characteristics of these speaker systems? They are usually described as sounding "smooth and unobtrusive, not brilliant but silky, not bassy but solid, sharp, clean, and natural." The two qualities most important in achieving this sound are (1) the selection of drivers with smooth wide-range response and excellent transient performance and, (2), the mounting of the speakers in a rigid vibration-free baffle with all resonances eliminated. A few commercially available speaker systems have been built on these principles with considerable success. There are also a number of suitable speaker components available for the audio fan who wants to build his own system.

To those with the "build it" urge there may be some lessons in the construction of the writer's "perfectionist" speaker system. This unit was designed and built

* *4141 Skyland Drive, Kingsport, Tenn.*



The completed loudspeaker serves as a base for the TV set as well as a source of excellent sound.

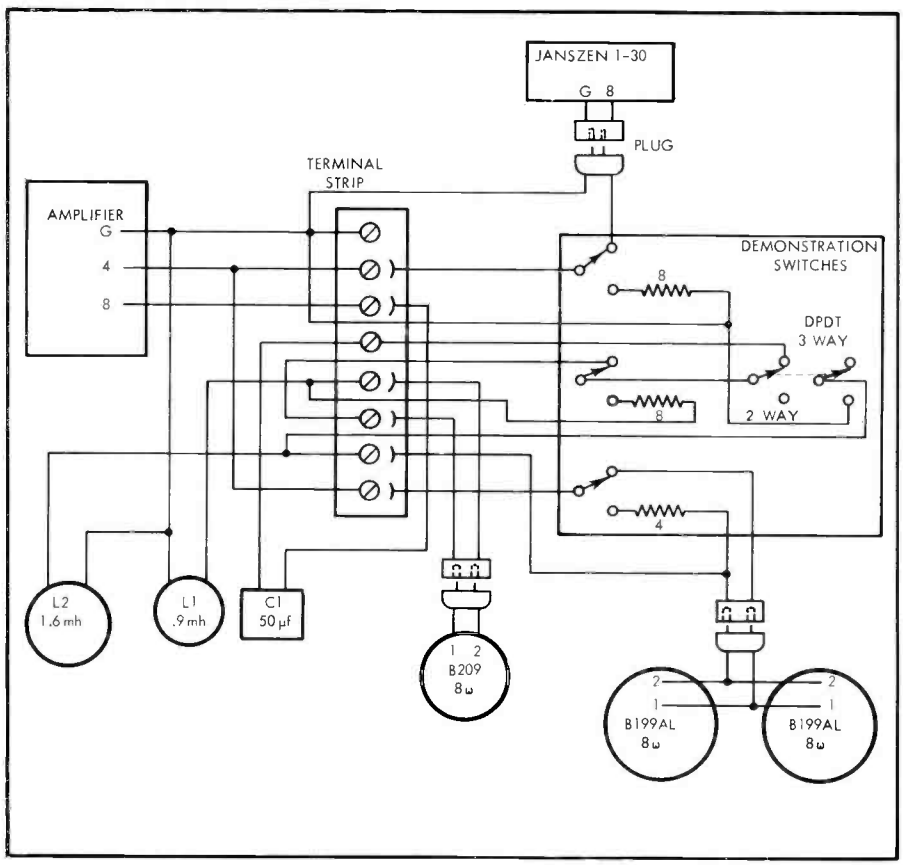


Fig. 1. Schematic of connections to the various elements of the author's three-way system.

General Electric presents

Model G-501
9¼" x 13" x 22"
A true bookshelf
speaker system.

today's biggest cubic foot of sound

This dramatic new design brings you General Electric's famous Extended Bass performance in an ultra-compact one cubic foot enclosure ideal for stereo.

Hear it . . . and you'll agree that here is full, natural sound as good as, or better than, many much larger and more costly systems. The G-501 offers realistic, smooth response within ±3 db over most of its frequency range from 45 to 16,000 cycles.

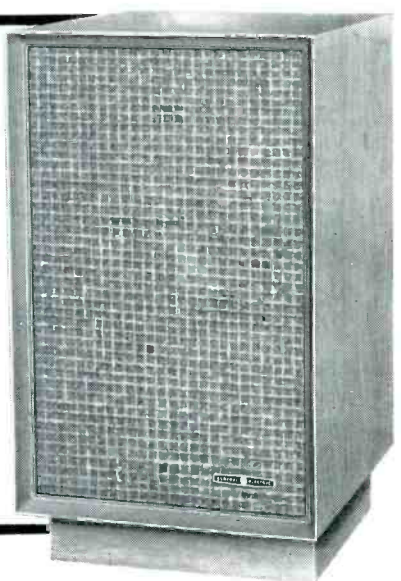
Unusually clean low-frequency response results from the closed-type enclosure and special high-compliance woofer. A new 3-inch tweeter achieves maximum dispersion of highs for full stereo effect. In walnut, ebony and walnut, mahogany and cherry veneers. **$85.00***

New General Electric 12-inch Speaker System

The G-506 combines enclosure compactness with full, smooth response from 40 to 18,000 cycles. The complete unit — with front-mounted woofer, tweeter and crossover network — occupies only two cubic feet of space.

But small size is gained through no sacrifice in sound! The Extended Bass design puts out *four times* the low-frequency power (+6 db) as standard 12-inch speakers in the same enclosure. Complete G-506 in four most-wanted finishes. **$129.95***

*Manufacturer's suggested resale prices. Slightly higher in the West.



Model G-506
15" x 14½" x 23¼"

hear both of these fine speakers at your Hi-Fi dealer now

Audio Components Section, Auburn, N. Y.

GENERAL ELECTRIC

to produce a natural sound. The final design is the result of a number of experiments and comparisons, and the results have been fully satisfying. Critical listeners generally agree that other components in the reproducing chain—records, pickups, and so on—introduce more color than this speaker system.

Details of System

This speaker system was built around the following components: A Janszen 1–30 electrostatic speaker for the frequencies from mid-range to the limit of high-frequency hearing; a Bozak B-209 midrange speaker for the middle and lower middle frequencies; and two Bozak B-199AL woofers for the bass.

The Janszen electrostatic has an exceptionally smooth response, free from peaks and resonances. It covers the range of from 500 cps up. It does require carefully balanced matching woofer and/or midrange speakers to produce best results. Listening tests indicate that the woofer should not fall off at the 500-cps point but should smoothly overlap into the 2000-cps range with a peak-free rolloff above 2000 cps. A gradual rolloff is best.

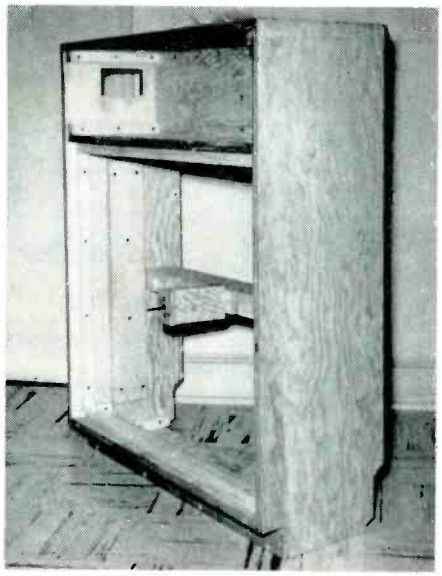


Fig. 2. The cabinet frame in early stages of construction.

It is quite a request to expect a woofer to work well in the 2000-cps range. Most units of 12- or 15-inch diameter show some cone break-up (segment resonance) below this frequency. In the pursuit of perfection it was therefore decided to cover the range from 2000 cps down with mid- and bass-range speakers. The Bozak units match the Janszen in efficiency level, and their relative volume is easily brought to the right balance. The B-209 midrange unit is remarkably flat in the 200- to 4000-cps range and it is highly damped and free from resonance.

The woofers are B-199AL models. These differ from the standard Bozak B-199 woofers in that they have a greater linear voice-coil travel, and a lower fundamental resonant frequency. This allows an extension of the bass range in both frequency and power. For optimum results they require, however, a larger infinite baffle—12 cu. ft. as compared to 8 cu. ft. for the standard model in a two-woofer system.

Broad-range slow-rolloff crossover connections are used with these speakers. This greatly improves the blending of the different units and minimizes crossover transient problems. The crossover between the woofers and the midrange is at 400 cps and the rolloff of the mid-

(*Continued on page 96*)

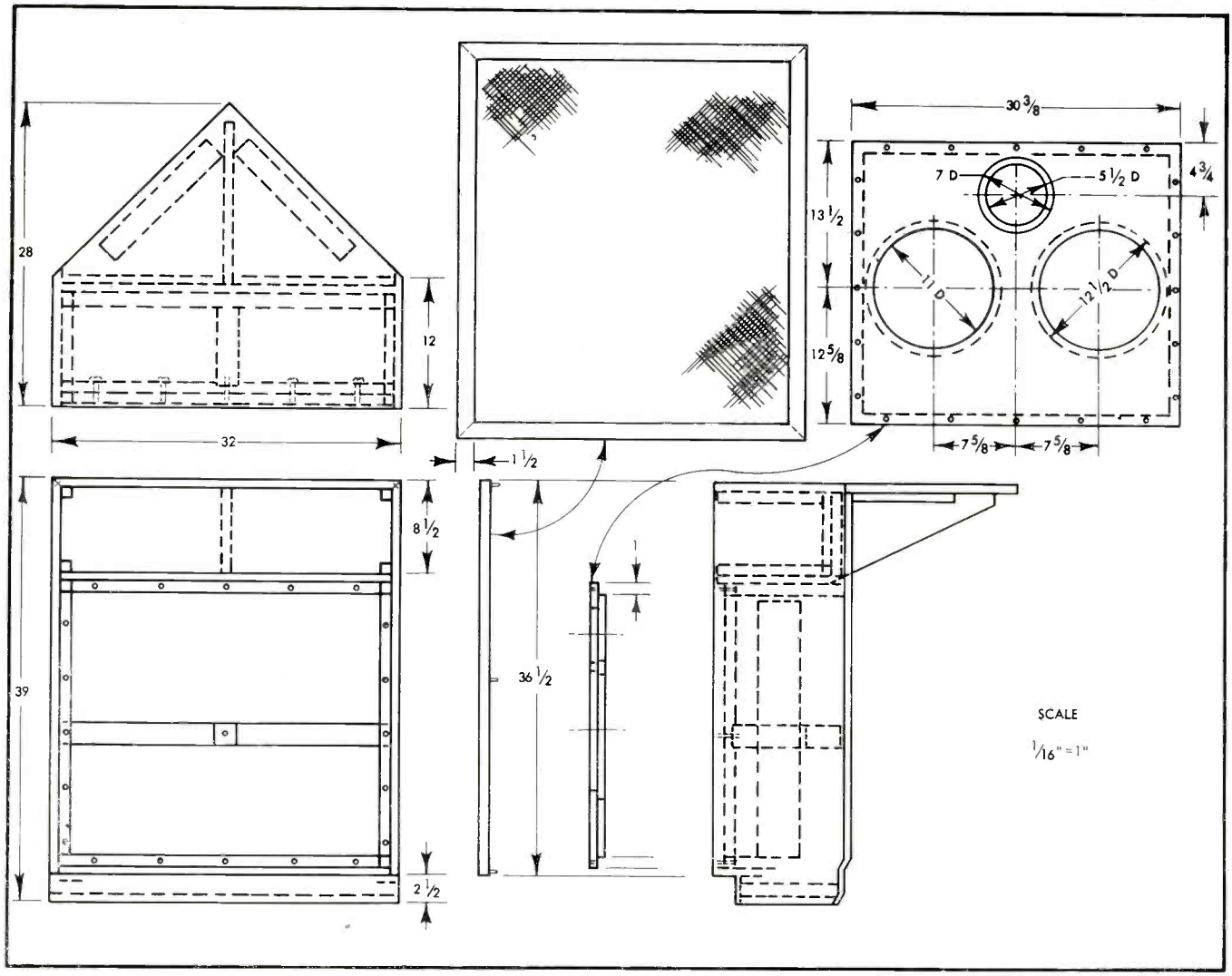
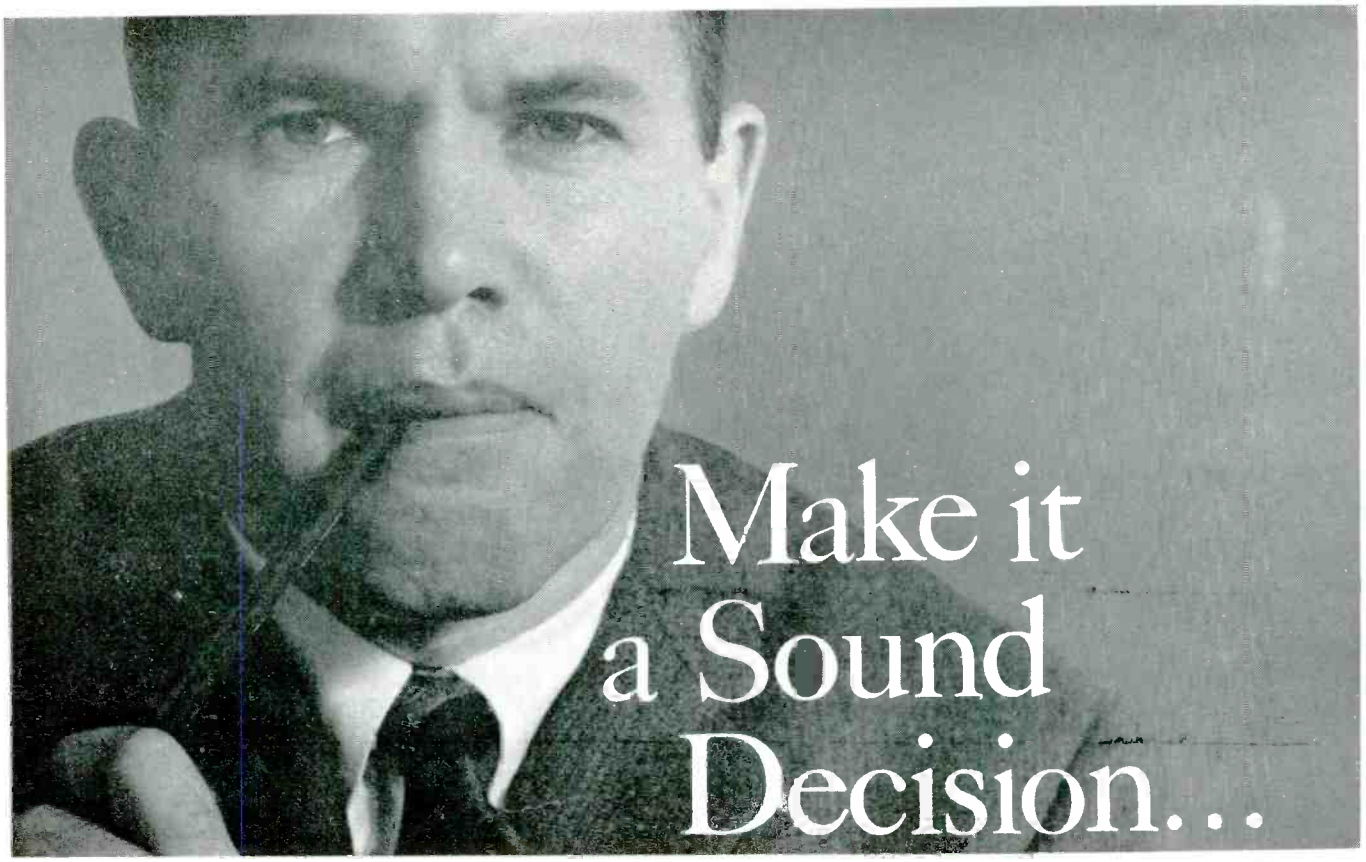
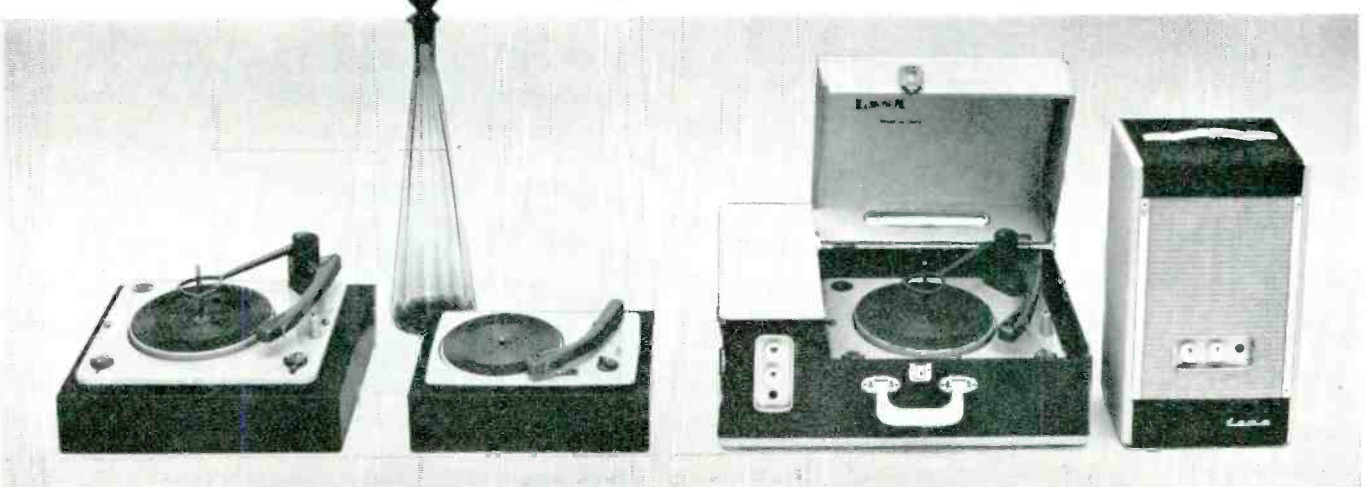


Fig. 3. Dimensions and plan for the loudspeaker cabinet described by the author.



Make it a Sound Decision... Choose Lesa!



■CD2/21 AUTOMATIC STEREO CHANGER $39.95 4-speed, pre-wired for mono and stereo. Jam-proof mechanism with constant 6-second change cycle. Flutter, wow, and rumble on a par with broadcast standards. Heavy duty 4-pole motor. Perfectly balanced no-resonance, no-feedback tone arm. ■4V3/11 MANUAL STEREO PLAYER $23.25 Pre-wired for mono and stereo, plays all size and speed records. Automatic stop at end of record play. Precision turntable speed control accurate to 1.5%. Small space, elastic suspension mounting. ■57/SA "LESAPHON" HI-FI PORTABLE PHONOGRAPH $105.95 Combines the CD2/21 with a powerful amplifier-speaker system in a handsome portable for truly full dimension sound reproduction. Beautifully styled, finished in tutone vinyl with gleaming brass trim. ■1/SA "LECOSTEREO" AMPLIFIER-SPEAKER $53.95 Custom-designed for superlative stereo, the 1/SA simply plugs into the 57/SA and you have a balanced stereo system with single-point control! ■

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HOW TO BUILD A STEREO CONSOLE THAT REPRODUCES MUSIC AS FAITHFULLY AS SEPARATELY MOUNTED COMPONENTS

For many years, serious music lovers have searched for a way to enclose high quality high-fidelity equipment in a cabinet that would match their finest furniture.

Until now, there was no practical solution. You had to compromise. You had to sacrifice the best possible music reproduction if you wanted a good looking cabinet. If you insisted on high quality reproduction, you chose components, some of which may not have been quite so appealing to the eye.

If you dislike compromise, Stromberg-Carlson's new kind of console will interest you. We call them Integrity Series Component Ensembles—and to an uncompromising music lover each word in that name will be significant.

At the start, we faced the same problem that every console manufacturer has tried to overcome: when full-range speakers were rigidly mounted in the same console as high quality components, there was a serious loss of sound quality.

This loss—most often recognized as muddy or boomy noise—is caused by "feedback." It occurs because sensitive components can detect the speaker vibrations which are fed back through the body of the cabinet. These vibrations are amplified with the music and reproduced as noise.

If you own a console now, but do not hear these noises, it is not because your ears are insensitive.

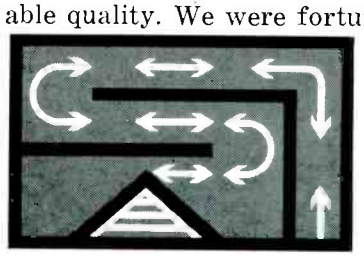
You do not hear them because we and every other console manufacturer had to eliminate them by compromising the musical reproduction of your console. You do not hear them because the sound you hear is not complete.

HOW TO BUILD A CONSOLE THAT ELIMINATES FEEDBACK NOISES

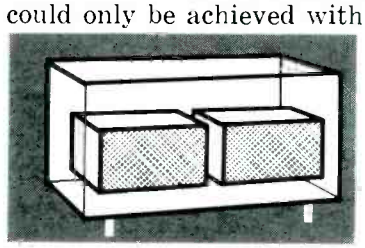
As we analyzed the problem, we realized there were seven projects that we had to accomplish before we could bring you this new kind of console.

PROJECT #1 **The first consideration was given to our components.** They had to have high quality reproduction. The standards we set for them can be most simply described by the phrase "Integrity in Music Reproduction." If you are familiar with Stromberg-Carlson stereo tuners, amplifiers, turntables and speakers, we believe you will agree they earn this description.

PROJECT #2 **Speaker systems were the next important project.** For our new kind of stereo console we needed two speaker systems of unquestionable quality. We were fortunate here, because we had already developed a system that met the quality requirements, the well-regarded Acoustical Labyrinth® Speaker System. Its quarter wavelength duct enclosure, properly coupled to a low-frequency radiator, achieved a system resonance lower than the unbaffled free air cone resonance of the radiator itself. This is the kind of quality we knew you wanted.



PROJECT #3 **To reduce the size of high quality speaker systems so that they would fit into a stereo console of reasonable dimensions.** We were certain that component-quality sound in a console could only be achieved with speaker systems that did not depend on the console cabinet for their enclosure. This meant that we had to reduce the size of the Acoustical Labyrinth enclo-

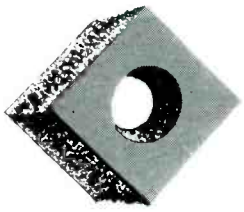


sure so that we could fit two separate speaker enclosures within a cabinet that had reasonable dimensions. It was not easy, but we did it. After many, many trials and tests we achieved the correct size without sacrificing one iota of the extremely linear and extended response of the system.

NOW THE MOST DIFFICULT PROBLEM HAD TO BE FACED

PROJECT #4 **To effectively eliminate feedback by effectively eliminating the mechanical coupling that allows it to occur.** Instead of treating the symptoms, we treated the cause. We developed a method of effectively isolating the speaker systems from the sensitive components. (As a result, Stromberg-Carlson Integrity Series Ensembles are the first successful uncompromised ensembles.)

The key development is what we call ISO-COUSTIC SPEAKER SYSTEM MOUNTING. This mounting, in which the resistance and compliance to vertical and horizontal pressures have been carefully engineered, has solved the problem. It allows Stromberg-Carlson to create a cabinet-within-cabinet suspension system which prevents transmission of speaker vibrations to the sensitive components. If you component owners could put your equipment into a cabinet whose speaker systems have our ISO-COUSTIC Mounting, the quality of the sound you'd hear would be as good as your component system is now. In fact, the components we use are the same ones you would choose for your separately mounted component system. They are interchangeable.



INTEGRITY SERIES WILL NEVER BECOME OBSOLETE

PROJECT #5 **To assure the purchaser of an Integrity Ensemble that his choice would never be obsolete,** we designed the units in accordance with a *modular concept*. All of the components are *completely interchangeable*. You can replace any component in the ensemble to keep pace with new developments—without ever replacing your fine cabinetry.

CABINETRY HAD TO BE EXCEPTIONAL, TOO

PROJECT #6 **To design cabinets with the permanent beauty of fine furniture.** Federico responded to the challenge by creating cabinetry in Traditional, Contemporary, Early American, Italian Provincial, French Provincial and Oriental styling. You choose from 16 basic models in these styles, in a choice of finishes. These cabinets, like a fine painting, best describe themselves. They must be seen.

PROJECT #7 **To give you maximum flexibility in your enjoyment of an Integrity Series Ensemble.** Every ensemble provides for your listening tastes and room acoustics by including the Stereo Choice Switch for precise regulation of stereo separation, with or without separate matching speaker systems. All ensembles provide space for adding a tape deck.

You may select your own Stromberg-Carlson stereo components or choose a recommended component complement—in any case Stromberg-Carlson components are always interchangeable.

If you now own a console or components, we invite you to exercise your critical judgment by listening to an Integrity Series Ensemble. (You will find that the better component shops—as well as the better department and music stores—have chosen to feature this new kind of stereo console.) Listen carefully. Look closely. Ask questions. Then accept not our judgment, but your own.

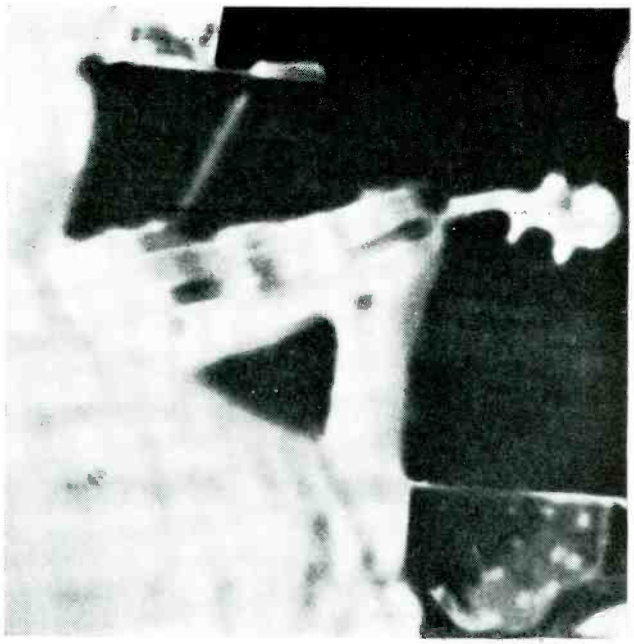
INTEGRITY SERIES COMPONENT ENSEMBLES

—three hundred and fifty dollars to about six thousand dollars. You may choose from 16 models in Traditional, Contemporary and Period stylings, each tastefully designed by Federico. You may select your own Stromberg-Carlson components or choose a recommended Stromberg-Carlson component complement—in any case Stromberg-Carlson components are always interchangeable.

For a complete color catalog of Integrity Series Component Ensembles and components write STROMBERG-CARLSON, Special Products Division, 1418 N. Goodman St., Rochester 3, New York.

"There is nothing finer than a Stromberg-Carlson"

STROMBERG-CARLSON
A DIVISION OF **GENERAL DYNAMICS**



For integrity in music...

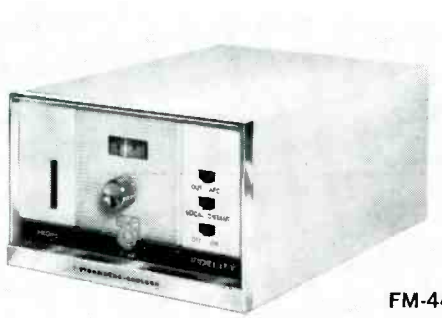
THREE NEW STROMBERG-CARLSON TUNERS

...in component systems
...in Integrity Series Ensembles

SR-455 AM-FM STEREO TUNER The SR-445 is actually two separate and complete units which have been placed together for convenience of mounting and use. They have individual circuitry in which no duplicate use of tubes or circuits is involved. Operate as an AM tuner, an FM tuner or together as an AM-FM stereo tuner. The SR-455 combines the separate AM and FM tuners described below. The specifications are exactly the same as listed for these two units. SR-455 ..... $129.95*

All three tuners are available in gold and white or black and brushed chrome. Top cover in white, black, tan or red available at extra cost.

SR-445



FM-443

FM-443 FM TUNER Exceptionally sensitive, low noise reception due to the wide peak-to-peak separation (475 kc) and long, linear slope (350 kc) of the balanced ratio detector, and the grounded grid cascode front end. Sensitivity is 2 uv for 20 db quieting, 4 uv for 30 db quieting (300 ohm). Local-Distant Switch results in 2 uv for 40 db quieting on local stations. Dial station selector and "hair-trigger" tuning eye. Temperature controlled circuits eliminate drift. Includes switched AFC circuit. Tuning Range: 88-108 mc. Bandwidth: 200 kc. Frequency Response: 20-20,000 cps. Self-powered with auxiliary power for AM-441 tuner. Provision for multiplex adapter. FM-443 ..... $79.95*

AM-442/AM-441

AM-442 AM TUNER For exceptional AM reception, this tuner has a frequency response of 20-7,000 cps, down 7 db at 7,000 cps. It features a tuned RF stage and 3-gang variable tuning condenser. Its tuning range is 540 to 1,600 kc; Bandwidth is 9 kc. Local-Distant Switch adds 20 db quieting on local stations. Adjustable ferrite loop and external antenna. AM-442 ..... $59.95*

AM-441 AM TUNER Same as above, but without its own power supply $49.95*

"There is nothing finer than a Stromberg-Carlson"

*Prices audiophile net, zone 1, less cover

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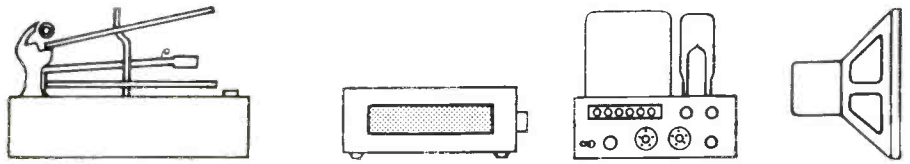
EQUIPMENT PROFILE



H. H. SCOTT 299 STEREO AMPLIFIER

The Scott 299, *Fig.* 1, is an integrated amplifier (control amplifier and power amplifier combined on one chassis) for stereo, rated at 17 watts per channel, and offering the performance and refinement of design that may be expected these days of a piece of equipment intended for high fidelity use. Considering everything that a stereo amplifier must do, it is relatively simple in appearance and straightforward in operation. The use of a substantial number of slide switches in place of the rotary type helps cut down the "busy" look and makes for an attractive front panel.

Controls

The 299 has a stereo-selector control, separate bass and treble controls for each channel but concentrically mounted, a stereo-balance control, a phase-reversing switch, and a ganged gain control.

The stereo-selector control has seven positions. To enable one to balance speaker levels, the first two settings, marked Balance A and Balance B, combine both input signals and feed them to either Channel A or Channel B. By alternating between these positions and adjusting the stereo balance control, one can equate the speaker levels. In the third position the stereo selector combines both input signals and feeds them to *both* channels, which is desirable when playing mono records with a stereo pickup. The fourth position provides true stereo, and the fifth position reverse stereo. In the sixth and seventh positions, either signal A or signal B is fed to both channels. If the speakers have previously been balanced —by using identical speakers or by means of L-pads or similar devices—one can balance the input signals by alternating between positions 6 and 7 and adjusting the stereo-balance control; thus one might balance the two sections of a stereo cartridge when playing a mono record.

The stereo-balance control provides equal level on both channels at mid-position. When turned fully to the left or right it eliminates one channel without affecting the level of the other.

The phase reversing control is a double-pole double-throw switch that reverses the connections on Channel B between the output transformer taps and the speaker terminals. This reversal can be achieved on any of the impedance taps (4, 8, and 16 ohms) because the "high" speaker terminal is connected to the desired tap by means of a jumper, as shown in *Fig.* 2.

To enable the user to know at a glance whether the unit is operating in the true stereo mode, reverse stereo, simulated stereo, or any other of the seven possible modes of operation, the 299 features a set of three pilot lamps that light up in various combinations, depending upon the position of the Stereo Selector control.

The 299 provides the following "conventional" controls, all of which are ganged: loudness-volume switch, which converts the volume control into either a straight gain control or a loudness control with automatic bass and treble boost at low levels; rumble filter; scratch filter; input selector.

In its first three positions, the input selector accepts the signals from the magnetic inputs and supplies European 78 phono, RIAA phono, or NAB (formerly NARTB) tape equalization. In the fourth and fifth positions it selects the high-level inputs, respectively tuner and tape amplifier. Intended for operation in conjunction with the input selector are two slide switches marked Channel A Pickup and Channel B Pickup; they permit one to choose on each channel between either of two low-level sources.

Inputs and Outputs

There are four inputs per channel: two magnetic inputs and two high-level ones, the latter marked tuner and tape. The magnetic inputs are intended for either magnetic phono cartridges or tape heads, with appropriate equalization determined by the position of the input selector. One chooses between Magnetic Input 1 or Magnetic Input 2 by the Channel A Pickup and Channel B Pickup switches. This meets the problem of the individual desiring to operate both a changer and a transcription turntable, or the one desiring to accommodate a tape head as well as a phono cartridge.

Magnetic Input 2 has two jacks, marked Low and High. The High jack is intended for cartridges with relatively high signal output and feeds the signal through a voltage divider to prevent the phono preamp and succeeding stages from being overloaded. The Low jack presents an impedance of 47,000 ohms, while the High jack presents 147,000 ohms. These impedances should be suitable for most pickups and heads. One can use either the High or Low jack on Magnetic Input 2, but not both at once.

No specific provision is made for piezoelectric cartridges, which typically require an input impedance of about 2 megohms to maintain bass response. On high-level inputs the input impedance is only 500,000 ohms, which is usually too low, although one might correct the situation adequately by turning up the bass control. Another possibility is to feed the cartridge into the magnetic input jack presenting a 47,000 ohm load. For some piezoelectric cartridges this will result in fairly correct equalization by converting the pickup into the equivalent of a velocity device throughout the audio range; in other words, by causing

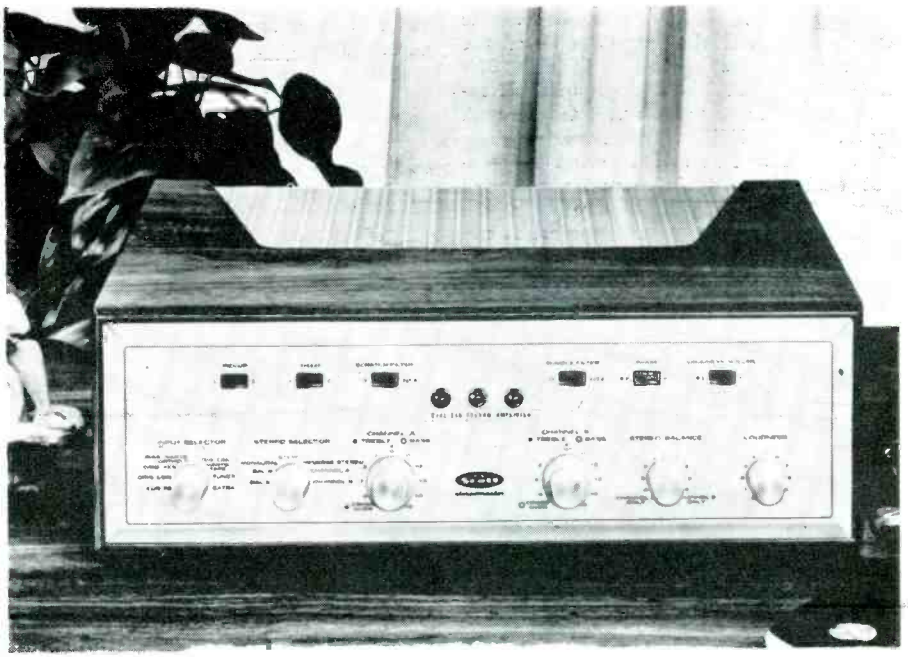


Fig. 1. H. H. Scott Model 299 Stereo Amplifier.

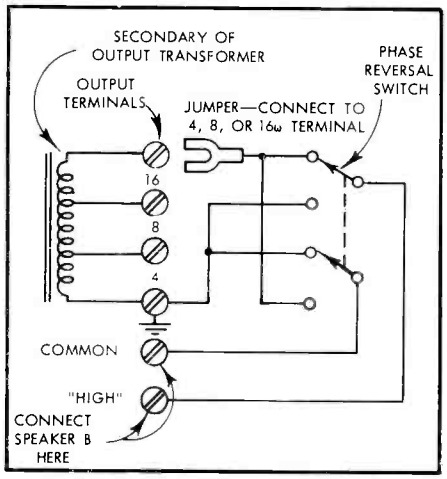


Fig. 2. Channel B output connections on the Scott 299.

the signal output to rise with frequency in the same manner as for a magnetic cartridge.

The speaker output terminals will accommodate 4, 8, and 16-ohm speakers. As previously discussed in connection with *Fig. 2*, connection to the desired tap of the output transformer is made by a jumper. This arrangement makes it possible to connect additional sets of speakers, or possibly a speaker for center-channel operation, to whatever terminals may be desired.

The 299 features a center channel output for feeding a third amplifier and speaker system. The signal is taken from the output transformer of each channel, via isolating resistors.

An output jack for feeding a tape recorder is provided on each channel. The manufacturer states that the tape recorder input should have an impedance of at least 200,000 ohms, which does not appear to raise a problem with most tape machines. Maximum recommended capacitance of the cable to the recorder is 200 μμf, which limits one to about 8 feet of low-capacitance cable (25 μμf per foot), and to proportionately less if other cable is used.

It may not be possible to record on some tape machines if the output cable of the machine remains connected to the 299's tape input jack. The 299 grounds all incoming signals other than that fed through by the input selector switch. However, some tape machines fail to disconnect the output cable from their amplifier circuitry when the machine is in the record mode. Hence the signal is grounded before it can reach the record head, as illustrated in *Fig. 3*. Some amplifiers meet this problem through a tape-monitor switch arrangement, which uses a special switch to accept the signal from the tape machine and at no time grounds this signal. In the operating manual for the Scott 222 (in the succeeding review), there is a diagram showing how to construct a simple external switching facility to meet this problem. Doubtless the manufacturer will furnish this diagram on request to owners of the 299.

Circuitry

Magnetic equalization (phono or tape) is achieved through frequency-selective feedback in the preamplifier stage. The signal from the preamplifier or a high-level signal goes through rumble and scratch filters of the losser type, followed by a stage of amplification, Baxendall-type tone controls, another stage of amplification, and the gain control (accompanied by the loudness-volume switch).

Placement of the gain control at a relatively late stage raises the possibility of overloading the earlier stages due to excessive signal. To illustrate, some tuners may present as much as 3 volts on peaks. The writer introduced 3 volts equivalent sine wave signal into the tuner input and measured 1.2 per cent IM distortion at 5 watts output (equivalent sine-wave power). But when the input signal was cut down to 0.5 volt, IM distortion at 5 watts output fell to the much lower figure of 0.23 per cent. The 299 has no input level-sets, so the incoming signal must be reduced at the source, for example by means of a gain control on a tuner.

After the gain control the signal goes into the power amplifier section, consisting of a phase splitter and the push-pull output tubes. In these days when the majority of high fidelity amplifiers appear to use either the split-load or long-tailed phase splitter, it is interesting to find in the 299 a reversion to one of the forms of floating paraphase inverter, which was common years back. A pentode-triode is used as the splitter. The output tubes, 7189's, are a relative newcomer on the scene and are tetrode operated with fixed bias.

A full quota of adjustments is provided in the power amplifier section, namely output tube bias, d.c. balance of the output tubes, and a.c. balance of the signals fed by the phase splitter to the output tubes.

Heaters of all the tubes in the control amplifier section are d.c. operated. The same d.c. source is employed to provide fixed negative bias to the output tubes.

Performance

At 1000 eps the reviewer measured 16 watts of power per channel on the 16-ohm tap before the waveform became noticeably distorted on an oscilloscope. This is but a fraction of a decibel below the manufacturer's 17-watt rating. At 30 and 15,000 eps, which are practical bounds for high fidelity reproduction, maximum "undistorted" power was about 7 watts, slightly more than 3 db down from power at 1000 eps. Considering that audio energy at the frequency extremes is ordinarily well below the energy at mid-frequencies, and considering that 7 watts will drive speakers of medium and high efficiency to very loud levels, the 299 should provide adequate power in the majority of situations. It may be noted 10 watts of "undistorted" power was available at 10,000 eps, while at the low end 16 watts were available at 100 eps, 14 watts at 50 eps, and 13 watts at 40 eps.

It was surprising to find Channel A of the 299 originally producing 1.5 per cent IM distortion at 1 watt equivalent sine wave power, 3.4 per cent at 5 watts, and 4.2 per cent at 10 watts; these readings were obtained by using just enough signal input to drive the 299 to full output with the gain control at maximum. Almost identical results were obtained on Channel B. Adjustment of the d.c. balance controls produced virtually no change, but a radical improvement was obtained by adjusting the a.c. balance controls. The results then were 0.19 per cent IM at 1 watt, 0.23 per cent at 10 watts, 0.7 per cent at 10 watts, and 1.4 per cent at 15 watts; even (slightly) better results were obtained on Channel B.

From this experience it appears that the purchaser is well advised to have his 299 thoroughly checked and aligned by a competent technician before installing it in his audio system. Of course, this is a rule that applies to all audio equipment; the reviewer's experience with the 299 is far from exceptional. (It may be noted here that in measuring IM in Scott's 222 amplifier, reviewed below, adjustment of the a.c. balance control produced no improvement on one channel and only slight improvement on the other.)

With gain full on and the controls at mid-position, frequency response was relatively flat, as measured on Channel A, remaining within ±2 db in the 40 to 15,000 eps range. Response was down 2 db at 20 eps and 3 db at 20,000 eps. With the gain control at a position 6 db below maximum, response was down 3 db at 15,000 eps and 5 db at 20,000.

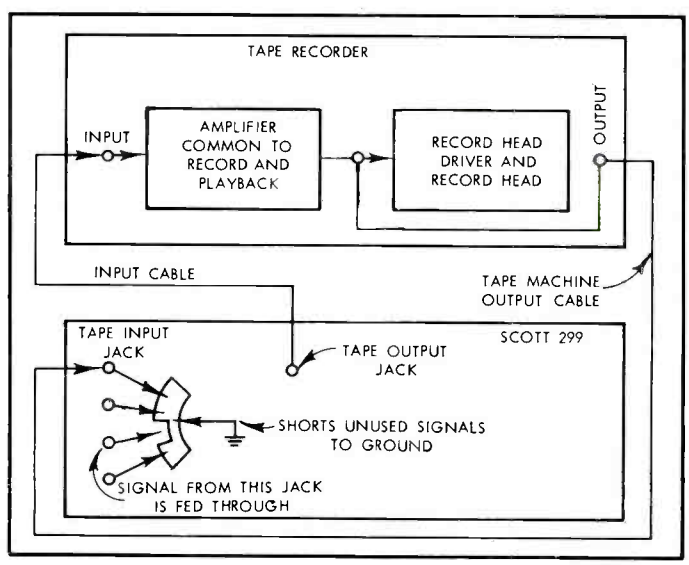


Fig. 3. Example of a tape recorder where the input signal is grounded when used with an amplifier such as the Scott 299.

Fig. 4. H. H. Scott Model 222 Stereo Amplifier.

On high-level inputs, a signal-to-noise ratio of about 72 db was measured, based on an input of 0.5 volt at 1000 cps, sufficient to drive the amplifier to rated power. Noise was measured with the input shorted. The manufacturer specifies a ratio of 80 db; 72 db is still very good. Excellent results were obtained on the magnetic inputs, based on signals sufficient to drive the unit to rated power. On RIAA phono position, about 7 mv input was required for full power output at 1000 cps, and the signal-to-noise ratio measured 63 db. Inasmuch as most magnetic cartridges will deliver substantially more than 7 mv. on signal peaks, a signal-to-noise ratio better than 63 db can be expected. This is, however, very good. On NAB tape position, the signal-to-noise ratio again measured 63 db. An input signal of about 8 mv was required to drive the amplifier to rated power at 1000 cps. Since the maximum signal delivered by a tape head at this frequency is much more likely to be around 4 mv than 8 mv, the indicated signal-to-noise ratio for tape heads is in the vicinity of 57 db, which is still excellent.

The master gain control provides quite good tracking between channels. During the first 40 db of gain reduction, the tracking error of Channel B relative to Channel A was ±2.5 db in the unit tested. Tracking error rose to 3.5 db at 45 db gain reduction and 5 db at 50 db reduction.

Ideally, a rumble filter removes the extremely low frequencies without affecting the moderately low ones. The rumble filter in the 299 does fairly well along these lines. With the filter on, response at 100 cps was reduced only 2 db, while response measured 5.5 db down at 50 cps and 9 db down at 20 cps.

The scratch filter is specified as having a cutoff frequency of 5000 cps, and measurements bore this out. Response was down 3.5 db at 5000 cps, 7.5 db at 10,000 cps, and 10 db at 15,000 cps with the filter on.

The loudness switch introduces almost as much treble boost as bass boost when level is reduced. At 30 db gain reduction, bass boost reached 9 db at 50 cps and treble boost reached 8.5 db at 10,000 cps. Further reduction in gain brought no additional boost in bass or treble.

Phono and tape equalization proved to be very accurate. At the high end, both were within 1 db of the RIAA and NAB curves respectively. RIAA bass boost was only 0.5 db below the RIAA curve at 50 cps, while tape bass boost was only 1.5 db below the NAB curve at 50 cps. There are still many amplifiers that depart substantially from the NAB curve despite their manufacturers' claims. It is a pleasure to be able to report on an amplifier, the 299, that conforms accurately to standard tape equalization and at the same time is able to maintain an excellent signal-to-noise ratio, not at all easy to do when full NAB bass boost is provided.

Operating Manual

The complexity of stereo compared with mono equipment has heightened the importance of the operating manual in assuring proper installation and operation of equipment. The Scott manual supplies full, clear instructions and a number of helpful diagrams showing how to connect the various input sources to the 299, how to connect the speakers, how to use the 299 as an electronic crossover, how to place the speakers relative to the listener, and how to connect to the center channel output jack. Also included are a schematic and instructions for making the bias, d.c. balance, and a.c. balance adjustments. —*H. B.*

H. H. SCOTT 222 STEREO AMPLIFIER

The 222 is a slightly smaller brother to the 299, with the similarities greater than the dissimilarities. The 222 is rated at 12 watts per channel instead of 17 watts, otherwise has virtually the same performance specifications at the 299, and retains most of the latter's features.

The 222 has one magnetic input and two high-level inputs, whereas the 299 has an additional magnetic input, with a choice between High- and Low-level jacks. The 222 lacks a rumble filter and a phase reversing switch, does not have the three panel lamps to indicate mode of operation, and does not provide European 78 phono equalization.

However, it is like the 299 in having a ganged gain control, volume-loudness switch, stereo balance control, separate bass and treble controls on each channel, a stereo selector switch providing the same seven modes of operation as the 299, a scratch filter, and a center-channel output.

Circuitry is largely the same, the principal difference being the use of 6BQ5's instead of 7189's in the output stage. Self-bias is employed. The same kind of phase inverter is used, along with an a.c. balancing control. No means are provided for adjusting bias and d.c. balance in the output stage.

The operating manual for the 222 provides not only instructions and diagrams similar to those for the 299 but also has the following useful diagrams:

1. Showing the audiofan how to construct external switching facilities to increase the number of low-level inputs.
2. Showing him how to construct external switching facilities for tape recorders that do not disconnect the output cable from the tape amplifier in the record mode.
3. Showing him how to construct a phase reversing switch. **L-31**

KOSS SP-3 STEREOPHONES

Designed by the manufacturer as a means for listening to two-channel or stereo programs binaurally, the Koss SP-3 Stereophones can be used for monitoring stereo recordings to considerably greater benefit. Many stereo recordings are microphoned so they sound satisfactory when reproduced binaurally, and for those instances where it is necessary or desirable

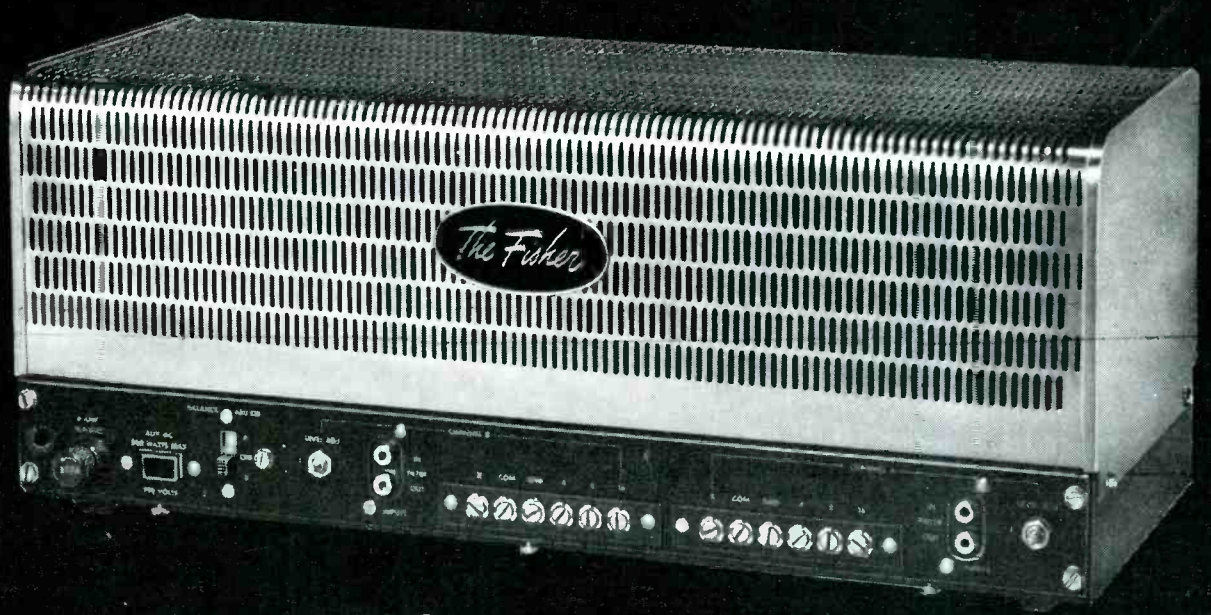
Fig. 5. Koss SP-3 Stereophones.

to listen without disturbing others the phones are extremely convenient. But the real advantage of them is as a means of monitoring stereo recordings as they are being made, particularly from microphones.

The Stereophones consist of two headphone units connected to a three-wire cable and plug. Each "phone" is actually a 3-inch dynamic speaker, and excellent low-frequency reproduction results from the close coupling between the diaphragm and ear. Similarly, the small cones are capable of response up to about 15,000 cps. Impedance of each unit is 4 ohms, and with recorders having two power amplifiers a

"The Aristocrat of stereo power amplifiers!"

— HI FI REVIEW



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■ **In their October 1959** stereo amplifier report, the editors of *HiFi Review* said the following of the FISHER SA-300: "This is undoubtedly the most 'sophisticated' stereo power amplifier available to the public at this writing. The advertised claims of low hum and noise levels appear to be readily available in production models now on your dealers' shelves. This is certainly the *quietest* amplifier likely to be found outside of a professional recording studio. The built-in 'controlled-frequency-response-filter' is a quantum jump in thoughtful engineering design. It was especially developed to permit this amplifier to operate with electrostatic speakers, and may also prove immensely valuable where subsonic woofer and supersonic tweeter problems are to be encountered. All in all, the SA-300 is the Aristocrat of stereo power amplifiers, and is a wise investment for superlative stereophonic hi-fi."

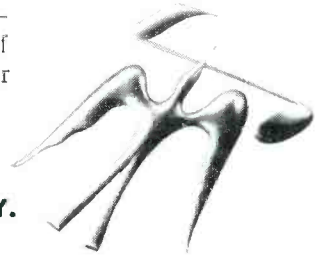

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Fig. 6. Fisher Model X-101A stereo amplifier—20 watts on each channel.

3-conductor jack can be mounted in a convenient location, with connections made to the two output transformer secondaries. For recorders with higher output impedances, adapters are available to match either 600 or 10,000 ohms.

The Stereophones are light and the individual units are well padded for comfort in wearing, even for long periods. L-32

FISHER X-101A STEREO AMPLIFIER

Combining two 20-watt power amplifiers and a complete stereo preamplifier-control unit into one cabinet always results in an interesting unit, and in these days of miniaturization—to whatever extent is possible—it shows a certain amount of ingenuity on the part of the manufacturer. Not that it is unusual for a complete system to be so compressed, but in many instances it is accompanied with such cost- and space-cutting gimmicks that the performance may suffer as a result. This is not the case with the Fisher X-101A, however, for its performance is high up on the scale.

Each channel has six inputs—two for phono, two for auxiliary devices, and one each for tuner and tape head—making twelve in all. Two recorder output jacks are provided, and a recorder-monitor jack is furnished on Channel A for use with monophonic tape recorders equipped with feed-through circuitry. These connections are ahead of both volume-loudness and tone controls. Output impedances of 4, 8, and 16 ohms are provided on both channels for loudspeakers. There are two level-set controls on each channel—one in the AUX 1 circuit, and one following the preamplifier section to control phono and tape-head inputs. The normal operating controls are: input selector, mode selector, balance, volume-loudness combined with the a.c. power switch, dual bass and treble tone controls, rumble switch, and loudness contour switch.

The input-selector switch has four positions for magnetic phono cartridges—two for monophonic and two for stereo use. The first two provide equalization for 78 and LP curves, and connect to the PHONO 1 jack of Channel A; the remaining two connect to either PHONO 1 or PHONO 2 jacks of both channels for stereo use, and provide RIAA equalization. The mode selector connects the output amplifiers to either Channel A or Channel B for mono inputs, and to both channels for stereo and reverse-stereo positions, making it possible to play mono records through both output channels when desired. The tape-head input position sets up the correct equalization for 7½-ips tapes, while tuner and auxiliary inputs are fed directly to the tone-control amplifier tube sections. The AUX 2 position has a high input impedance for use with ceramic cartridges if desired.

The tube line-up in each channel is as follows: 12AX7 (or 7025 or ECC83) as preamp, with feedback equalization; 12AX7 as tone-control amplifier; 12AX7 as booster amplifier and phase splitter; and two EL84's (7189 or 6BQ5) as pentodes in the output stage. Plate power is furnished by a GZ34 (5AR4), with the plate current of the four output tubes serving as heater current for the two preamp tubes—with the double benefit of d.c. on the preamp heaters and reduction of heating by the elimination of cathode resistors for the output stages. Physically, the unit is 15½ in. wide, 13 in. deep, and 4 13/16 in. high in chassis form. Ventilated wood cabinets are available.

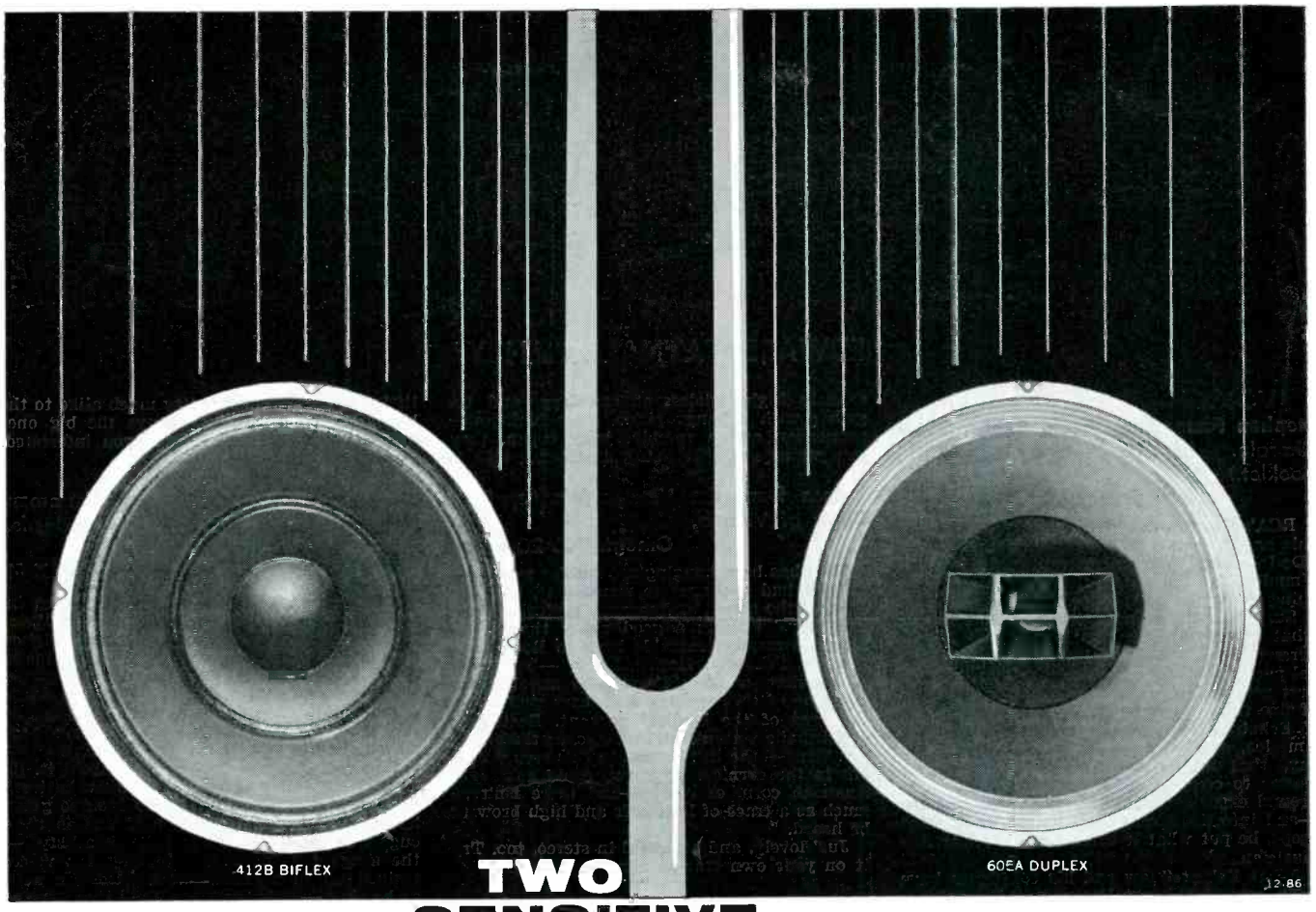
Performance

Specifications for the X-101A call for an output of 20 watts per channel at a rated harmonic distortion of 0.7 per cent and an IM distortion of 2 per cent, with the usual 20–20,000 cps flat frequency response. Measurements indicated an output of 21 watts on one channel and 23 on the other at 1 per cent harmonic distortion. Intermodulation measurements were in accordance with specifications. Since the phase-splitter circuit of each channel is provided with a means of adjusting the drive to the output tube grids, any minor differences in the amplification of the output tubes can be compensated readily. The type of phase splitter is that commonly known as the cathodyne or split-load circuit, and it is inherently balanced if the plate and cathode resistors are of exactly equal values. Actually there is some unbalance because of the capacitance between heater and cathode, but this affects only the frequency range from about 8000 cps up, and has very little effect on listening quality. However, even though the phase splitter is perfectly balanced, there may be a difference between the amplification provided by the two output tubes, and this can not be balanced out (in any practical circuit) in the output stage itself, so users must resort to tube matching to obtain exact balance between tubes in the output stage. The use of a variable cathode resistor in the phase splitter results in feeding different values of signal to the two output tube grids—that is, signals that are not perfectly equal in amplitude though they are exactly opposite in phase. But such an intentional change in the drive to the output stage can result in extremely low over-all distortion, and in an amplifier using comparatively small tubes, it is important that every step be taken to keep distortion to a minimum. Checking the amplifier under test, we found that a variation of the control (chassis mounted) from the optimum position to one extreme changed the IM distortion from the rated 2 per cent to as high as 8 per cent. The phase splitter circuit, which employs one half of a 12AX7, has a plate load of 100 k ohms and a cathode load consisting of an 82 k fixed resistor and a variable resistor of 50 k ohms. The grid resistors of the output stages are 470 k ohms. The circuit has the advantage of being inexpensive, yet capable of balancing the amplifier to a minimum of distortion.

Maximum variation of the volume-loudness control between channels was noted at 3 db, and the tone controls were observed as tracking within 5 db throughout the entire range. RIAA equalization for phono was within 1 db throughout the range.

Considering the relative simplicity of the X-101A, together with the flexibility of control operation, the over-all design must be credited with following a system philosophy which is in keeping with the requirements of a satisfactory—in our opinion—amplifier. Among the things we believe to be necessary in any control amplifier are: a loudness control, separate tone controls for each channel, and means for paralleling the output sections to either input section. The Fisher X-101A has all these.

Quality of construction on the unit tested was up to usual Fisher standards. While the flexibility of the unit is not as great as with the Model 400, which is a preamp-control unit only, it could hardly be expected. We would still like to see a phase-reversing switch in the speaker circuit, and we believe some provision should be made to change the tape-head equalization as needed for the common tape speeds—3¾ and 7½. The X-101A is still a fine unit, however, and it is not likely that the individual who buys Fisher equipment would be satisfied with 3¾-ips tape anyhow, so that is not too much of a problem. As to the phasing switch, it could be mounted elsewhere in the system—even on one of the speakers. L-33



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Record Review

EDWARD TATNALL CANBY*

VOICES

Stephen Foster Song Book. Robert Shaw Chorale. (Includes "Play-It-Yourself" booklet.)

RCA Victor LSC 2295 stereo

RCA's heady extravaganzas continue and this one turns out to be a beauty, though the "Do-It-Yourself" aspect is pretty feeble as a gimmick. It's the record that counts and anything extra you have to pay is well worth it.

Sure, everybody knows Stephen Foster. But what comes through clearly in these Foster arrangements is Foster's by-now almost classical purity of melody. The man was certainly a first rate musician and a marvelous composer of fine tunes, perhaps in the Schubert class—if Schubert had been born in 19th century America, or Foster in Vienna. It is clear, I'd say, that an accident of circumstance led Foster to compose only that which his background experience and training made possible—and into these songs, so limited in outward scope, he put what it takes to be a really fine musician.

What Robert Shaw and his colleagues have done here is to treat Foster melodies with a classic restraint, relying on the simplest of harmonies in line with those that Foster would himself have understood, avoiding the modern tendency to dress up the straightforward tunes with fancy barber shop or jazzy (ragtime) coloration. I don't mean that these Shaw settings are dry—they're as schmaltzy as you could wish and some of them get pretty complicated, too. But the sentiment is strictly in line with the style of the melody—diatonic (scale-wise) harmonies for diatonic tunes; the somewhat highbrow sound of the whole actually serves to bring out the simple beauty of the Foster songs on their own—where more zippy arrangements merely make them sound old-fashioned.

Most of this is choral singing, with assorted solo voices intermingled; parts are male-voice, as seems appropriate; the faster items—"Doodah!" and the like—are touched up with a bit of banjo, just enough to keep things in perspective. Words are words and Foster is Foster; if you don't like my description, try the record and judge for yourself. You'll be bound to enjoy it unless you're a musical aristocrat or something.

As for the Gimmick, a pretty booklet with arrangements of the same songs (for piano and voice) by Skitch Henderson, it's good looking, decorative, but otherwise very poor-second-best Foster. The sketchy arrangements (no pun intended) altogether lack the style of the recorded settings and, silly idea, only the first verse of each song is printed! How'n heck are you to do it yourself if you don't have the other verses?

Gospel Songs. The Grace Gospel Singers, piano organ, tambourin, traps.

Rondo-lette SA 115 stereo

Not so bad. The seven young negro girls (I'm looking at their picture) have collective pretentions to higher things—they've had Training, or some of them have, and they look like a good bet for TV or Broadway or something; but Mother Nature and good old Religion win out here: though there are some fancy high notes, some styled-up endings, mostly the girls just can't help lettin' go. And what a sound! Mostly, their voices are extremely high, adolescent sounding, and together with a bangy piano, some high-power percussion and a rumbly, juicy organ, they can get superb effects. Try last band, side 1.

Voices from the Vienna Woods. Boys Choir of Vienna.

Omega OSL 28 stereo

This has been hanging around for months—haven't had a chance to mention it, but I've enjoyed the sweet, sentimental, typically Viennese boys' singing a good many times. The music is mostly traceable back to Beethoven, Strauss, Schubert, Haydn, Mozart—but never forget that in Austria you need merely mention one of these gentry and tears well up in the eyes of the lowliest peasant. Beethoven and Schubert aren't highbrow, over there, you see. Thus— the Big Names on this record ooze out in the corniest style you could ask for—Austrian corn, of course—and there isn't so much as a trace of long hair and high brow to be heard.

Jus' lovely, and beautiful in stereo, too. Try it on your own tear glands.

Gilbert and Sullivan: The Pirates of Penzance. D'Oyly Carte Opera Co. New Symphony Orch, Godfrey.

London OSA 1202 (2) stereo

Here's another continuing series and I note this recording as one of many—probably all of the G & S operas, sooner or later. Note, too, that there is a parallel series from England being issued on Angel, by the Glyndebourne Opera company; take my respectful word for it that London's original D'Oyly Carte group is far, far ahead in the game, as it has been for so long. They have the tradition, the style, the attitude, the type of voice, that makes G & S living satire rather than half-dead Victorianism. Nobody else has it quite so good.

This one is particularly nice in stereo, what with the various "outdoor" scenes where pirates, policemen and assorted ladies are prowling around hunting each other. Wonderful effects. I liked particularly the monologue "asides" of the male chorus, in the midst of all this. Very imaginative use of the stereo recording medium—English Decca (London) has a good edge on everybody else in this respect, I'd say. (Or had when this album was made.) Keep your eye peeled and your purse propped open for any and all future D'Oyly Carte stereo.

Voices of African Birds. Recorded and Narrated by Myles E. W. North.

Cornell Univ. Records

(124 Roberts Pl., Ithaca, N. Y.)

This adds a new slant to the notable Cornell series of bird song records; the birds are from a strange continent, to begin with, and the narrator is no longer the familiar, slow-paced Dr. A. A. Allen, whose dry, sentimental bits of wisdom and fact have given continuity to most of the earlier Cornell offerings. He starts this one off, but bows out in favor of the man from Africa, who sounds just like his name. Very British, with a strange outlander touch.

Once you get used to the Senior District Commissioner's voice—he is Commissioner for all of Kenya—and his somewhat discursive background accounts, you'll find the bird sounds fascinating. Even an ordinary tyro like me can tell in a moment that these are no yankee bird calls. As always, a lot of the little birds will sound pretty much alike to the beginner, but there are always the big ones and the odd-ball fowl to keep you interested. Good stuff and unique.

Moussorgsky Mélodies—enregistrement intégrale. Boris Christoff, assorted pfs., orch.

Angel 3575 D/LX (4)

For lovers of Russian music this is an interesting specialty. As indicated by the album title, it comes from France, where a good many of the recordings evidently were made. These are all the loose Moussorgsky songs, including a few with orchestra—they constitute a pretty big dose for one-time listening and so you will want this album as a long-range pleasure, to be absorbed a bit at a time.

Christoff is good—no two ways about it. He has the right sort of big, mobile basso-baritone voice to put Russian style into Moussorgsky; he knows the tradition to a T and is thoroughly at home in a medium that is all style—the songs are impossible to sing for voices trained up in a different tradition. He acts, as he sings—he bellows, grunts, heaves, sighs, groans—and this is utterly right. He hits perfectly that garish, deep-Romantic nightmare quality that is the most dramatic aspect of late-19th century Russian music and in particular of Moussorgsky himself.

Best of all, Christoff has an excellent ear and grasps every nuance of Moussorgsky's often tricky harmony and tortured melody. Because of this, he is able to project the grunts and the groans, the half-spoken passages, without ever losing the thread of musical line. Lesser singers make hash of it all too often.

One oddity—the famous series of Nursery songs, sung in the first person by a little boy mostly to his nurse, are done by Christoff entirely in a thin, nasal semi-falsetto. Sounds a bit silly at first, but very possibly this is the proper Russian tradition, at least for a male voice. I found it a bit hard to take and, personally, I find Jennie Tourel's soprano-voice approach more effective as music. But what is a huge basso to do when he's supposed to act the part of a five-year-old? Mighty precocious little lad it would be, who could sing in Christoff's natural basso!

Purcell: Welcome to all the Pleasures (Ode on St. Cecilia's Day, 1683). Blow: Ode of the Death of Henry Purcell (1695). Alfred Deller, John Whitworth, April Cantelo et al., Kalmar Orch. of London.

Vanguard BGS 3015 stereo

There is probably no music more immediately strange to the average modern ear than that of Purcell, out of the 17th century; and no type of voice is more startling, too, than the male alto or countertenor—of which there are two in this recording. But Purcell doesn't take long to get through to most of us—he was one of the world's true top musical geniuses—and the countertenor soon loses his oddity and becomes another musical instrument, particularly effective in music such as this where he was originally the proper performer. Purcell himself was a countertenor.

It strikes me that this is Alfred Deller's finest countertenor singing to date, in Vanguard's long series of Deller recordings. His voice in both of these works is stronger, steadier, better controlled than I remember

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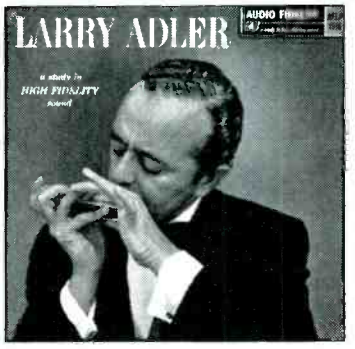

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LEON BERRY, Vol. II includes "Syncopated Clock", "No Other Love", "Boulevard of Broken Dreams". **AFLP 1829/AFSD 5829**

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him in the past; there are fewer yawps, less semi-femininity, more of the human-oboe quality that is so superbly effective in the music. He is particularly good, balanced by Mr. Whitworth's similar but slightly lower countertenor voice, in the Blow piece.

There never was a more exquisite exact musical ear than Deller's, there is no living voice, to my knowledge, more perfectly suited to the strange, sensuous, highly ornamented Purcell melody than his.

The "St. Cecilia" Ode is an early one, not the more familiar Ode recorded elsewhere. (Vang. B6559) It is on a modest scale, has gorgeous moments including the inevitable long aria on a ground bass, a passacaglia if you wish—this one strongly suggesting the great lament in "Dido and Aeneas" that was the first of Purcell's works to become world-famous in modern times. Blow's music in memory of Purcell, who died young, is much less colorful in melody and harmony but sticks to the same general stype of expression, entirely "pre-Handelian", still very much the pure English music that developed out of the French Lully and the Italian Monteverdi.

If Blow seems at first less exciting, less colorful, we must take account of two reasons. First, he was a less-great composer, though an excellent one. (An older man than Purcell, he outlived him by many years, as Haydn did Mozart, influenced and was influenced in turn, as was Haydn.) Second, we have to keep in mind that Blow wrote his Ode in the period just before Handel, when Purcell's (and Monteverdi's) earlier, more colorful experiments in harmony and melody were already considered out of style, crude, undesirable. Blow wrote more neutral music—for our ears; but for his own time, it was modern, tasteful and more "advanced" than Purcell's.

You can't blame the man. And you can reflect that the same thing happened to Shakespeare's style in the same period and on into the 18th century. He was considered uncouth and crude; his stories were often re-written in what seems to us a far more monotonous and colorless style—but which to the 18th century represented modern progress and sophistication.

The Blow, by the way, is composed for two altos (countertenors) and two recorders, a combination that is ruthless in the extreme in generating natural intermodulation tones. The two voices produce violent beats; the recorders generate even stronger ones. Vanguard's recording is good but my pickup had a bit of trouble here and there, coping with these extraordinarily tough wave fronts. It's hard to tell in such situations whether the more audible *bzzzzz* sounds are electrical difference-tones or part of the acoustical original. Interesting.

Zen & Senryu. Alan Watts, Sumire Hasegawa Jacobs. Music by Vincent Delgado.
MEA LP 1002
(Musical Engineering Associates Box 403, Sausalito, Calif.)

They throw things like this out at you and you're supposed to know what it's all about. If you don't (and how many record reviewers do?) then more fool you. Nevertheless, I found the exploration of this cryptic (for me) disc quite interesting—I was able to tie it to some extent into what I'd vaguely heard as to the goings-on among the advanced young people these days, beatniks and all.

What do you hear? No explanation of anything, of course, neither on the disc nor on the jacket, which merely gives sources for what is spoken. A jangle of oriental strings; then an American male voice with a slightly British accent reads a poem. Not a long poem—merely a few words. Jangle again, followed by a high, intense screetch of foreign language. This should be, we suppose, the lady named Sumire Hasegawa Jacobs, who clearly must have married outside the family. Her presentation is interesting but quite obviously unintelligible if you don't know the language which, I'll hazard a guess, is just possibly Japanese. (I honestly would not know from first hand experience, though to be sure I have heard a reasonable amount of Japanese for an oldster antidating the present U.S.-Japanese cultural rapproachement.) The lady finishes in a breath . . . pause—then another male-voice poem in English, more jangles, more of the Japanese(?) original. So it goes for a whole LP side, and subjects range over the eternals, such as clouds in a blue sky and what-not.

Side 2 (Senru) is outwardly the same, but the English poems—if they are poems—consist of half-sentences, mostly beginning with a present participle, left dangling. To paraphrase, I could fabricate one of these myself: *"Sitting in a chair, the clouds parted."* No, the clouds didn't sit in the chair: you are left with a feeling that maybe the poet sat in the chair and . . . well, anyhow, that's the way it goes, and the side 2 subject matter has a distinctly modern ring to it as well as a satirical and even rather crude touch, in a high-brow sort of way. Things are mentioned that are not always considered proper in conventional Western society, though maybe in this new world they are felt differently.

What is all this gibberish about—nine included? Heaven knows—but Mr. Watts is a well known leader of the new East-West thinking, and a great many intelligent Americans are dabbling in Zen quite seriously these days—it is a form of Buddhist thinking not in my mind clearly either philosophy, religion, or aesthetics but a sort of elemental blend of all of them.

Don't by-pass matters like this too quickly. The presentation, like most new-fangled movements, is self-conscious and almost deliberately arty, or cliquey. But the new movement, like the beat movement in general, may well be groping towards a very genuine need in our hard-boiled, Madison Avenue culture. A need for all of us, even engineers, though maybe *you* aren't yet quite as positively aware of it as Mr. Watts is.

If you enjoy barging into new things, so to speak, bindside formost, just for the heck of it, you'll maybe want to try this disc. There's an earlier one that might be more helpful called "Haiku" (MEA LP 1001) that they didn't bother to send me; it "explains the relation of Zen Buddhism to Japanese poetry"—Alan Watts does, I should say.

Maybe he also explains the relation of Alan Watts to Zen and, incidentally, to Sumire Hasegawa Jacobs. The Director of these recordings, in this connection, is named Henry Jacobs. Might be a clue.

Handel: Judas Maccabeus. Utah Symphony, Univ. of Utah Chorus, soloists, Abravanel.
Westminster WST 301 (3) stereo

This is another in the current Utah series of Handel works, following upon last year's "Israel in Egypt." The two are so different that a direct comparison is perhaps beside the point; I can only say that I enjoyed this recording more than "Israel" and think that it is generally a better job, perhaps simply because it is more suited to the particular aggregation of performers on hand. The microphone treatment is definitely better in some respects—notably the placement of the solo singers, who in "Israel" practically breathed down your neck, incongruously. Here they are mostly at a distance and in modest volume, more nearly in musical balance with the rest of the ensemble. (But the harpsichord continuo is now unnaturally close for such a situation.)

This University chorus is indefatigably enthusiastic and its singers' interest in the music is quickly passed on to us as listeners. The group is a fine "instrument" and only a more disciplined sense for good phrasing and rhythm is missing, the conductor's fault. The solos improve upon the standard oratorio style, singing with the expected big solo voices but with more animation and better musical and text sense than is common in American productions of this sort.

Indeed, this recording is a rather nice illustration of the impact upon the old-line, massive, heavyweight oratorio performance now being made by "authenticity"—the big fuss over the return to the "original" ways of doing things. We still have here a huge chorus and a big orchestra, plus "big" soloists of characteristic modern voice-types. But we also have a harpsichord-and-cello continuo accompaniment, restored to life according to the original Eighteenth Century practice (and over-amplified in the recordings, as above mentioned); we have simpler orchestration, much nearer to the original sounds than the flossied-up and thickened symphonic versions so widely used in past oratorio production.

All in all, though this is a "conventional" big-scale Handel effort and will not particularly please the musicologists, it does decidedly benefit from these new-fangled restorations of old practice, and you will find the music quite remarkably accessible in the listening. A booklet with comment, story, and words is helpful.

Bach: Arias for Voices and Instruments. Bach Aria Group, Wm. Scheide.
Decca DL 79405 stereo

This is a good record, if slightly zany. If you can imagine old Herr Bach dressed up with a French beret on top of his long wig, maybe an operatic jerkin or something 'round about his middle and a faded pair of blue jeans on the lower extremities, you'll have an idea of the utter mixture of performance styles that are combined by these well known concert soloists, joined for "chamber music" in concert form!

They all sing and play effectively, but they might as well be speaking different musical languages. It isn't a matter of "wrong" style—this is simply a jumble of utterly unrelated styles, all bunched happily together; and apparently the performers don't have the faintest idea that blue jeans don't go with . . . well, that, say, high-Italian opera singing isn't suited to a contemplative Bach aria, nor is Schubert-like piano playing, however beautiful, a proper accompaniment for the same.

This is typical American, alas. When will we ever develop a *performing* sense of style? When will our artists get away from the idea that each and every one of them can perform *anything*, in any style, nationality or period?

It all comes from the typical diverse American musical training and heritage, without any clear "classical" style and tradition of its own, mixed and borrowed from every part of that European world of music that is ours as well as Europe's. Our big musicians simply go their own way as a matter of course, feeling no stylistic pain at all.

Yes—many an "authentic" performance is musically dull and pedantic; this recording is anything but dull and generally it is very musical. But *some* day, we'll learn to pick and choose our artistic ensembles for over-all stylistic blend and aptitude, the way we pick our business and engineering and scientific committees in line with the purpose in view.

You'll hear big names all right, here—Eileen Farrell, Jan Peerce, Paul Ulanowsky, Julius Baker and so on. They're all good, and so their Bach is good, too, even if it *is* very unauthentic (and generally wrong, I think) to cradle-snatch any Bach aria out of its proper context, where it belongs as part of a larger work. Lots of pros and lots of cons here, and you can't dodge any of them.

ETCETERA

Prokofieff: Symphony #5; Symphony #7. Paris Conservatory Orch., Martinon.
RCA Victor LSC 2272, LSC 2288, stereo

These two separate but complementary recordings are part of an interesting RCA Victor import series from France, with a French conductor, and I'm all for this variety in basic RCA fare. These are characteristically French performances, all-out, with both the strengths and weaknesses of the breed.

The weaknesses are utterly unimportant, to my ear anyhow—for instance a nasal, slightly out-of-tune tone quality, especially in the winds. Some people will say that this is a student orchestra and you can't expect it to play in tune; I tend to think, from long listening experience, that this is a French quirk of style—it happens too often. The French just don't mind a few "beats" here and there, between two or more instruments playing slightly different pitches. A nice effect, in the proper circumstances, and I agree with them—I like it. I also enjoy that loud, forward woodwind sound that is uniquely French,

(Continued on page 100)

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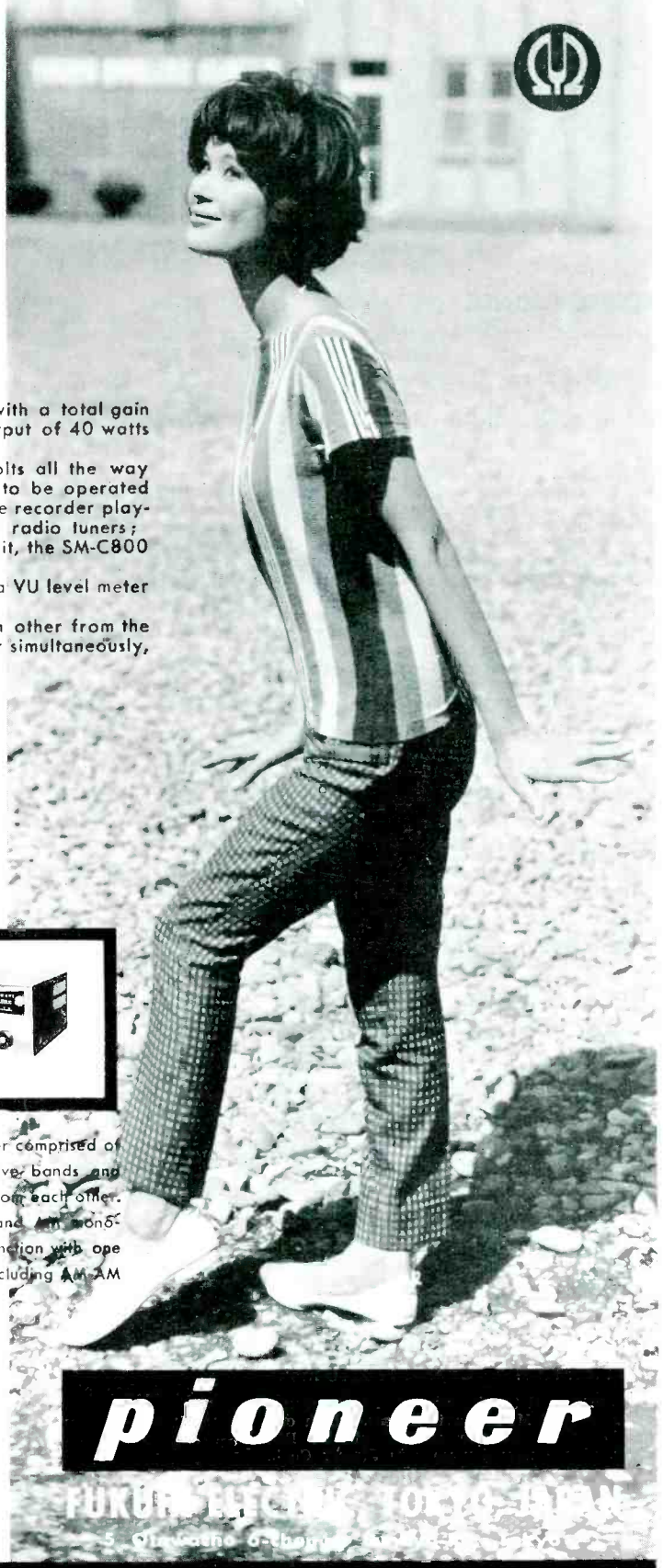

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CHARLES A. ROBERTSON*

STEREOPHONIC

Mahalia Jackson: Great Gettin' Up Morning **Columbia CS8153**

Nat Cole: Every Time I Feel The Spirit **Capitol SW1249**

Victory Baptist Choir: Sunday Meeting **Warner Bros. WS1270**

That the immense vitality of gospel singing and its increasing effect on popular music have become forces able to attract the attention of the larger companies is demonstrated by these recordings. Columbia has furthered the career of Mahalia Jackson in an attractive series, but is presenting her for the first time, amazingly enough, in the company of a gospel choir. Her previous choral support was drafted from more worldly groups and sang from arrangements. It seems likely that her attendance at Joe Bostic's marathon gospel sing at Madison Square Garden, last Spring, resulted in the selection of the lively corps of songsters assembled around her. As with Mildred Falls, her regular pianist, their assigned task is to anticipate the singer's every change of tempo and expression, while she molds an impassioned panegyric. The same kind of group improvisation is common to jazz, but no jazz singer alive can match Miss Jackson's singing of *I Found the Answer*, or *God Put a Rainbow in the Sky*. The guitar playing of Jimmy Raney is exceptional, and the stereo picture is well proportioned.

Nat Cole makes no effort to equal this intensity of feeling, but his voice carries more sincerity and conviction than even he imparts to a ballad. If his ambitions were to soar to greater heights, the arrangements and conducting of Gordon Jenkins would keep him earthbound. The choir of Chicago's First Church of Deliverance, whose pastor the Rev. Ralph Goodpasteur wrote a song on Miss Jackson's program, *To Me It's So Wonderful*, helps out admirably on a dozen older spirituals, giving each an appropriate gospel beat.

The Victory Baptist Choir of Los Angeles was recorded on location and consists of two hundred voices, with stereo allowing ample room for all. A typical church meeting includes a short sermon by the Rev. Arthur Peters, traditional hymns, and recent compositions by Roberta Martin and Virginia Davis. Shepherding each selection to a moving climax is an inspired organist, with elements in his playing that could only come from knowledge of a riverboat calliope.

Miles Davis: Kind Of Blue **Columbia CS8163**

Edith Piaf: Piaf! **Capitol T10210** mono

A continental touch flavors this appearance of a revamped Miles Davis Sextet, which can now boast of the presence of pianist Bill Evans, plus a new drummer in Jimmy Cobb. Whether the increased subtlety and finesse are due to these additions or to the nature of the leader's five originals must be left to the future to determine, for his theme here is the azure plaint of the torch singer rather than the deeper throb of the blues. His trumpet echoes the yearning lament of a Libby Holman on *Freddie Freeloader*, where Wynton Kelly sits in as pianist. After Evans strikes an international note on the liner by comparing this type of improvisation to a mode of Japanese painting, the scene shifts to France and Spain on *All Blues*, and *Flamenco Sketches*. Those patrons of summer festivals who felt slighted because Davis neglected to announce his numbers may take some consolation in the fact that he seems equally diffident toward Columbia. These two titles, at least, are reversed on the label. Upon sorting them out, you will find tenor saxist John Coltrane nobly shouldering the sorrows of a Racquel Meller on one, while Davis extracts the hypnotic instensity of an Edith Piaf from the swirl of a *bal musette* on the other. The members of the rhythm section are well distributed in stereo.

Piaf offers an opportunity to prolong this mood, sending along on Capitol a dozen songs recorded in Paris. Outstanding are *The Crowd*, her last season's bestseller in France, and *Until the End of Time*, one of four numbers selected from the score of the film *Les Amants de Demain*. There is no stereo to divide her ninety-odd pounds, but her voice is powerful enough to extend to the utmost an orchestra conducted by Robert Chauvigny.

Brownie McGhee And Sonny Terry: Pick A Bale Of Cotton **Janus Stereo FST2012**

Brother John Sellers: Big Boat Up The River **Monitor Stereo MPS6002**

Country blues singing and primitive recording techniques kept such steady company at one time that the terms seemed almost synonymous. Of recent years they drifted apart and on these two stereo discs the divorce is complete. There is a simple grandeur to the art of Brownie McGhee and Sonny Terry which the inadequate sound of twenty years ago failed to conceal, and records made when they first met are still prized. Their consistent admirers may easily possess several versions of the dozen songs on the current program. Most of these folk enthusiasts have heard the pair in concert and are aware of how much is lacking on monophonic records. They will be delighted to find the guitar and lead voice of McGhee on one channel, while Terry fills out the other with harmonica and vocal obligattos. Stereo placement duplicates exactly the positions assumed on the stage and the amount of separation is just right for a lifelike performance. Late comers can find no better introduction to the title song, *Crawdad Hole, Raise a Ruckus Tonight*, and *Worried Life Blues*. The titles on the second side are imprinted rather aimlessly on the label and liner.

Brother John Sellers, by comparison a more contemporary singer, begins with the country blues and branches out in several directions. With the backing of an instrumental quintet, he endeavors to relate each number to his experience in a context ranging from spirited handclaps on Huddie Ledbetter's *When I Was a Little Boy*, to the rhythm and blues impetus given *Trouble is a Woman*. Boyhood memories fill the title tune, *Watermelon on the Vine*, and *You Get a Line and I'll Get A Pole*. A former member of a Mahalia Jackson gospel troup, he includes a powerful reading of *City Called Heaven*. His conception of *Strange Fruit*, the ode Billy Holiday made famous, differs considerably from hers in its masculinity, and the theme is amplified on *Chain Gang*, and *Prison Wall Blues*. Mickey Baker, a guitarist who made his reputation in the popular field, is among the accompanying forces of Ernest Hayes, Haywood Henry, Lloyd Trotman and Panama Francis. Any lapses on his part are compensated by his work on *Martha Blues*, where he approaches the agonized outcry of Robert Johnson, who was without peer among blues guitarists. The sound on previous Vanguard and London recordings made Sellers luckier than most of his confreres, and his good fortune continues here under the supervision of Dave Hancock.

Count Basie: One More Time **Roulette SR52024**

Thad Jones: Motor City Scene **United Artists UAS5025**

Among the problems besetting a big band today is the necessity of playing for dancers in a spacious ballroom one week, and then entertaining the more sedate inmates of a hotel supper club the next. Quincy Jones, who is completing plans for a band of his own, shows an awareness of this situation that should stand him in good stead when he heads out on the road as a leader. In filling a commission from Count Basie, he delivers ten compositions which exploit in turn carefully graduated section work or the full voice of the band. If the emphasis is on the polished inflection, remember where Basie is working these days and be happy the bills are being paid. Solos by Frank Wess, flute, and Joe Newman, playing muted trumpet, fit the subdued textures well, and Marshall Royal's alto sax is suitably melting on *The Midnite Sun Never Sets*. The leader's piano encourages a hearty unison shout on *Rat Race*, and *Mutnik*.

Thad Jones, joined mostly by former Detroiters, salutes his native city at the head of a perky sextet. His fellows in the front line, however, are also Basieites usually associated as soloists with the driving side of the band. Given a chance to stretch out on four themes provided by Jones, they demonstrate the finer points of group interplay and an ability to create nuances of their own. Jones alternates between cornet and fluegel horn, while Billy Mitchell solos fluently on tenor sax. Trombonist Al Grey, an interloper from Virginia, shines on both sets, meandering through a toothsome blues for Basie. Tommy Flanagan, Paul Chambers and Elvin Jones comprise the rhythm section, and stereo centers the soloists nicely.

Charles Mingus Jazz Workshop: Jazz Portraits **United Artists UAS5036**

Most of the hazards of recording before a live audience are overcome in this concert by the Charles Mingus Jazz Workshop at the Nonagon Art Gallery, where a series of Jazz Profiles brightened the New York season last winter. Rather than follow the custom of presenting assorted artists, each program focused on a single group, in this instance one whose leader feels his best work is done outside a studio. Taking up the slack caused by the need to find a substitute pianist at the last minute, which has Richard Wyands sitting in for Horace Parlan, may also have placed him on his mettle. Whatever the reason, Mingus has never recorded to greater advantage and his bass playing is nothing short of spectacular. As the sole accompanist for John Handy, alto sax, at the beginning of *I Can't Get Started*, he weaves guitar and bass figures together so expertly that an impression of two instruments being played at once is conveyed. Because of his extreme facility and dramatic use of a strumming effect, at times Mingus seems to be plucking a huge guitar. Besides a full bass tone, he obtains sounds which other musicians can accomplish only through electronic aids.

On *No Private Income Blues*, fervid exchanges between Handy and tenor saxist Booker Ervin build to a shattering climax.

* *732 The Parkway, Mamaroneck, N. Y.*

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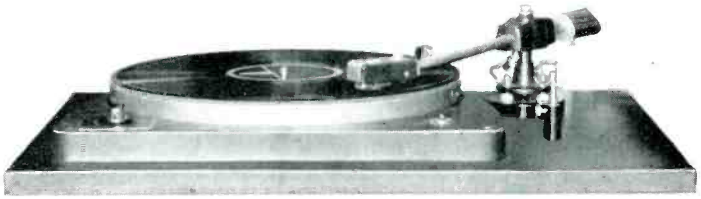

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Not so long ago the mahatmas of hi fi were solemnly preaching anent loudspeaker enclosures that "the bigger the box, the better the sound." Since the advent of stereo, this catch-phrase is no longer heard. The reason, obviously, is purely commercial. The monaural market was able to swallow one big box, but the stereo market couldn't swallow two.

Since necessity is the mother of invention, this situation created a galaxy of new geniuses. Though they had never thought of it before stereo, or even said it couldn't be done, there suddenly appeared a rash of small boxes, even "shelf-size," all with the most astonishing attributes. They were "even better" than their big brothers. Actually, they were nothing more than smaller versions of the same old bass-reflexes and folded-horns with their inevitable boom and distortion.

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Advertisement

Two other compositions by Mingus are the result of his scoring for *Shadows*, a film produced by John Cassavetes. Handy's playing makes his recording debut something of an event, and drummer Dannie Richmond's use of finger cymbals is a treat. The engineering by Rudy Van Gelder has depth and presence, with emphasis on the full scope of the bass flights. The room is adequate for the group and holds an attentive and unintrusive audience.

Duke Ellington: At The Bal Masque
Columbia CS8098
Shorty Rogers: The Wizard Of Oz
RCA Victor LSP1997

These exhibition bouts feature two heavyweight leaders and arrangers trying out their fanciest footwork on some lightweight material. An engagement at the Bal Masque, situated in the Americana Hotel at Miami Beach, prompted Duke Ellington to bring his piano to the fore in interludes styled after Carmen Cavallero. When the rest of the band recovered its equilibrium, the response was in kind—lavish with expression and copius in humor. Clark Terry, trumpet, and tenor saxist Paul Gonzalves huff and puff on *Who's Afraid of the Big Bad Wolf?* to blow it into swinging shape. On *Donkey Serenade*, Quentin Jackson's trombone solo, soulfully shaded with plunger mute, will stop any of the four-legged friends in its tracks. With the piano centered in stereo, the fart comments of the band around it are especially cogent. *Satan Takes a Holiday*, as prodded along by Harry Carney's baritone sax, is a treat for any sound system.

Shorty Rogers likes the score Harold Arlen wrote for the Judy Garland film because of its "cute, merry quality," and designs his settings accordingly. After an Afro-Cuban overture to begin the safari, he shifts the burden between large and small units within the band, creating effects that are well realized in stereo on *Let's Fall in Love*, and *Ding Dong! The Witch is Dead*. Pete Jolly's piano sparkles on *Over the Rainbow*, and the assembled Giants include Barney Kessel, Bud Shank, Larry Bunker, Jimmy Giuffre and Mel Lewis. Five other Arlen songs serve as an encore. Both discs are easy to dance to, and would make excellent presents for recent graduates of rock and roll.

Dave Brubeck: Gone With The Wind
Columbia CS8156

Enjoying a brief respite from concerts, festivals and world tours, the Dave Brubeck Quartet relaxes and wanders footloose through a set of tunes that fit like an old pair of shoes. The leader's tempos are slow and restful on *Georgia On My Mind*, and *Lonesome Road*, while the sound of his piano is deep and full. Joe Morello on drums, with the assistance of bassist Gene Wright, leads the way on two versions of *Camptown Races*, one being wafted along by breezy West Indian rhythms. He takes over completely on *Short'nin' Bread*, compounding a heady mixture from melodic and percussive ingredients. Paul Desmond varies the tone of his alto sax to accommodate either a warm and vital *Basin Street Blues*, or a magnolia-scented *Gone With The Wind*. The intimate stereo miking is attentive to each soloist in turn.

Turk Murphy: At The Roundtable
Roulette SR25076
Rex Stewart And Dickie Wells: Chatter Jazz
RCA Victor LSP2025

The revivalist band of the redoubtable Turk Murphy now carries not only a drummer, but a girl singer whom the leader engages in vocal duets. On her own, Pat Yankee sings *Oh Daddy*, and *Nobody Wants You When You're Down and Out*, in a style reminiscent of the estimable Claire Austin. Two originals make this set noteworthy. *Red Flannel Rag*, written by Murphy, features pianist Pete Clute, while clarinetist Bob Helm contributes *Daybreak Blues*. Thad Wilkerson, the drummer, is reinforced by tuba sorties from Bill Stanley. After doing without a percussionist for so long, the leader's trombone and Bob Short's trumpet sound revitalized on *Chicago Breakdown*, and *Kumaquit*. A studio, rather than the New York bistro where Murphy recently appeared, is the scene of the recording.

Rex Stewart and Dickie Wells collaborate on a dozen of the light, swinging conversations so popular in clubs of this type. With each assigned a channel, the stereo interplay is pretty well described by the leadoff tune, *Little Sir Echo*, although the responses are contradictory on *Gimme a Little Kiss, Will Ya, Huh?* Stewart releases muted statements on cornet, drawing replies from the trombonist that range anywhere from exclamatory disclaimer to soothing assurance. A rhythm section of John Bunch, Leonard Gaskin and Charlie Masterpaolo encourage the spirited funmaking on *Side By Side*, *Together*, and *Show Me the Way to Go Home*.

Jerry Shard: Vibe-Rations
Urania Stereo USD2023
Joe Glover: That Ragtime Sound!
Epic Stereo BN536

A bit of ragtime, swing and a number of stereo ideas are cheerfully combined on these items. Jerry Shard and his trio play in a room off Broadway, now called the Piccadilly Circus Bar, that has featured a smooth, intimate type of swing since Adrian Rollini introduced it there in the 30's. As the Rollini formula is still going strong, Shard adheres to it closely, playing melodious vibes or a tuneful set of chimes. In stereo, they are spotlighted between Bill Suyker's guitar and Dick Romoff's bass, and the arrangements are tightened up to permit a total of fifteen tunes.

Joe Glover, who was pianist with Milt Shaw and his Detroiters back in the 20's, allots four tunes to a big band with two pianos, then assigns a single pianist to quartet or small band on four numbers each. Most effective in stereo is the larger group, with pianists Irv Brodsky and Milt Kraus filling both channels on *Little Rock Getaway*, *Black and White*, and *Down Home Rag*. Most rewarding musically is the septet, with drummer Chauncey Morehouse helping out Charlie Shavers, trumpet, and clarinetist Jimmy Lyrell on *Carolina Shout*, and *Hurricane Rag*.

Franck Pourcel: Viennese Waltzes In Stereo
Capitol ST10214
The Melachrino Strings: Rendezvous In Rome
RCA Victor LSP1955

Continental strings cavort in gay abandon on these albums. Most collections contain the Strauss, Lehar, and Ivanovici waltzes programmed by Frank Pourcel, but doubtless in versions whose origins are Austrian, Hungarian, American, or any country other than France. So what better way to tempt the stereo purchaser, (and this recording will be released in stereo only,) than to offer them in arrangements that are characteristically French? Pourcel complies with saucy Gallic accents, and the fine recording was made in the Pathe-Marconi studios in Paris.

George Melachrino conveys his personal impressions of Rome in four original compositions that include views of the Colosseum, street scenes, train noises, bells of the basilica, and the Vatican. His settings of familiar melodies list a number of stereo effects, none of which interferes with a penchant for lilting strings or the sound of Leon Gossens' oboe. *Volare*, *Three Coins in the Fountain*, and *Arrivederci, Roma* are all designed for dancing.

Harry Belafonte: At Carnegie Hall
RCA Victor LSO6006
The Kingston Trio: At Large
Capitol ST1199

Two benefit performances, held on successive evenings last Spring and taped on the scene, account for the two-record album of a Harry Belafonte concert at Carnegie Hall. The identical programs are combined by taking the best of each, but without intersplicing any selection. Many who are familiar with his studio recording of these folk songs will find them vividly recharged by the electricity which flows between the singer and a live audience. The tempos are slower, climaxes reach a greater intensity, and the awesome

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hush before a number is a greater tribute to his command of an audience than the thunderous applause at the end. Each receives an extended treatment, with the greater part of one side devoted to an uncut *Matilda*. Stereo works its wonders well, not missing a whisper from the singer as he is accompanied by a forty-seven piece orchestra, conducted by Robert Corman, or a small group seated downstage. But when the voices of a chorus on stage, of the members of the orchestra, and the audience are joined together at his behest, some readjustment of the control settings may be desirable.

The Kingston Trio draws from sources best known to folklorists to offer an enlarged repertoire on their current release. The custom of revising material to fit their spirited and witty style is followed, with the usual entertaining result, on a dozen songs. In addition to *M.T.A.*, which hurtled up the hit list faster than the Boston subway, there are *All My Sorrows*, *Good News*, *The Long Black Rifle*, and *Remember The Alamo*. On their first stereo album, they charmed a concert audience with the skill of a Belafonte. The result of controlled studio conditions, their second affords a close and dynamically expressive look at the group's methods of putting varied material together.

Buck Clayton: Songs For Swingers
Columbia CS8123

Two happy results of Stanley Dance's mainstream series, begun on the Felsted label last Spring, are a British concert tour for Buck Clayton and this recording date with the musicians who are making the trip. In preparation, Clayton supplies four originals and arrangements of four standards. The troupe carries an extra trumpet player in Emmett Berry, who employs a full, open tone on this occasion to contrast with the leader's muted embellishments. That this practice works in stereo is a coincidence, but a very pleasant one. It also works on Clayton's two blues themes, where their disparate styles seem to unite in a single lyric expression, so well do they complement each other. In addition to alto sax, Earl Warren plays lucid clarinet, and Buddy Tate is on tenor sax. Trombonist Dickie Wells furnishes the atmospheric effects on *Night Train*. The rhythm could do with a guitar, but perhaps the choice lay between that and the spare trumpet.

MONOPHONIC

Music Of New Orleans: The Birth Of Jazz, Vol. IV
Folkways FA2464

The story of the first recorded scat chorus is too well known to bear repetition, but too often it is retold as though Louis Armstrong originated a new style of singing on the spur of the moment when the lyrics of a song eluded him back in 1925. Musicians have always used the vocal imitation of instruments in practice to clarify written passages, making it second nature for Armstrong to overcome temporary distress with a wordless incantation. Its commercial properties proved magical and encouraged a host of imitators of varying degrees of sensibility. Had they not helped prepare an unsuspecting public, it is doubtful that symphony conductors would put aside their dignity today and allow a microphone to eavesdrop on their warbled instructions to a rehearsing orchestra. Armstrong's antecedents for this form of expression are found in the New Orleans style of ensemble playing, primarily as interpreted by the second line of aspiring musicians who followed the polyphony of the marching bands without benefit of notation. Evidence of how thoroughly it became a part of the language of these youngsters is contained on the fourth volume of the series in which Samuel B. Charters is recapturing much of the city's jazz history.

Louis Keppard is heard reconstructing the sound of a 1910 band as it played *Bucket's Got a Hole In It*, vocalizing all the different parts with rare accuracy and ingenuity. The style harks back to the days when he worked as guitarist with his younger and more famous brother Freddie, whose cornet mannerisms are affectionately duplicated. That a member of a rhythm section should remember so well the tonality and peculiarities of

his companions of nearly half a century ago is astonishing. There is no better proof that this knowledge is basic to the traditional ensemble and a source of its strength. Harrison Barnes exchanges some reminiscenses of Buddy Bolden with cornetist Charlie Love, who leads a quintet on *Maple Leaf Rag*. The balance of the current installment is allotted to H. J. Boisseau, a connoisseur of ragtime who spent his younger days trading tunes with cabaret pianists. Before allowing a melody to flow beneath his fingers, he talks disarmingly about the environment which fostered it, giving vivid impressions of the Irish Channel, Tom Anderson's, and the burlesque queen who inspired *Red Rose Rag*. Some of the material was taped as long as seven years ago, and the sound suffers accordingly.

Mose Allison: Creek Bank **Prestige 7152**

For a young pianist to attain his fourth LP in a period of slightly more than a year is quite an achievement, even in these days of an ample supply of jazz albums. Where Mose Allison is concerned, it is all the more remarkable because much of his work consists of original sketches. Stemming from the country blues heard during a childhood in Mississippi, they are rare and genuine bits of Americana. Four current pieces depict a pastoral scene including the moon over a country lane, a rural picnic, the antics of a mule, and a visit to the swimming hole indicated on the title. He sings on *If You Live*, a more somber vehicle in which conditional promises are made against the drummer's steady backbeat. His characteristic twang is also heard on Willie Mabon's tale of a soothsayer, *The Seventh Son*.

When playing the works of other composers, Allison incorporates modern elements in his style to a greater degree, as on *I Didn't Care*, and *Cabin in the Sky*. Exchanges between Addison Farmer, bass, and Ronnie Free, drums, enliven Parker's *Yardbird Suite*, and Ellington's *Prelude to a Kiss*.

Cannonball Adderley: Jump For Joy **Mercury MG36146**

In arranging the score of Duke Ellington's "Jump For Joy," Bill Russo successfully evades all the convenient jazz categories. Although strings are employed, the presence of Julian Adderley, alto sax, and trumpeter Emmett Berry bars a chamber jazz classification. While the composer revised the 1941 show in 1958, Russo adds enough original ideas of his own to remove it from the strictly Ellington domain. What he does accomplish is the first complete presentation of a work that should have been recorded long ago, and taut, dry writing for strings that fits the soloists and provides considerable interest. A regular rhythm section of Milt Hinton, Bill Evans, Barry Galbraith and Jimmy Cobb contrasts admirably with the four strings, which are joined on percussive figures by Hinton. Berry's muted flights are beautifully framed, and Adderley plays with fluency and the required variety of tone.

Barney Kessel Plays "Carmen" **Contemporary M3563**

In scaling "Carmen" down to LP size, Barney Kessel retains a certain amount of operatic scope by dividing his modern jazz version of the score between two basic groups. One follows the conventional small-band setup, and the other highlights his guitar among five woodwinds and rhythm, while two scenes are played as improvised duets with vibist Vic Feldman. The familiar airs are kept from being submerged for long by assigning vocal lines to Buddy Collette, Ray Linn, Andre Previn, Joe Mondragon, and Shelly Manne, who does everything but roll Carmen's cigarette on his drums. Surely he has lived out West long enough to manage that too. As Bizet's music was considered remarkable at the time for the use of flute and harp, he would probably enjoy hearing his themes transposed for Collette's flute and Kessel's guitar. He would like the recorded sound, at least. Vernon Duke's informative liner notes fail to credit the far-out brain behind the new titles. AE

AUDIO ETC.

(from page 14)

He *won't* ever have reason to if he buys a tape cartridge machine.

So, you see, I think that RCA in its persistent way has its mind and eye on a long-range objective that is uncommonly hard-headed, whether you may like it for yourself or not. The cartridge in these terms is not only a good idea—it is the *only* idea.

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Instant Sound

And thus, onwards to the machine itself, which is generally less important than the big principle of the tape cartridge. RCA's SCP-2 is just one embodiment of the idea; anybody and his brother can see that others are possible and probable.

Let me proceed crabwise and make a physical distinction between the basic RCA Victor tape cartridge chassis, the mechanical tape deck with pushbuttons, heads, motor drive, etc., and the surrounding "package" of amplifiers, controls, furniture, speakers. These latter will vary widely; the deck itself, at least in the RCA lines, looks to be fairly standardized. It is a darned ingenious little package, let me tell you, in spite of a few faults I can find with it. The tape deck lifts right out of this first cartridge machine, as it doubtless will lift out of other models to come; it is self-contained, very economical in space (it could be slightly smaller perhaps, in a pinch, but not much), it is mechanically efficient, quiet, steady, and surprisingly foolproof in ordinary operation. It really works.

Thus, for example, the automatic instantaneous stop at either end of the tape motion is astonishingly simple and completely reliable. Push either the fast forward or fast rewind button and at the end of the tape the stop is instantaneous, on a dime, and never fails. The action depends on a small lever that is moved over by the sudden increase of tape tension and locks things tight, instantly. No slow braking, no electrical contacts, no tape inserts, no relays, and the tape is fastened on its hub by nothing more complex than an ordinary loop.

It works because there isn't any inertial mass to keep things spinning, as in the much heavier tape reel and mounting—just the tiny lightweight center spindle, without side pieces, and the small roll of tape itself. Tricky, and a most ingenious mechanical solution of one of the major inertial problems in the handling of all tape.

There isn't any doubt that this cartridge, in its own way, is mechanically good and very effective in the one major intent of its whole construction—slip-in, no-thread, instant sound. It *is* a pleasure to

slip one recording in, slip it out, put in another, flip sides, each in one easy motion taking a second or so. All you need to do its to try it for a day or so to find that it really is a far cry from threading tape by hand, even in the most ingeniously designed reel-to-reel machine. (A far cry, that is, for people who want this sort of thing, who value it highly. It may mean nothing at all to you, just as the record changer and the "all-groove" needle may be your favorite anathema, and mine.)

I can't make this point too clearly, because it is the basic point of all, the crux of the whole cartridge argument. All other matters are secondary.

To continue with one more virtue, the fool-proof approach is carried even into the ingenious "trip" that keeps you from erasing tape when you don't intend to. It's just a small lever on a spring mount that is situated under the rear flange where the cartridge goes in. Two little holes in the cartridge itself, one for each direction of play, allow the lever to remain undisturbed in normal playing operation. Try to record and a solenoid practically grabs the control out of your hand, won't let it turn, along with the above-mentioned loud squawk. Your recording is protected—though the first time I tried this I almost jumped out of my skin at the loud noise.

To "defeat" this gadget and allow for recording and erase, no more than a piece of freezer tape or anything similar that covers up the holes in the cartridge, will force the lever back and break the protective circuit as the cartridge is inserted. You can fix it separately for each "side." This protection is in line with those useful automatic double-exposure preventers in most modern small cameras (even those have a "defeat," in the better models) and you must admit that RCA is technically one up on anybody else right here. Positive, automatic erase protection, so you can't record even if you go so far as to try to move the recording control.

Incidentally, and as a further point of good thinking, the actual record knob is nicely tied in with this safety feature via the solenoid that will not allow it to be moved. This knob is spring loaded and snaps out of "record" position when the STOP button is pressed.

I had only minor difficulties with the cartridge deck's mechanical operation, mostly not too important. On one of the machines the rewind wouldn't work—a brake that didn't let go. It was OK on the other. Annoying, but superficial.

Another small problem was more important and also more interesting. There's an odd halfway point of resistance as you insert the cartridge into the deck that can fool you, if you aren't paying close attention, into thinking it is seated all the way, when in fact it is not, by a small fraction of an inch. Unfortunately, the machine will operate in this position, with some strange results. One night, at a folk singing party, I got a fine stereo recording that plays backwards but won't play frontwards. Imagine my surprise! (Imagine the fury of a purchaser who ran into this trouble.) The cartridge evidently wasn't quite seated; the heads recorded on

the wrong area of tape, hitting a channel that properly runs in the other direction. That's how I figured it out, anyhow.

RCA would squirm if it heard my backwards stereo, but all that is needed is a bit of finagling that would insure more positive seating, and would prevent the machine from operating until the line-up was exact. It's possible that my halfway point involved warpage of the cartridge itself, which I hear has caused some early troubles now probably cleared up.

Abnormal Operations

I said something about normal operation. As you can now imagine, the tape cartridge is intended for vast quantities of *normal* operation—and very little else, especially such abnormal procedure, involving manual handling of the tape, as editing, or adding and removing tape from the cartridge's insides. Quite right and within the clearly directed philosophy of the cartridge design.

Do I know. I tried, and found out very, very quickly that to do anything at all with the tape itself, once the cartridge is laid open in its two halves, is fiendishly difficult. No reels, just the little plastic hubs that sit loosely in their holes like tiny flanged manhole covers—they slip completely out of place if you look at them, tape and all; and to manipulate them you must somehow manage to hold back the spring brake that keeps tape from unwinding, thereby using up extra fingers. A turn or so by hand, winding or unwinding, and before you know it your tape is off the roll in a spiral snarl that takes hours to untangle. Everything just falls apart; the plastic sheath slithers away, the hubs pop out of their sockets.

When you do try winding on tape, you find that it won't lie evenly, there being no reel flanges, so that the cartridge halves won't fit over the uneven roll, or it scrapes and sticks after reassembly. All in all, I know of no quicker way to get into a sweat than to dicker with this cartridge's insides! I had to; I wanted to play a piece of 4-track tape that I had made on my other recorder, the Tandberg, and so I started by patching it onto the short RCA cartridge demo tape that I had on hand. I never did get to play it that way and only managed to rescue my tape from disaster by using my big Ampex 350 as a template, slipping the cartridge hub over one of its spindles, and reeling very carefully, back onto the conventional plastic reel.

I also wound too much tape into the cartridge. It's hard to judge when to stop; if you put on too much, the rolls bind against each other halfway through the run, and you spend the next hour painfully reversing them inch by inch, until they are free to move. (The trick is that the bigger roll gets bigger faster than the smaller roll gets smaller, as you'll figure out if you can visualize the cartridge. Thus they get closer and closer, until—the fatal jam-up.)

No, the cartridge is not for manual handling. But I do think that in the future somebody could market a simple edit-rewind accessory that would hold the hubs and tape in line, something on the order of those editing gadgets that handle 8 and

16mm movie film. It would be great for those of us who will insist on opening up our cartridges, to tinker with the insides. But please don't ever forget that you aren't *supposed* to be messing around opening up your cartridges, any more than you are supposed to play with the insides of your dial telephone! (Not even for broken tape. You fish out the loose ends and splice the tape *outside* the cartridge.) If the tape doesn't play, you take it to your dealer, just like any other home appliance. And pray.

The SCP-2 "Package"

My final words are going to be somewhat blunt. I am still all for the cartridge itself and its potentialities in sound as well as its physical convenience and reliability. I admire RCA's basic tape deck no end. But this particular embodiment of the cartridge principle, the SCP-2 stereo recorder, seems to me a disappointment and I do not like it. It is disappointingly mediocre in performance and conventional in construction just where, in this crucial situation, it should shine out as a splendid example. It will do RCA's cause no very great good, I think, and is likely to compound the general misunderstanding concerning the cartridge itself by its slightly unspectacular operation. I can say this because it is *my* disappointment, as a proponent of the cartridge system, that is involved here. In basic respects I'm on RCA's side.

Again let me categorize. There are the bugs, first, those assorted minor failures that we usually expect in new production of any model, which often vary from individual machine to machine. And then there are the inherent troubles, faults, weaknesses, that are part of the design, common to all models or apparently so. The two merge, but I can cite clear examples of both that had me discouraged.

Bugs are less important, except when there are too many of them, or they are of the careless sort—like the STOP pushbuuton that just fell off when I pushed it. Unglued. Or, a more serious one, the maladjusted level indicator on my second machine—when it flashed to indicate correct recording level I got a grossly overloaded and very distorted playback signal; when their was no flash at all, the level turned out just right. The first machine was OK in this respect; but it had something wrong in one amplifier circuit which let out horrid squawks, every so often, that stopped only when I gave the machine a good slap on its sides. As mentioned, a rewind didn't work on one of the machines. On the other, the playback was unaccountably muffled on all material, and adjustment of the tone control had nothing to do with it, as far as I could tell. Could have been head alignment—but this machine had just been especially checked out by RCA. By a most unfortunate pure coincidence I had a Columbia Records executive in the house the day I tried out this second example of the SCP-2, with its lifeless high end. He gave one snort and that was that, but he should have heard the first one, which sounded really fine on playback of RCA's recorded tapes. Why such a difference? RCA has had a lot of

time to get this machine's production in hand and stabilized. These things and other small, petty items of the sort aren't the kind you can excuse because of an excess of zeal—a "green" promotor so enthusiastic about his new product he doesn't have time to check it out properly. RCA Victor is hardly that kind of outfit.

The inherent difficulties, characteristic of the whole production, are less easy to pinpoint but still they weigh out cumulatively. Sure, this is an "ordinary" home machine in a field where performance standards haven't always been of the highest. But, for example, why do these amplifiers—of *all* amplifiers, you might think—turn out to be so noisy? At full volume the hiss is positively steamy; there is generally an impression of background disturbance in all the playing through the machine's own power plant that is most unfortunate, right here where it will be assumed by so many listeners to be *inherent in the cartridge system itself*. It isn't, but a lot of folks will jump to conclusions that cannot possibly be to RCA's advantage.

The problem can be summed up, I think, if I suggest that we have here a standard, run-of-the-mill home machine, unimaginatively put together, unnecessarily bulky and clumsy, but probably no worse than, nor better than many others of the general type. This is exactly the trouble—for to incorporate the crucial tape cartridge deck inside such an ordinary package is incredibly unwise, in view of the present hot situation! For once, there should have been a really imaginative, enthusiastically designed, outstanding package built around the cartridge, even if it meant a loss in cash for awhile. Common sense, for goodness' sake! Instead. . . .

Well, I do have one more item to mention specifically, that hit me especially hard—the two-channel recording feature. The best I can say is that it is adequate for superficial home entertainment, on voice-quality. It works, it plays back, it'll give you stereo or binaural effects according to your material and mike technique, more or less. But as I've already suggested, I am enthusiastic about the new possibilities for home use of two-channel recording, and I want more than mediocre sound.

That's just what I got. First, the ceramic mikes, nattily squared off in good looking cases, are strictly inferior in tone quality—I tried them against the ceramics furnished by Tandberg and the difference was astonishing, in favor of Tandberg. The Tandberg cermics are darned near professional in the quality of sound they give. The RCA mikes seemed to me painfully ordinary. Why?

Then the recording itself. I'm no circuit-man and I'll make no technical criticism; I only know that the recorded playback sound, of all types, was uniformly inferior to the input signal, the noise was high, it seemed impossible to get a really healthy level on the tape (comparable to RCA's own, on the excellent recorded commercial cartridges), the sound was generally unconvincing. The quality from the mikes is, for anyone who knows what can be done, just plain weak-kneed. No highs, no presence . . . phooey! A real disappointment.

I followed RCA's suggestion that you may copy off your old half-track tapes onto cartridges, or tape your disc records into cartridges and I found that the resulting playback quality was not remotely comparable to the original. That's a fair test. Even a low-priced home tape recorder should be able to reproduce a disc record from its tape with sound that is pretty nearly equivalent to the input sound heard through the same system. Why not? All I can say is things didn't work out that way here—and I tried two machines. It's really not up to me to say why. I'm just a simulated customer, after all.

Cartridge Disc AB

This whole business is tantalizing because there are such big silver linings to these bleak clouds. Let me say quickly that the playback of the commercial cartridges on my first RCA Victor SCP-2, by-passing the built-in power and feeding the preamps direct into my outside system, was excellent, and absolutely all that could be asked for. I must say again, *the cartridge is inherently good.*

Just to prove it for myself, I did a long AB test on an RCA Victor LP stereo disc versus the very same recording in a tape cartridge—it was the Mendelssohn "Reformation" Symphony with the Boston Symphony under Munch, one of my favorite recent records, I got the two going in sync (after I had slowed down my too-fast changer turntable with a careful finger) and switched back and forth from one to the other.

Let me tell you, the AB was very nearly a draw, with the cartridge sound clearly a bit ahead on over-all impact. The cartridge noise level was a bit lower, or at least smoother and less noticeable, the sound perhaps a shade cleaner than that of the disc, the cartridge bass definitely richer and the dynamic range as good or maybe better. (The bass could have been a matter of equalization, of course, and/or perhaps a slight attenuation of the bottom end on the stereo disc in order to accommodate a long playing time. Has been done.)

Definitely, the cartridge could match the disc on every important count, and perhaps surpass it. My ears won't tell me whether the very high highs were more audible on the disc than on the tape but I know well enough that the ultra-top range is insignificant in musical importance compared to the over-all quality of sound and the presence of clean middle and medium-high highs, to 10,000 cps or so.

You are certainly free to argue that last point to suit your own preferences, and you can judge the cartridge performance, accordingly, from your own angle. Give *me* clean response to 10,000 and you can have the rest, that tiny fraction of a per cent of the whole of the music that is 'way, way up. Naturally, each of us must fit these things into our own listening patterns. I can only pass on my own reactions, and suggest that they do apply to many thousands of other musical listeners as well as myself.)

* * * *

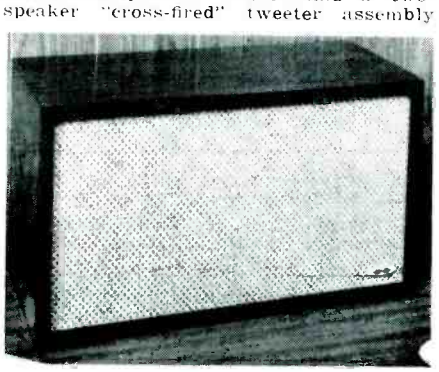
That's it, for the moment. It is clear

(*Continued on page 104*)

NEW PRODUCTS

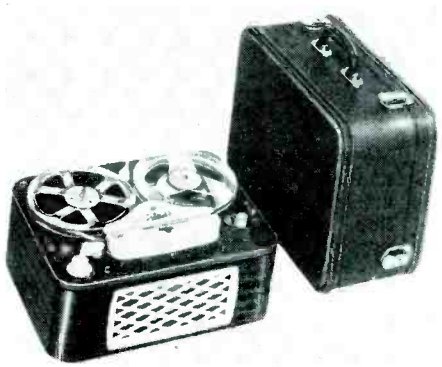
• **Norelco Stereo Recorder.** Engineered and manufactured by Philips of the Netherlands, the Norelco "400" features 4-track stereo and monophonic record and playback for tape economy; three speeds, 7½, 3¾ and 1⅞ ips, for versatility; and simple piano-type keyboard controls for ease of operation. It will also play back conventional 2-track stereo tapes. Housed in a high-fashion carrying case, the "400" consists of tape-drive mechanism, two preamplifiers with controls, two 4-watt power amplifiers, and a Norelco wide-range speaker. Also furnished is a Norelco dynamic stereo (dual elements) microphone. All that is needed for stereo playback is a second speaker. The machine has inputs for recording from microphone(s), tuner and phonograph, with facilities for mixing microphone with either tuner or phono. An output jack for monitoring with stereo headphones is also incorporated in the unit. Because of the special Philips magnetic head with gap of only 0.0001 in., extended high-frequency response is possible even at the lower speeds. Frequency ranges are stated by the manufacturer to be: 50 to 18,000 cps at 7½ ips; 50 to 14,000 cps at 3¾ ips, and 50 to 7000 cps at 1⅞ ips. Signal-to-noise ratio is better than 55 db. Wow and flutter content is under 0.2 per cent at 7½ ips. An automatic stop is actuated by metallized tape end after wind, rewind, record, and playback. This is a remarkably fine recorder for the discerning home recordist. For further information, write: North American Philips Company, Inc., High Fidelity Products Division, 230 Duffy Ave., Hicksville, N.Y. **L-1**

• **Heathkit Acoustic-Suspension Speaker.** As a result of a recent licensing agreement, Heathkit becomes the sole kit licensee of Acoustic Research, Inc., and is now offering the AR acoustic suspension principle in kit-form speaker systems. The first Heathkit to use the system is the AS-2, a kit version of the AR-2. The 10-in. acoustic-suspension woofer and a two-speaker "cross-fired" tweeter assembly provide frequency range of 42 to 14,000 cps within ±5.0 db. Harmonic distortion at 10 watts input is less than 2.0 per cent above 60 cps. The AS-2 is furnished with a completely assembled, pre-finished cabinet and a matching crossover network. Assembly consists only of mounting the speakers, constructing the crossover network, and lining the cabinet with fiber glass which is supplied with the kit. For full details write Heath Company, Benton Harbor, Mich. **L-2**

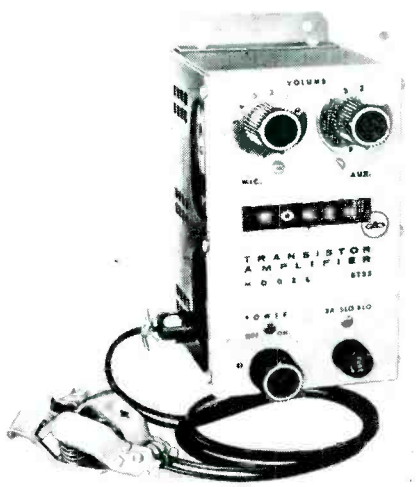


• **Fisher Integrated Tuner/Audio Control Center.** This unit is Fisher's answer to the discerning music lover's demand for maximum operating efficiency and flexibility, with minimum installation and maintenance consideration. The new model 100-T is an ultra-sensitive stereophonic FM-AM tuner and a flexible master audio control center mounted on a single integrated chassis. It is designed for every type of stereo and monophonic operation. All types of record players, tape recorders, and external tuners can be readily connected for the reproduction of any stereo or monophonic program material. It will also accommodate, directly on the chassis, the Fisher MPX-20 FM multiplex adapter. Fourteen front-panel controls and switches, plus five on the rear, afford an unlimited selection of program source and the highest possible degree of control. A center-channel output jack permits the connection of a third amplifier and speaker for a more uniform spread of the stereo sound pattern. The FM and AM sections of the 100-T are wholly independent in operation and can be used individually for monophonic reception or simultaneously for FM-AM stereo. The preamplifier is virtually without noise or distortion. Frequency response is 20 to 20,000 cps within ±1.0 db. Distortion is less than 0.2 per cent at rated output of 5 volts. Hum and noise are held to a minimum by d.c.-powered filaments. The 100-T may be used with any high-quality dual-channel power amplifier, such as the Fisher Model SA-300. Engineered to provide top performance without compromise, this unit will satisfy the most discriminative user. Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N.Y. **L-3**

• **Tandberg Four-Track Recorder.** Developed primarily for educational and industrial users, the new Tandberg four-track monophonic tape recorder affords maximum recording and playing time on quarter-inch tape. The Model 4 which is manually operated, and the Model 4F which is a remote-control machine, will record, play, or erase four separate tracks, each of which is entirely independent of the others. Both models have three operating speeds—1⅞, 3¾ and 7½ ips—with a frequency range at the latter speed of 30 to 16,000 cps within 2.0 db. Channel separation is better than 60 db at 1000 cps. Among features of the recorder is a selective erase switch which permits erasure of any one track without affecting the other three. Tandberg of America, Inc., 8 Third Ave., Pelham, N.Y. **L-4**



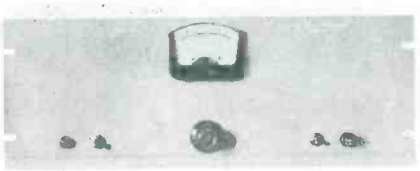
• **Transistorized P.A. Amplifier.** Engineered essentially for mobile operation, the Bogen Model BT25 can be operated from any 5- to 14-volt d.c. source, including 6- or 12-volt automotive electrical systems. It will supply a full 25 watts of output power from a 12-volt battery with a current drain of three amperes. Maximum over-all gain is 103 db. The unit has two separate inputs, one for a microphone and the other for tuner, phono, or tape recorder. Each input is individually controlled, permitting mixing of the two channels. Despite its high power rating, the BT25 is remarkably small and light, measuring but 6⅝ × 3¾ × 4⅜ ins. and weighing only 3 lbs. It will fit in the glove compartment of most cars. The output receptacle on the amplifier is internally wired to match an 8-ohm speaker, but taps are provided on the output transformer for handling impedances ranging from 2 to 16 ohms. This is an ideal unit for fire department or police use, or for any general application where a small high-powered p.a. amplifier is required. Bogen-Presto, P.O. Box 500, Paramus, N.J. **L-5**



• **Transistorized Harmonic Generator.** Intended primarily to simplify and speed up the servicing of transistor radios and other types of transistor circuits, the HG-104 is ideal for trouble-shooting high fidelity components and other audio circuits. The instrument provides audio, i.f., and r.f. signals simultaneously, thus elim-

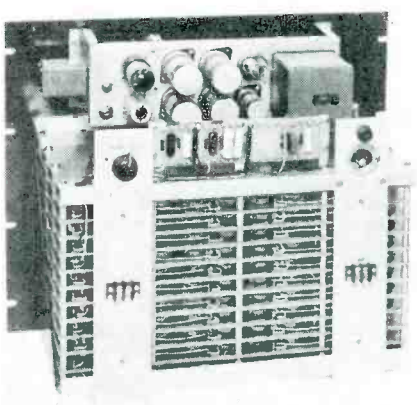
inating set-up time and frequency selection. Use of the HG-104 also eliminates the need for unsoldering transistors for test until the faulty one has been discovered. Sencore, Addison, Ill. **L-6**

• **A.V.C. Amplifier.** Developed for broadcast and public-address application, this amplifier will maintain a constant output within ±1.0 db with input changes as great as 30 db. Exceedingly rapid automatic gain reduction prevents syllable clipping, and slow automatic gain increase avoids automatic control at syllabic frequencies. For broadcast application, the gain control feature automatically keeps modulation at peak levels without exceeding modulation limits and eliminates the element of human error. For p.a. and



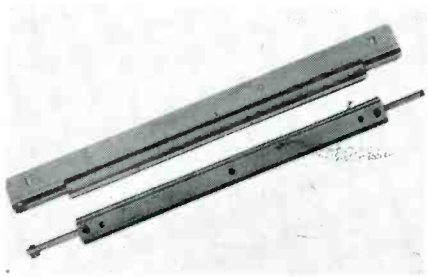
paging system applications, automatic compensation is made within very wide limits (30 db, or 1000 to 1 in signal voltage) to keep the output level constant within 2.0 db. Frequency response is 20 to 20,000 cps within 1.0 db. Over-all gain is 35 to 38 db with a signal-to-noise ratio of 60 db. Rated power output is 6.0 milliwatts at 2.0 per cent total distortion. An adjustable gain-reduction and gain-increase speed control enables variation in attack and release timing. The unit has a self-contained power supply, and is housed in a ventilated and shielded cabinet designed for standard rack-panel mounting. Complete technical specifications may be obtained by writing to Amplifier Corp. of America, 398 Broadway, New York 13, N.Y. **L-7**

• **Audio Delay Line.** This device is now being produced by The Daven Company, Livingston, N.J., for use in the compatible stereo broadcasting system developed by Floyd K. Becker of Bell Telephone Laboratories, and first revealed to the engineering fraternity in an article by Mr. Becker in the May, 1959, issue of AUDIO. At present the system is being used successfully by the National Broadcasting Company. The Daven delay line, Spec. 7251, has the following characteristics: total delay 10



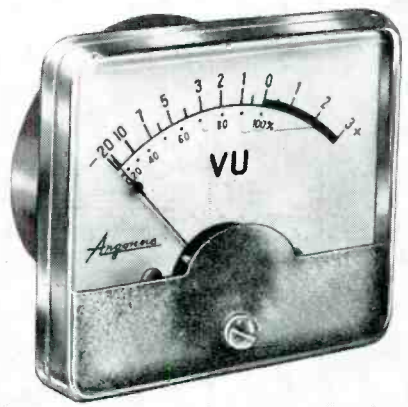
milliseconds; phase linearity ±1.0 per cent, 100 to 10,000 cps, ±3.0 per cent below 100 cps; frequency response ±2.0 db, 30 to 10,000 cps; input impedance 600 ohms at normal level of +4.0 dbm; output impedance 600 ohms; harmonic distortion at +4 dbm less than 1.0 per cent; insertion loss zero; hum and noise level is down 60 db. Requests for further information should be directed to the attention of E. L. Grayson at the address shown above. **L-8**

• **Aluminum Component Slides.** These slides are intended for use with record changers, turntables, amplifiers, tuners,



or similar cabinet-enclosed equipment which must be moved forward for accessibility. Designated CS-1311, the slides have a load capacity of 30 lbs. and maximum extension is 14 ins. Equipment slides smoothly on precision ball bearings. A special silencer spring eliminates vibration and resultant distortion. Robins Industries Corp., 36-27 Prince St., Flushing 54, N.Y. **L-9**

• **Illuminated VU Meter.** Encased in clear plastic, this instrument utilizes a precision jeweled-bearing D'Arsonval movement and provides 2.0-per cent accuracy for full-scale meter deflection. The 3900-ohm "A" scale indicator is calibrated and damped in accordance with standard VU meter practice. The upper scale of the large 3-in. meter reads – 20 to + 3 db, while the lower calibration reads 0–100 per cent modulation, with 0 db corresponding to 100 per cent. Useful frequency range is 20 to 20,000 cps. The meter will reach 99 per cent of steady state reading within 0.3 sec. when a sine wave is suddenly applied. Dimensions are 3½"w x 3-1/16"h x 2¼"d. Argonne Electronics Mfg. Corp., 165-11 South Road, Jamaica 33, N.Y. **L-10**



NEW LITERATURE

• **Semiconductor and Materials Division, Radio Corporation of America,** Somerville, N. J., announces availability of the "RCA Semiconductor Products Handbook HB-10," devoted exclusively to data on RCA semiconductor devices including transistors and silicon rectifiers. A companion to the "RCA Tube Handbook HB-3," the new publication is available in conjunction with the HB-3, or separately. The new handbook has been compiled to meet the requirements of electronic equipment design engineers primarily, but will prove useful to all who have need for up-to-date technical information on semiconductor devices. Convenient loose-leaf form permits revision of data on existing types and the addition of data on new types as they are made available. Subscription to the handbook HB-10 is $5.00 domestic ($5.50 foreign), and includes one binder, data sheets, and service for one year.

• **Allied Radio Corporation,** 100 N. Western Ave., Chicago 80, Ill., is now distributing its new 1960 catalog. Consisting of 444 pages, of which 232 are in color rotogravure, this biggest of all Allied catalogs lists more than 40,000 items. Featuring extensive listings of stereo components, it also includes a wide selection of complete systems. In addition, the catalog lists several do-it-yourself stereo systems featuring Allied's own Knight-Kits. Do-it-yourself enthusiasts will find a bigger-than-ever selection of hi-fi amplifier, tuner, and preamplifier kits, plus expanded listings of custom cabinet kits for speakers and other components. Music lovers who desire the finest in record entertainment will find listed a wealth of specially selected stereo records from which to choose. Latest 16⅔-rpm "talking book" records are also included. Your copy of this great catalog will be mailed free upon written request. **L-13**

• **CBS Electronics, Information Services,** 100 Endicott St., Danvers, Mass., will mail free Bulletin E-355 which gives complete technical data on the first in a series of complementary NPN-PNP power-transistor lines. These complementary pairs of transistors permit new circuit design economies. The planned line of five NPN-PNP pairs is the result of a customer application survey made by CBS Electronics. The pairs feature high voltage—up to 100 volts—and proved reliability (exceeding MIL-T-19500A) for audio, control, voltage regulation, servo and computer applications. **L-14**

• **Audio Fidelity Professional Products Inc.,** 770 11th Ave., New York 19, N.Y.,

will mail without charge an attractive folder listing the complete line of Telefunken microphones as well as a number of professional audio components and accessories. Of particular interest to TV, stage, and motion-picture producers is the "Microport," a small FM receiver and transmitter assembly of the "wireless microphone" type which has a range of approximately 1700 yards. Users of professional audio equipment have a distinct need for this publication. Write for it.
L-15

• **General Electric Company, Semiconductor Products Department,** Charles Building, Liverpool, N.Y., is now publishing a new edition, the fourth, of the "Transistor Manual," which contains 227 pages of information on transistors and their uses in electronic circuits. Included in the 20 chapters is information on basic semiconductor theory, transistor construction techniques, biasing, switching characteristics, transistor servicing techniques, and several articles on circuitry. In addition, the book contains a revised and up-to-date listing of all American JEDEC-registered transistor types with their basic specifications and interchangeability information. The "Transistor Manual," fourth edition, is priced at one dollar.

• **Allied Radio Corporation,** 100 N. Western Ave., Chicago 80, Ill., has just published "Understanding Transistors," a 64-page handbook which not only serves as an excellent introduction to transistors, but also as a helpful reference for those already acquainted with the subject. Written by Milton S. Kiver, well-known author of many volumes on electronics, the book opens with a concise discussion of the properties of germanium. Opening sections of the book clarify basic theory and provide a solid foundation for the succeeding chapters. Many transistorized circuits, with a detailed explanation of each, are included. There are more than 50 diagrams and illustrations. Price of "Understanding Transistors" is fifty cents.

• **CBS Electronics,** Danvers, Mass., has available for dealers a new phono cartridge cross-reference chart. It lists both CBS-Ronette and Columbia CD cartridges for exact replacement of more than six million cartridges now in use in the U.S.A., and provides a convenient tabulation of technical specifications. Exact-size silhouettes for each cartridge provide a quick identification of model number, and a handy table illustrates and describes various bracket installations. The 8-page catalog, Bulletin PF-285, is available free to independent service dealers through their distributors.

• **Radio Shack Corporation,** 730 Commonwealth Ave., Boston, Mass., has just announced publication of its annual electronic parts and equipment catalog, "1960 Guide to Electronic Buying." The publication scores a number of firsts for a parts distributor's catalog. It is printed entirely in rotogravure on 8½" × 11" magazine-size paper stock, contains paid display advertising and articles written by leading authorities, and features a handbook for the engineer and the hobbyist. The catalog lists some 40,000 electronic items. Net, as opposed to list, prices are shown. It includes over 100 pages of hi-fi products, and some 200 pages of industrial and service items. Price of the catalog is thirty-five cents postpaid to consumers; it will be mailed free to industrial concerns requesting copies on a company letterhead.

• **Sylvania Electric Products Inc.,** 1100 Main St., Buffalo 9, N.Y., has available a new characteristics and replacement guide for semiconductor diodes. Included in the 12-page booklet are complete data on the ratings and electrical characteristics of all Sylvania types as well as a replacement guide to virtually all EIA registered diodes. Copy will be mailed upon written request.
L-16

ABOUT MUSIC

HAROLD LAWRENCE*

Encore! Bis! Altra Volta! The subject of encores again came into the news this past summer when Russian critics scolded Leonard Bernstein, on tour with the New York Philharmonic, for imposing a repetition of Charles Ives's *The Unanswered Question* upon his Muscovite audience. Last year New York critics filed a similar complaint against Yehudi Menuhin for playing a Bach solo encore at a New York Philharmonic concert. Both these performers struck back at the critics—Bernstein in statements to the press and Menuhin in an article for the *Saturday Review*—and attributed their actions to what Menuhin calls, "the collective heart and spirit of a friendly crowd." But just as reporters and politicians differ on the size and sympathies of a street rally, critics and artists differ likewise on the volume and intensity of applause at a concert. This disagreement is one of the many factors that have made, and continue to make, the encore an often controversial issue in public music-making.

There is no mistaking the spontaneous outburst of applause, shot through with cries of "bravo," that follows a truly outstanding performance. Everyone present expects the artist to favor his audience with an encore or two. In the case of such a performer as Wilhelm Backhaus, this could be a lengthy affair, lasting until the house management turns on all the lights, drops the curtain, or rings bells in an effort to drive out the musical squatters on both sides of the stage. The encore, however, is not always as simple a matter as this. A musical-sociological study of the encore-taker should include the following categories: manner, motive, time, place, and choice of repertoire.

When you come right down to it, every performer fully intends to take encores at the conclusion of his recital, and indeed comes well prepared with a number of additional pieces. Less predictable is the manner in which he proceeds to take the encores. The ever-ready encore-taker is never too sure of his reception and rushes back on stage after only a smattering of applause, hoping to intercept the audience's move for the exits. The short intervals between bows and the rapid succession of pieces soon make it perfectly clear that the artist is performing "unilateral" encores, based not on the public's enthusiasm, but on its mere presence.

The reluctant encore-taker, on the other hand, appears never to have heard of encores. He beams at the audience, bows elegantly, but will only perform when the public becomes explicit in its demand and begins to shout, "encore," or calls out titles of favorite pieces.

Encores are sometimes dictated by a cool reception rather than by a heartfelt ovation. Obviously unsatisfied with the meager applause that greeted the première performance of a modern orchestral work at a Boston Symphony program, Serge Koussevitzky spoke to the audience: "I can see that you didn't understand this piece. We'll play it again to give you another chance to appreciate it."

Between Movements

Applause between movements of a continuous musical composition is generally frowned upon by experienced concert goers. When it occurs, the performer pretends to ignore it, averts his eyes from the direction of the hall, and waits for the right moment to resume the performance. The late Hans Kindler, on tour with the National Symphony, once encountered between-movements applause during a rendition of Tchaikovsky's *Pathétique* Symphony in Springfield, Massachusetts. He waited discreetly for it to stop; instead, it seemed to gain momentum. Several times, the conductor raised his arms to give the downbeat, but the audience simply would not be quiet. So he turned around, and gently reprimanded the listeners: "You really shouldn't do that, you know. All the same, thank you very much. And since you seem to like this movement so well, I'll play it for you again."

Encores of this variety, however, constitute rare events in the concert hall. The Springfield audience in that incident had the first movement repeated, but usually it is the *scherzo* or *allegro finale* that is encored, as in the case of the first performance of Roussel's Symphony No. 4, for example.

In the history of orchestral encores, surely Leopold Stokowski surpassed all other conductors in terms of the duration of his post-concert offerings. As guest conductor of the N.B.C. Symphony, he once directed performances which were broadcast from the Cosmopolitan Opera House (now the New York City Center). The public was invited and the price of admission was $1. Because the radio program lasted one hour, Stokowski felt that the public was not getting its money's worth. Accordingly, he scheduled encores after the show went off the air, solely for the benefit of the studio audience. On one occasion, the orchestra was deployed in the usual Stokowskian manner; that is, in a highly unorthodox arrangement. No section was in its traditional place; furthermore, a cluster of brass players was located *behind* the podium, along the apron of the stage. At no time during the program did the brass sound. But after the announcer had signed off, Stokowski informed the audience that they were about to hear their "encore": Shostakoviteh's Symphony No. 6. The work began, and still the brass remained silent. Finally, after half an hour of Shostakovitch had elapsed, the players

* *26 W. Ninth St., New York 11, N. Y.*

received their cue—and what a cue it was! Stokowski suddenly spun around on the podium, his snowy mane and famous profile caught in the spotlight, and pointed a well-manicured hand in their direction. The effect was startling.

In the realm of symphonic, chamber, or solo instrumental concerts, interruptions of a symphony, quartet, or sonata for encore purposes is largely a thing of the past. The same might be said for operatic encores, though vestiges of this tasteless practice still exist. No less a renowned artist than soprano Renata Tebaldi indulged in an encore during a San Francisco performance of *Tosca* less than five years ago. Responding to an especially noisy ovation (reinforced by a claque), she stepped out of character to acknowledge the applause and cheers, and then signalled the conductor to repeat the aria, "Vissi d'Arte," thereby making an artistic shambles of the opera's dramatic continuity.

Tebaldi's encore annoyed not only the critics but also the opera buffs who like their Puccini straight. The same critics would have been far more annoyed at the behavior of certain earlier singers who interpolated totally unrelated songs or arias into the operas they sang. In his entertaining book, *The Music Goes Round*, the late recording impresario, Fred Gaisberg, tells of two such vocal sinners. The first, Miguel Fleta, "would respond to a *bis* with encore after encore of popular songs which had nothing to do with opera," while the second, Jan Kiepura, "would make sure that a piano was ready in the wings for accompanying him as he rushed out to take his encores—all, of course, irrelevant to the opera."

While one cannot wholly agree with Artur Schnabel, who once said, "Applause is a receipt not a bill," there are times when it might be a good idea to dispense with the encore and adopt the ancient Russian custom of applauding the applauders. Æ

COMING HI-FI SHOWS

Nov. 6–8—Seattle, Wash., New Washington Hotel. (*Rigo*)

Nov. 8–15—Mexico City: Fifth High Fidelity Fair, 300 Insurgentes Avenue Building. Gala inauguration ceremonies, Nov. 7, 5:00 p.m. Also in the same week, First International Symposium on Audio, Hotel Plaza Vista Hermosa, a meeting of audio engineers. For information, write or phone Miguel Augusto Aranda, President, Asociacion Mexicana de Impulsores de Alta Fidelidad, A.C., Genova 16-2, Mexico, D.F., Mexico. Telephone 11-24-57.

Nov. 13–15—Portland, Ore., New Heathman Hotel. (*Rigo*)

Nov. 20–22—Philadelphia, Pa., Benjamin Franklin Hotel. (*Rigo*)

Dec. 4–6—Minneapolis, Minn., Hotel Leamington. (*Audio Div., Paul Bunyon Chapter, ERA*)

Jan 13–17—Los Angeles, Pan Pacific Auditorium. (*IHFM*)

Jan. 23–26—San Francisco, Cow Palace. (*MRIA*)

Jan. 27–30—Vancouver, B. C., Canada, Hotel Georgia. (*DHFA*)

STATEMENT REQUIRED BY THE ACT OF AUGUST 24, 1912, AS AMENDED BY THE ACTS OF MARCH 3, 1933, AND JULY 2, 1946 (Title 39, United States Code, Section 233) SHOWING THE OWNERSHIP, MANAGEMENT, AND CIRCULATION OF

AUDIO, published Monthly at Lancaster, Pa., for October 1, 1959

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Sworn to and subscribed before me this 9th day of September, 1959.

(Seal) Donald F. Mattone, Notary Public.

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AMPLIFIERS

(*from page 26*)

An alternative approach is the twin-coupled amplifier referred to previously. This uses completely separate transformers but employs large capacitance from screen to cathode to achieve tight coupling at the higher frequencies. The double transformer achieves sufficiently close coupling for the low frequencies, which is not difficult.

The Circlotron circuit utilizes a comparatively ordinary output transformer and only needs one of them. Its disadvantage is the fact that it needs two high-voltage suppliers. While this may not be any more expensive (probably is less expensive, in fact) than using two output transformers or a more expensive single one, it does have the disadvantage that the high-voltage suppliers are virtually attached to the plates and cathodes of the output stage. This means that capacitances in the supply circuit and the power transformer are effectively in the audio circuit of the amplifier which can introduce complications in that direction.

So each circuit has its critical factors and it is only by taking careful account of the various critical factors in each circuit, watching out for the possibilities of blocking, or other spurious conditions —the things that can happen due to the difference between practical program material and the kind of signals used for measuring amplifier performance— that a satisfactory amplifier can be produced. Using any basic circuit as a starting point it is possible to design out the various bugs that spoil amplifier performance.

So, rather than saying that any one particular circuit is basically the best circuit, it is better to look a little closer and see how well the circuit has been designed as regards avoiding some of the spurious things that can happen in amplifiers. Æ

MICROPHONE PREAMP

(*from page 50*)

J_2	Output connector, Amphenol 91-860
Q_1	2N133 transistor
Q_2	2N132 transistor
R_1	5600 ohms, ½ watt
R_2, R_6	120k ohms, ½ watt
R_3	560k ohms, ½ watt
R_4, R_8	100 ohms, ½ watt
R_5, R_9	10,000 ohms, ½ watt
R_7	390k ohms, ½ watt
R_{10}	20,000 ohms, ½ watt
	2 Penlite batteries
	Miscellaneous hardware
	Insulated mounting board, 3×5 in.
	Aluminum box, 5×3×1½ in.

UNIVERSAL STEREOPHONIC CONTROL CENTER

(*from page 21*)

acterizes the extremely quiet performance of the control unit. Transient response is excellent, as shown by the square-wave photographs of *Fig.* 2, with no signs of ringing or overshoot. The frequency response is flat and smooth as shown by the response curve of *Fig.* 3. This smooth response leads to the over-all clean sound of the control unit. Further, its excellent low-frequency response really shows up on strong bass passages, such as organ pedal notes. Distortion is low, as shown by *Fig.* 4, and RIAA equalization exact, as shown by *Fig.* 5.

Extensive listening tests and measurements have been conducted using representative samples of both magnetic and ceramic stereo phono cartridges. The cartridges used were the Fairchild XP-4 and 232 magnetic cartridges and the Electro-Voice 21-D ceramic cartridge. All cartridges tested performed excellently in conjunction with the control center. The control center had gain to spare, even with the low-output Fairchild cartridges—5 millivolts for 7 cm/sec deflection. Using the standard Westrex 1-A stereo test recording, both types of cartridges showed flat, smooth

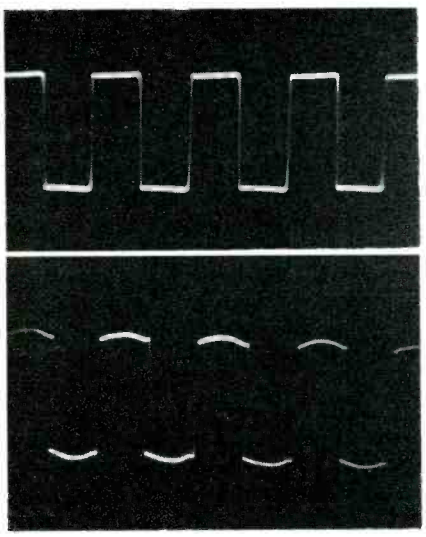


Fig. 2. Square-wave responses of the amplifier. Upper, 2000 cps; lower, 60 cps.

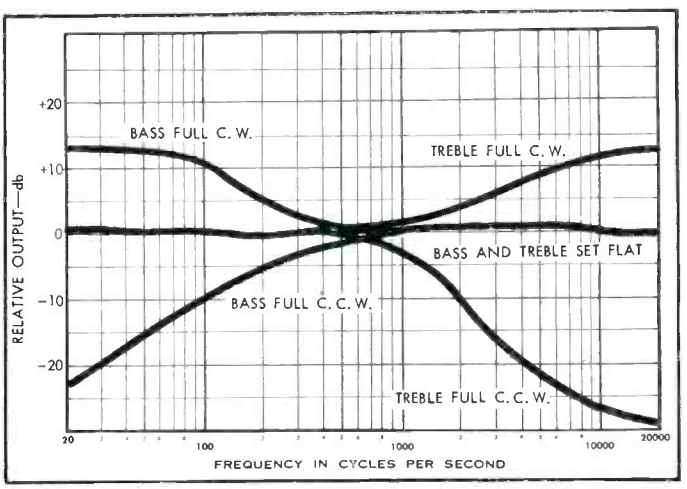


Fig. 3. Frequency response curves, showing tone-control performance.

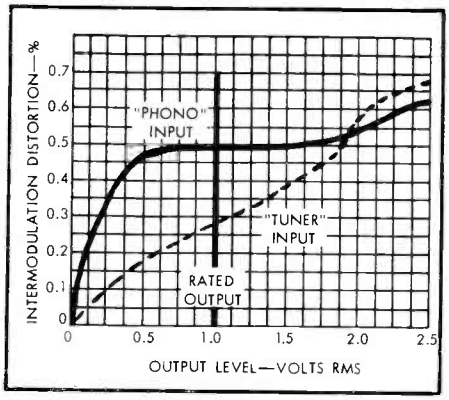


Fig. 4. Distortion vs. output curve.

frequency response.

Using the Fairchild 232 stereo cartridge, a comparative listening test between stereo disc and tape was conducted. Using RCA Victor's "Hi-Fi Fiedler" (disc LSC-2100 and tape BCS-41) an audience was asked to note the difference between stereo disc and tape on an A-B basis. Most listeners could not note any difference. Those that did identified the disc primarily by the surface noise of the disc.

Construction

Do not be frightened by the seemingly complicated circuit schematic of *Fig.* 1. All stereophonic control units must look complicated for they contain twice as much circuitry as their monophonic equivalents. A quick glance at this schematic will show that both channels are almost identical and that construction is a matter of building two control units within a single housing. The only place where differences between the two channels exist is in the vertical-lateral mixing circuit (V_{2B} and V_{6B}). However, the difference here is in the resistive mixing and these components can be mounted on the TYPE switch (S_2) directly. This makes both channels identical in construction.

As can be seen in the photographs, the author used two identical wiring boards for the main circuitry. It is suggested that a similar type of construction be used for easiest construction. Separate channel construction also has the advantage of keeping the left-right channels physically separated thereby reducing interchannel crosstalk. Because of the outstanding hum and noise performance of the control unit it is important, regardless of what type of construction is adopted, that the entire control unit be encased in a metal enclosure so as to shield it from unnecessary hum pickup.

The phono preamplifier stages (V_1 and V_5) should be shock-mounted to prevent microphonics. Shock mounting of these tubes can be easily done by placing a small rubber grommet on each mounting screw between the tube socket and the chassis and allowing the tube socket to float on these grommets.

All leads carrying a.c. to the control unit should be shielded to minimize hum. Use two-conductor shielded cable for connections to the pilot light (PL_1), power-switch section of S_3 (S_{3C}), and a.c. heater wiring for V_3, V_4, V_7 and V_8. *Do not* use shielded cable anywhere else in the control unit as the high capacitance of shielded cable will cut down the high-frequency response of the control unit. Instead, use twisted-pair wiring for *all* connections between input and output jacks to the amplifier, and between the amplifiers and all controls. Twisted-pair can be easily made by tightly wrapping together two pieces of hookup wire. One wire should be used as a shield and connected to common ground and the other wire used as the signal conductor. There is only one exception to this twisted-pair rule. When wiring between the amplifiers and the tone controls, use twisted-pair but also cover the bundle of twisted-pair cables running to *each* tone control with a loosely fitting shield of braided copper, and ground the copper braid. This additional shielding is necessary because the tone controls are particularly sensitive to hum pick-up. Be sure to keep all twisted-pair cables from one channel well separated from the twisted-pair cables of the other channel.

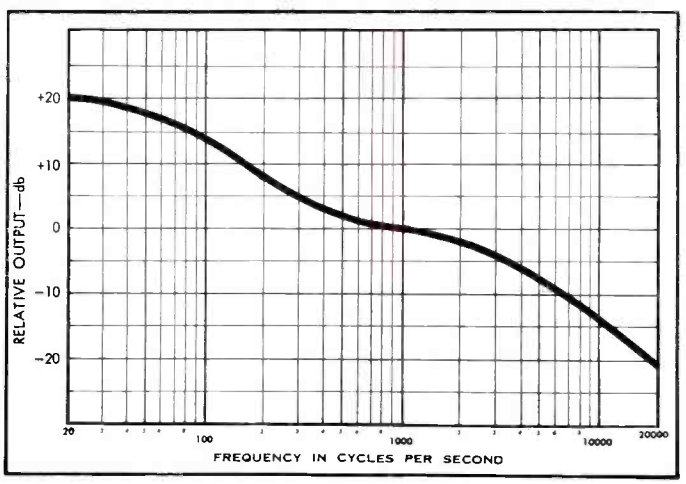


Fig. 5. Curve of RIAA equalization compared to the resultant curve of the amplifier.

Grounds for each channel should not be connected directly to the chassis, but should be connected to a separate ground wire connected to the chassis only at the input phono jack. Connect the left ground wire bus to the chassis at J_1 and the right ground wire bus to the chassis at J_7. The power supply ground return lead (pin P of P_1) should be grounded to the chassis with a ground lug at the power plug, P_1.

Low-noise deposited-carbon resistors are liberally used in the phono preamplifier section of the control unit. Do not substitute conventional carbon types. The use of deposited-carbon or wire-wound resistors in this critical circuit is well worth the additional cost in terms of the superior low thermal-noise performance that results. Keep all leads in the phono preamplifier as short as possible. As a matter of fact, all leads should be kept short to minimize hum pick-up and cross-talk.

If a ceramic or crystal stereo phono cartridge is to be used, the AUX input should be converted to a piezo-electric cartridge input. Break the "x" connections shown on switch sections S_{1-C} and S_{1-D} and add the dotted connections shown in *Fig.* 1. This modification allows the vertical-lateral TYPE switch, S_2, to function when the selector switch, S_{1}, is set to AUX. A ceramic or crystal cartridge should be used only in the AUX input because the 5-megohm level controls (R_{16} and R_{56}) in the AUX position form a proper load for these cartridges.

The control unit can be constructed to handle tape inputs either from a tape preamplifier or directly from the tape head itself. If you already own a tape head preamp, the control unit should be built as shown and the tape preamplifier output connected to the tape input of the control unit. However, if you desire to drive the control unit from a stereo tape head directly, it will be necessary for you to include a tape-head preamplifier in the control unit. In this case, break the "X's" shown on the tape input leads in *Fig.* 1 and add the tape head preamplifier shown in *Fig.* 6. Try to shock-mount the two additional 12AX7's and be sure to use low-noise types such as Mullard or Telefunken.

In order to insure symmetry of mixing in the vertical-lateral mixing circuit, plate and cathode resistors of the phase-inverters (R_{19}, R_{49}, R_{59}, and R_{60}) should be matched to within 1 per cent. The simplest way to match resistors is to take an ohmmeter with you to the supply house and measure 22,000-ohm, 1-watt resistors until you find four that match within 1 per cent.[2] It is not necessary that these resistors be exactly 22,000 ohms, only that they match each other.

The BALANCE control is a two-gang 500,000-ohm linear potentiometer that should be wired so that the resistance in the left channel increases and the resistance in the right channel decreases as the control is rotated clockwise, and vice versa. The GAIN control is also a two-gang potentiometer, 250,000-ohm, audio-taper type. It should be wired so that the output of both channels increases as the control is rotated clockwise.

A 25-μf, 150-volt electrolytic capacitor, C_{78}, should be connected from the heater of the right cascode phono preamplifier, V_5, to ground at the socket of this tube as shown in *Fig.* 1. This capacitor insures a low return impedance to ground for the d.c. heater supply and lowers the hum pick-up of the cascode preamplifier.

Power Supply

The power supply (shown schematically in *Fig.* 7) should not be built on the same chassis as the control unit, but should be built separately and placed about five feet away from the main control unit. The power supply was designed especially for use with the control unit and it is not suggested that other power supplies be substituted. As noted earlier, it is essential that d.c.

[2] This is sure to make you popular with the store personnel. Better still, buy a dozen resistors and select matched pairs after you get them home.

heaters be used for the cascode preamplifier to prevent hum. The power supply shown in *Fig.* 7 provides d.c. for the heaters of the cascode and other stages without the use of a special power transformer. This is done by placing the 6.3-volt and 5.0-volt heater windings in series-aiding and using this 11.3-volt source for the heater rectifier diode. Unless the windings are placed in series-aiding, the voltages will *subtract* and only about 1.3 volts will be available for the heater rectifier. Before permanently soldering together the two leads from the 5.0-volt and 6.3-volt windings, measure the total available voltage across the two windings with an a.c. voltmeter and, if necessary, reverse one set of windings so that the total voltage is about 11.3 volts a.c. The two wires may then be soldered together and the power supply completed. The d.c. heater supply has sufficient current capacity for four tubes only, so do not attempt to supply the heaters of the entire control unit with d.c. If the tape head preamp of *Fig.* 6 is incorporated, it is suggested that these two 12AX7's (V_1 and V_2 of *Fig.* 6) be powered by the d.c. heater supply and tubes V_2 and V_6 of the control unit be switched over to the a.c. heater supply (pins K and L of P_1).

Control-Unit Adjustments

Connect the control unit to its power supply. Before turning the power on *be sure* that all tubes are in place and that the power supply d.c. heater adjustment resistor (R_{10} in *Fig.* 7) is at its maximum resistance. Unless this is done, the d.c. heater voltage may be too high and burn out several filaments. Allow the unit to warm up for about fifteen minutes then adjust the heater voltage at the socket of the right cascode preamplifier (pins 5 and 9, V_5) to 6.3 volts d.c. by means of the heater adjustment resistor (R_{10} in *Fig.* 7).

If you have included a tapehead preamplifier, this must now be adjusted to the NARTB tape playback characteristic. To do this, connect your tape head to the control unit and insert a 10-ohm

TABLE II

STANDARD PLAYBACK EQUALIZATION

(Values given in volts rms)

Frequency cps	NARTB Tape	RIAA Disc
20	2.00	0.92
50	1.40	0.71
100	0.90	0.45
200	0.50	0.26
500	0.20	0.14
1000	0.10	0.10
2000	0.060	0.074
5000	0.038	0.039
10000	0.032	0.020

1000-cps input signal set at value required to produce output of 0.10 volts; input signal then held at this value for all other frequencies.

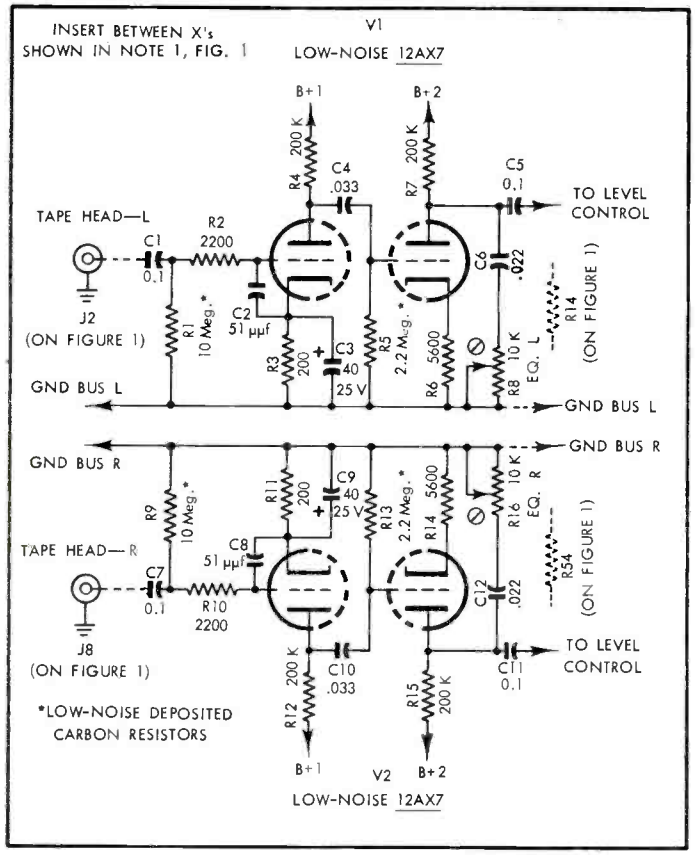


Fig. 6. Schematic of tape-head preamplifier which may be incorporated into the amplifier.

resistor in the ground lead, as shown in *Fig.* 8. Adjust the equalization first for the left channel. Set the SELECTOR switch, S_1, to TAPE. Connect an audio generator to the 10-ohm resistor through a 1000-ohm resistor as shown. Connect an a.c. VTVM to the left TAPE OUT jack, J_5 in *Fig.* 1, and turn the left tape level-set control, R_{14}, all the way up. Set the SELECTOR switch, S_1 to TAPE. Set the generator to 1000 cps and adjust the output so that the VTVM indicates 0.1 volts rms.

Set the audio generator to the frequencies listed in Table II and by adjusting the left tape-equalization control, R_8 in *Fig.* 6, set the outputs to match those listed for NARTB equalization in Table II. Each time the equalization control is adjusted, return the generator to 1000 eps and re-adjust its output for 0.1 volts rms.

Repeat this same procedure for the right channel. Connect the a.c. VTVM to the right TAPE OUT jack, J_{11} in *Fig.* 1. R_{54} is the right tape level-set control and R_{16} in *Fig.* 6 is the right tape-equalization control. The tape-head pre-

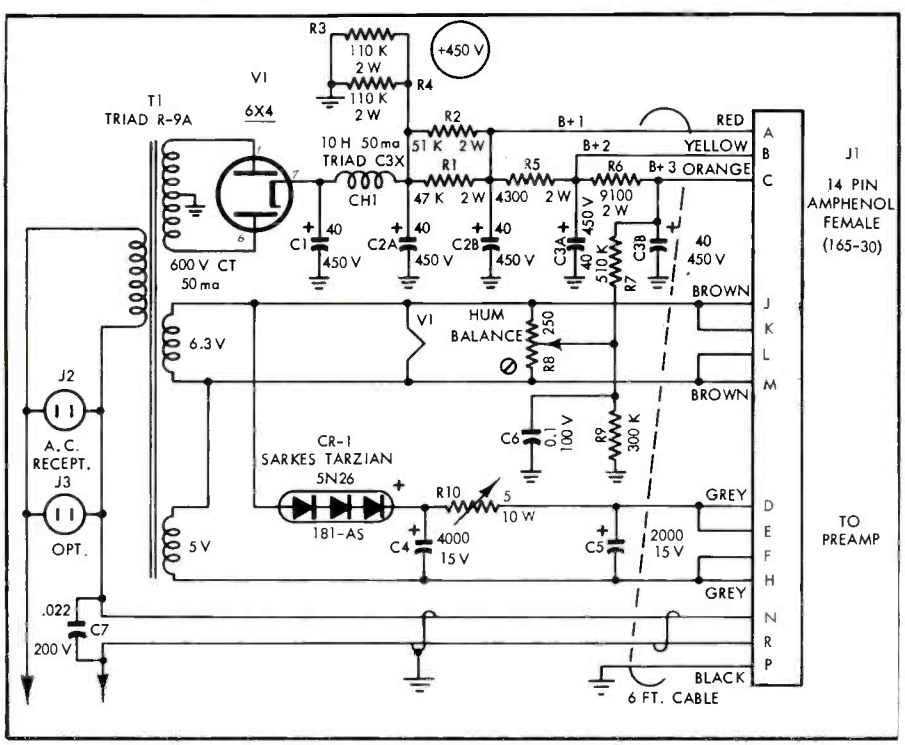


Fig. 7. Schematic of the power supply.

amplifier is now adjusted to the standard NARTB playback curve.

The remaining two adjustments are made with the control unit connected to a magnetic phono cartridge and a pair of power amplifiers and speakers. Set the SELECTOR switch to PHONO, the TYPE switch to 45/45 and turn the GAIN and phono level-set controls (R_{14} and R_{53}) for maximum volume. Adjust the power supply hum balance control, (R_8 in *Fig. 7*), for minimum hum.

Place an older monophonic LP on your turntable. With the FUNCTION switch (S_3) in the forward stereo position (position 2) and the GAIN control set at midrange, adjust the phono level-set controls to a comfortable listening level. With the BALANCE control centered, adjust the level-set controls so that the sound level is equal in both speakers.

With the FUNCTION switch still set in the forward stereo position, switch the TYPE switch to VERTICAL-LATERAL. The left speaker will have the lateral signal component and the right speaker will have the vertical distortion component. Temporarily turn off the left amplifier and turn up the volume. Listen to the distortion component in the right speaker and adjust the right phono level-set control for minimum distortion. The vertical-lateral mixing circuit is now balanced.

This completes the construction and testing of your versatile stereophonic control center. If properly constructed, you have built a fine piece of high-fidelity equipment having excellent response characteristics and control facilities that will not be soon obsoleted. . . . Unless mass three-channel stereo is around the corner! Æ

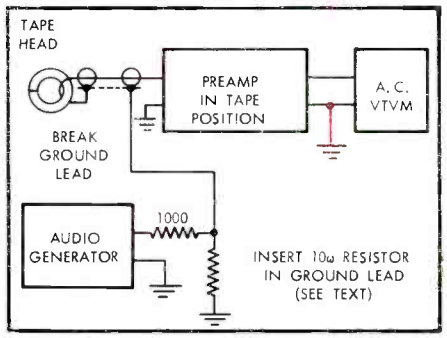
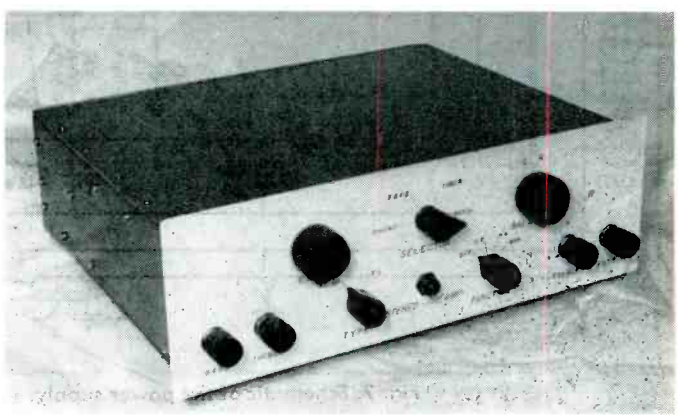


Fig. 8. Method of connecting an oscillator into the tape-head circuit to make adjustments.

PARTS LIST

For Figure 1

C_1, C_{23}, C_{24}, C_{25}	40 µf, 30 v., electrolytic
C_3, C_{17}, C_{26}, C_{41}	.022 µf, 400 v., paper
C_4, C_{27}	4.7 µµf, ceramic
C_5, C_9, C_{15}, C_{21}, C_{28}, C_{32}, C_{45}, C_{49}, C_{55}	0.1 µf, 400 v., paper
C_6, C_{11}, $_{12}$, C_{29}, C_{35}, C_{36}	0.1 µf, 200 v., paper
C_7, C_{30}	240 µµf, mica
C_8, C_{31}	560 µµf, mica
C_{10}, C_{22}, C_{33}, C_{46}	.068 µf, 200 v., paper
C_{13}, C_{18}, C_{37}, C_{47}	0.22 µf, 200 v., paper
C_{14}, C_{38}	2700 µµf, mica
C_{16}, C_{19}, C_{40}, C_{43}	2200 µµf, mica
C_{18}, C_{42}	220 µµf, mica
C_{20}, C_{34}	40 µf, 25 v., electrolytic
C_{48}	25 µf, 150 v., electrolytic
J_1, thru J_{12}	Chassis-mount phono jacks
P_1	14 terminal male plug, Amphenol 165-31
PL_1	6.3-volt pilot light
R_1, R_{44}	51,000 ohms, low noise, deposited carbon
R_2, R_{18}	1800 ohms, ½ watt
R_3, R_{18}, R_{43}, R_{58}	2000 ohms, ½ watt
R_4, R_{11}, R_{44}, R_{51}	510 k ohms, ½ watt
R_5, R_{10}, R_{45}, R_{50}	100 k ohms, low noise, deposited carbon
R_6, R_{46}	470 k ohms, low noise, deposited carbon
R_7, R_{47}	2.2 megs, ½ watt
R_8, R_{48}	33,000 ohms, ½ watt
R_9, R_{49}	1500 ohms, low noise, deposited carbon
R_{12}, R_{52}	10 megs, ½ watt
R_{13}, R_{14}, R_{15}, R_{53}, R_{54}, R_{55}	500 k ohms, audio-taper potentiometer
R_{16}, R_{56}	5 megohms, audio-taper potentiometer
R_{17}, R_{38}, R_{57}, R_{78} (R_{19}, R_{20})	1 meg, ½ watt
(R_{59}, R_{60})	22,000 ohms, matched pairs, 1 watt
R_{21}, R_{222}, R_{61}, R_{62}	750 k ohms, ½ watt, 10%
R_{23}, R_{23}, R_{63}, R_{64}	360 k ohms, ½ watt, 10%
R_{25}, R_{65}	1500 ohms, ½ watt
R_{26}, R_{66}	39,000 ohms, ½ watt
R_{27}, R_{67}	91,000 ohms, ½ watt
R_{28}, R_{32}, R_{68}, R_{72}	2.5 megs, linear-taper potentiometer
R_{29}, R_{33}, R_{69}, R_{73}	150 k ohms, ½ watt
R_{30}, R_{70}	10,000 ohms, ½ watt
R_{31}, R_{71}	100 k ohms, ½ watt
R_{34}, R_{74}	3300 ohms, ½ watt



Over-all view of the author's pre-amplifier - control unit.

R_{35}, R_{75}	220 k ohms, ½ watt
R_{36}, R_{76}	500 k ohms, linear-taper ganged potentiometer
R_{37}, R_{77}	250 k ohms, audio-taper ganged potentiometer
R_{39}, R_{79}	2200 ohms, ½ watt
R_{40}, R_{80}	47,000 ohms, 1 watt
S_1	4-pole, 4-position ceramic rotary switch, shorting type (SELECTOR)
S_2	2-pole, 2-position ceramic rotary switch, shorting, (TYPE)
S_3	3 pole, 4-position ceramic rotary switch, shorting, (FUNCTION)
V_1, V_5	12AY7 tube
V_2, V_3, V_6, V_7	12AX7 tube
V_4, V_8	6C4 tube

For Figure 6

C_1, C_7	0.1 μf, 100 v., paper
C_2, C_8	51 μμf, mica
C_3, C_9	40 μf, 25 v., electrolytic
C_4, $_{10}$	.033 μf, 300 v., paper
C_5, C_{11}	0.1 μf, 300 v., paper
C_6, C_{12}	.022 μf, 400 v., paper
R_1, R_9	10 megs, low noise, deposited carbon
R_2, R_{10}	220 ohms, ½ watt
R_3, R_{11}	200 ohms, ½ watt
R_4, R_{12}	200 k, low noise, deposited carbon
R_5, R_{13}	2.2 megs, low noise, deposited carbon
R_6, R_{14}	5600 ohms, ½ watt
R_7, R_{15}	200 k, ½ watt
R_{8}, R_{16}	10,000 ohms, linear-taper potentiometer, (equalization)
V_1, V_2	12AX7 tube, low noise

For Figure 7

C_1	40 μf, 450 v., electrolytic
C_2, C_3	40-40 μf, 450 v., electrolytic
C_4	4000 μf, 15 v., electrolytic
C_5	2000 μf, 15 v., electrolytic
C_6	0.1 μf, 100 v., paper
C_7	.022 μf, 200 v., paper
CR_1	Selenium rectifier Sarkes-Tarzian 5N26
J_1	12-pin female plug, Amphenol 165-30
J_2, J_3	A.c. receptacle
L_1	10 Hy., 50 ma, Triad C3X
R_1	47,000 ohms, 2 watts
R_2	51,000 ohms, 2 watts
R_5, R_6	110 k ohms, 2 watts
R_3	4300 ohms, 2 watts
R_4	9100 ohms, 2 watts
R_7	510 k ohms, ½ watt
R_8	250 ohms, 2 watts, potentiometer, wire-wound
R_9	300 k ohms, ½ watt
R_{10}	5 ohms, 10 w., adjustable
T_1	Power transformer, 300-0-300 v. at 50 ma; 5 v. at 2 a.; 6.3 v. at 3 a. Triad R-9A
V_1	6X4 tube

"PERFECTIONIST" SYSTEM

(*from page 54*)

range unit starts at about 1600 cps. No crossover element is added to the Janszen. It has its own built in 500-cps high-pass filter. The bass speakers actually contribute sound in the 30- to 1800-cps range, the midrange speaker in the 200 to 2800, and the high-frequency speaker from 500 to 30,000 cps. The speakers are driven by a 50-watt high-quality amplifier. Both the 4- and 8-ohm output taps are used for matching and channel balancing. The midrange unit and the electrostatic can be connected to either the 4- or 8-ohm taps. This allows the mid- and high-range volume to be adjusted by several decibels to allow for room acoustics. The Janszen has an additional adjustment control on the back for this same purpose. The crossover networks and speaker control circuits used are shown in *Fig.* 1.

For best listening, the optimum height of the electrostatic tweeter is about at ear level when seated. The midrange unit should be close to it and the woofers about half way between them and the floor. These requirements, plus a desired corner location, led to the general design of the speaker cabinet. The need for 12 cu. ft. of space in the infinite baffle without it appearing too large led to one innovation in the design. The cabinet was built without a back. That is, it was planned to fit flush with the wall and carpeted floor. The corner wall was found to be extremely rigid and acoustically dead. More so than 1-inch plywood. Why not use these surfaces and gain volume? It was only necessary to solve the problem of getting a good tight seal and to devise a logical method of assembling the system.

Construction

This was accomplished by building the frame shown in *Figs.* 2 and 4. The corner was square enough that no special cutting was required. A template cutout for the floor moulding was used to coping saw the bottom rear of the cabinet. Sponge rubber weather stripping was attached to the inside of the cabinet along all floor and wall intersections. The cabinet was firmly attached to the wall with angle brackets as shown in *Fig.* 5, two to the floor board and two on the top inside to the wall studs. Soft putty can be applied around the moulding or at any points of bad fit, however air tightness is not required and leaks of a few square inches are insignificant. Firm, vibration-free mounting of the

Fig. 4. Another view of the frame. Having no back, it must be firmly attached to the walls.

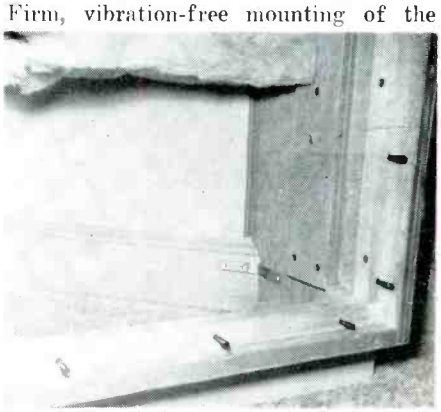


Fig. 5. Detail showing method of attaching the cabinet frame to the wall.

Fig. 6. Before attaching the loudspeaker mounting board, the entire interior is filled with pieces of fiber glass.

cabinet frame is essential, however.

The dimensions and general plan of the cabinet are given in *Fig.* 3. The corner shape makes possible an extremely rugged frame for the speaker mounting board. The perpendicular sides and the box frame for the Janszen utility model speaker makes a box girder type of construction. Additional braces and stiffeners are glued and screwed to the top and sides as shown. A 2×4 built-up plywood cross brace is used, and a brace post is installed between the cross brace and the center of the speaker mounting board. The speaker board is made up of two ¾-in. plywood panels screwed and glued together to form a rigid 1½-in. speaker support. The design of the cabinet is such that the finished frame can be attached to the corner, then the speaker mounting board with speakers attached is fitted into the front of the frame against a 1×1 moulding. The moulding contains a series of 2×¼ in. carriage bolts spaced every six inches around the edge. The bolts fit through counter-bored matching holes around the edge of the speaker mounting board and by attaching washers and nuts, the mounting board can be securely fixed to the frame. A finished moulding with grill cloth is then attached to the frame covering the entire front and held in place by friction fit pins.

When the frame is constructed it should be painted or wood finished and then attached to the wall. The necessary wiring should then be installed in the cabinet. An eight-terminal strip was installed at the left front of the shelf for making all connections to speakers and crossover network components. Since this was easily accessible by just removing the front moulding and grill cloth it greatly simplified comparative listening tests. A plug outlet for 110 volts was also installed at this point to power the Janszen. This circuit was run from an auxiliary outlet on the control preamp, so that the power was on only when the hi-fi system was being used. A demonstration switch panel was installed on the left side of the speaker cabinet. The switches allow any combination of the speakers to be heard. There is also a switch changing the speakers from a three-way system to a two-way system. There is sufficieint room on the shelf to mount the crossover components, the terminal strip and switches and still install the Janszen. The Bozak speakers were bolted to the speaker mounting board and wired. Cinch-Jones plugs were used to connect the speakers on the mounting board with the proper leads in the cabinet for ease in installation.

Damping the Cabinet

The acoustic insulation of the interior of the cabinet was the subject of several experiments. Proper damping of space resonances and minimization of the fundamental resonance of the woofers are the main objectives. The best results were obtained with the following procedure: 120 sq. ft. of Gustin-Bacon Ultralite fiber glass, ¾ lb. per cu. ft., 1 inch thick was procured. All interior frame surfaces were lined with the 1 inch material. Then the entire interior volume was filled with pieces of the fiber glass triangularly cut in sections of about 4 inch size, as seen in *Fig.* 6. The mounted speakers were covered with two layers of tightly stretched cheesecloth, with holes cut out for the magnet covers, stapled to the mounting board. Over this was placed at 16-in. circle of fiber glass with an X cut in the center to slip over the magnet cover, as shown in *Fig.* 7. The edges of the circle were stapled to the mounting board. The midrange unit was similarly treated, then a V shaped pocket of 1-in. fiber glass was formed around the mid range unit to isolate it partially from the woofers. The pocket was also filled with fiber glass cuttings.

You might fear that all this filling with fiber glass would use up a large portion of the interior volume. Actually

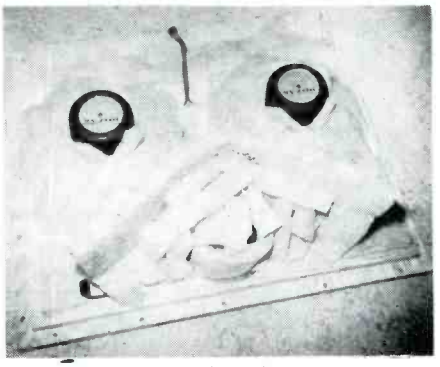


Fig. 7. Woofer and midrange units are thoroughly surrounded with fiber glass after installing mounting board.

the very fine fiber glass takes up less than 1 per cent of the total volume. It effectively increases the volume because it slightly lowers the resonant frequency of the speakers in the cabinet. More important is its effect of virtually eliminating all interior cabinet resonances. The effect of the fiber glass baffling directly on the back of the woofers is noticed only in the range of the fundamental speaker resonance. (About 40 cps in this case). It has the effect of increasing the damping in this range, which causes the output at the resonant frequency to be reduced, but it produces a broader and smoother response in this region.

The speaker plugs were connected and the speaker mounting panel fitted into the fiber-glass-packed frame and the nuts securely tightened, resulting in the appearance shown in *Fig.* 8. The Janszen utility model 1-30 was then put in the shelf and rested on a ½ inch pad of felt. The front panel was painted a flat black. This matches the color on the Janszen and nothing is visible through the speaker grill cloth. The finished front moulding with attached grill cloth is then attached by the friction fit pins and the unit is complete. The finish on the cabinet is a soft gray which matches the walls and nearby book shelves. The grill cloth is an open weave drapery material dyed a matching gray. A TV receiver is built in on top of the speaker, and its audio output can be played through the entire system. There is virtually no vibration of the speaker cabinet at wide open volume levels.

The circuit connections of the speakers allow considerable leeway for balancing the loudness of the three channels for optimum listening in rooms of varying acoustics and for listeners with different preferences. While the unit has not been measured in an anechoic chamber, it apparently has a flat response from 35 cps to the upper limits of hearing. Even more important, it produces a very natural sound almost entirely free of artificial coloring of any kind. On the Cook Chromatic Scale Test record there is a series of tones on the musical scale recorded from 32.7 to 8372 cps. They are recorded with a Fletcher Munson characteristic and when played back at a very low level they should all sound equally loud. All listeners have agreed that no loudness difference is detectable on any of the tones.

Frequency sweeps with an oscillator, microphone, and an oscilloscope show extended range and good wave form to above the limits of hearing. They also show no resonances or peaks or dips throughout the range. Before the fiber glass backing was used on the woofers, there was a tendency to rate the tones around 40 cps as slightly too loud. With the speaker in other acoustic surroundings this may not be observed, but the fiber glass backing seemed to smooth out the response.

Fig. 8. Approaching the final stages—the loudspeaker mounting board in place awaits only the grille-clothe in its frame.

The transient behavior of the system is judged to be excellent. Microphone oscilloscope studies with square waves and pulses have shown the presence of no resonance save the fundamental resonance of the woofers. This has always been small in magnitude and damped out within two cycles. The Cook Chromatic test record has two good transient tests. The first is for the bass range. It consists of three trains of short tone bursts followed by the steady tone of the pitch used in making the short bursts. The first train of bursts is a series of sine-wave tones of 62 cps but only 2 cycles in duration. The second train is the same but the bursts are 4 cycles in duration. The third consists of bursts of 8 cycles duration. The object of the test is to determine the shortest bursts in which the tone can be recognized. Perceptive listeners can definitely identify the tone of the 2-cycle bursts on this system. This is rather unusual.

The second transient test on the Cook record involves very short tone bursts in the 1000- to 2000-cps range. This is the range in which many cone speakers show resonances. On some speakers the tone can not be recognized from the short burst or the burst will sound a half tone or so different from the reference tone which follows. There is no confusion in recognizing the tones on this system.

The completed system has been very satisfactory. In addition to being quite accurate theoretically, it reproduces music pleasantly. When the sound source calls for it, it can be highly impressive. We have found differences in records not previously noted and we are looking forward to greater improvement in the recording art. Æ

OUTPUT TUBES

(*from page 42*)

tortion from 3.5 percent to 1.0 percent. It will also increase the damping factor from 0.072 to 2.65. The new Figure of Merit for the 6V6 is 450. This figure implies that the 6V6 with 10.6 db of feedback is 3.5 times better than the 2A3 without feedback. Note, however, that the relative values of the Figures of Merit again depend very much on the damping factor and the importance which we assign to it.

The foregoing shows how we may recompute our basic Figure of Merit for a tube with feedback (around output stage only). Our Figure may also be used to determine the result of placing tubes in parallel to achieve more desirable performance.

For example, if we want an output stage capable of 35 watts, we may wish to determine whether a pair of tubes in push-pull is best, or whether two pairs of a different type in push-pull-parallel will be still better. For a single pair we could use the EL34 which has a Figure of 15.7 in fixed bias. A smaller tube which could deliver adequate output in push-pull parallel is the EL84. It has a Figure of 23.4. In paralleling tubes we double the power output, but the voltage input remains the same. The power sensitivity is therefore doubled. The distortion at full output remains the same for each tube. The damping factor remains the same since both the tube plate resistance and the load resistance have been halved, keeping their ratio constant. The basic Figure of Merit is therefore doubled by putting tubes in parallel.

As a result of the above discussion we see that we may obtain 35 watts from a pair of EL34 tubes with a Figure of Merit of 15.7, or that we may achieve it with four EL84 tubes and a Figure of 46.8 (See Table III). This is quite a substantial increase over 15.7, and leads us to wonder whether a high Figure of Merit is not to be obtained merely by paralleling enough tubes.

The answer is yes, if we confine ourselves only to the basic Figure of Merit, and choose to disregard other factors, among them the cost. Even the most devoted purist, however, would pause to think before putting twenty or thirty small tubes in parallel in order to achieve what just two large tubes can do.

Aside from the cost, there is another danger in putting too many tubes in parallel. This is the effect which paralleling has on the driver tube. Each time a tube is added in parallel, the input impedance goes down. As the number of tubes in parallel grows large, the input capacitance may easily become large enough to affect the high-frequency response of the driver stage, particularly

if the output tubes are triodes. There is the matter of grid-circuit resistance, however, which may be of considerable importance when adding only one additional pair in parallel.

Grid-circuit Resistance

The data on every output tube always includes a characteristic called Maximum Permissible Grid-No. 1 Circuit Resistance. This characteristic, as its name implies, shows the highest value of resistance which may be placed in the grid circuit. The value varies over a range of as much as five to one for a given tube, depending on whether fixed or cathode bias is used. Fixed bias always requires a lower value of resistor.

If a tube has a relatively low value of permissible grid-circuit resistance, than severe limitations are placed on the driver stage. The a.c. load resistance seen by the driver cannot be large. This will limit the gain or increase the distortion of the driver and often does both. Paralleling tubes always makes this problem worse, since as tubes are paralleled the permissible grid-circuit resistance is greatly reduced. (Halved for two pairs, divided by three for three pairs, and so on.) It may be greatly to our advantage then to include the maximum permissible grid circuit resistance as a factor in our Figure of Merit. In addition there are several other characteristics which we may wish to use.

Efficiency

The efficiency of the tube type is important. A good tube is one which converts a large percentage of the d.c. supply power into a.c. power. It would certainly be poor design if we added more cost and complexity to the power supply than we saved on the output stage. Let us then include plate-circuit efficiency as one of our factors.

The power required by the filament circuit may influence our opinion of a tube considerably. Tube A may appear to have a much higher efficiency than tube B, until we see that A's heater power more than makes up the difference in plate circuit efficiency. This is admittedly of minor interest to the home constructor, but as before he may omit this factor from his Figure of Merit if he so desires.

The final factor is that of cost. This may be taken care of easily by giving the cost of the lowest priced tube (6V6) the arbitrary value of 1, and then expressing the cost of any other tube as its ratio to the 6V6 cost.

A new table taking these factors into consideration is Table III. Table III has two Figure of Merit columns. The column headed F_2 does not include cost while F_3 does. Each of the new Figures includes the factors that went into making up the first Figure of Merit (F_1).

The following are the formulas used:

$$F_2 = Eff \times R_{g_{max}} \times F_1$$
$$F_3 = F_2 \times Cf$$

where

Eff = Efficiency
$R_{g_{max}}$ = Maximum grid-circuit resistance
Cf = Cost factor

Table IV lists the additional characteristics used to make Table III from Table II.

With these tables at hand the designer is now able to make a logical and systematic choice of output tubes. And if he chooses to omit certain factors it will not be from ignorance, but because he chose to give that factor an arbitrary value of 1. (Note that multiplying (or dividing) any Figure of Merit by one will not change its value.)

As new tubes are brought out they can be appraised by this method, and if new factors are considered important they can be added conveniently to the framework already established. Æ

RECORDS

(*from page 68*)

though the relatively less potent string playing is, I suppose, also French, and negatively so. Negative or no, the emphasis here on forward brass and woodwinds is interesting after our own stress, in the U. S. A., on big, opulent string sound, whether it may be the Philadelphia, the Boston, or Morton Gould and André Kostelanetz. (He's American, now.)

As for Prokofieff, these are his two most ingratiating symphonies. The Fifth is his best known, a big, melodic work of a conservative cast; the Seventh is to my mind just as good, though it is his last and exhibits a certain tired, disillusioned end-of-an-era effect. It is wonderfully melodic, too, full of superb orchestration and some of the best satire on the modern Russian school of sabre-dance symphony that you'll ever run into. Hidden satire, of course, but it's there.

Excellent stereo and excellent sound, too, and the French playing avoids the big-string schmaltz that too often gets thrown into the more sentimental tunes in Prokofieff. Again, a pleasant and welcome change of emphasis.

Moscow Nights—Popular Russian Hits. Monitor MP 590

Ugh. I was momentarily curious about this—what *do* the Russian young people dance, to, in Moscow? That's what we have here, a quick look via your own ears, so to speak, into current Moscow night life. Nice cover, young people in a Russian dance hall.

The ugh refers to everything but one rather mild blues, slightly American in flavor (as far as is now allowed, I suppose)—the St. Louis Blues, with guitar. Sounds odd, very odd, and rather pleasant. The rest is just the sort of sleazy semi-Russian dance stuff you might expect, about as exciting as Muzak, if I may use a trade name. Main difference is that Russian pops singers don't croon; they sing like opera or "folk song," with big, wobbly voices.

If you want background music in Russian, this is it.

Sibelius: Symphony #5; Pohjola's Daughter. The B.B.C. Symphony, Sargent. Capitol-EMI SG 7181 stereo

It's been a long time since I listened to this old-time war-horse of early symphonic mod-

ernity, and I'm impressed both by the music and by the up-dating of performance, that in this version makes it sound remarkably newer than it used to.

The British have always been the leading non-Finn promotors of Sibelius, who tends to sound old-fashioned and over-Romantic to us Americans. Sir Malcolm Sargent has kept the old man's music thoroughly fluid and alive over there, just as Sir Thomas Beecham keeps another British favorite, Delius, going stronger than ever.

The Fourth and Fifth are decidedly the best of the Sibelius symphonies, I'd say. One is sunny and full of craggy melody, the other is remarkably bleak and strikingly modern in structure, all things considered. But the Fifth, the sunnier one, was subject—twenty years ago or more—to ultraschmaltzy Romantic interpretation. That's what we used to get, from such as Stokowsky and many another. But here, surprisingly (to me, anyhow), the schmaltz is more modest, the inner structures and sonorities more lively, the music much less banal than I would have thought possible.

It's a matter of hi-fi (wide-range stereo sound does wonders to bring out the masterful Sibelius orchestration) and a re-evaluation of the musical elements. For instance, when the inevitable great, big pretentious Sibelius tune comes along, à la "Finlandia," this orchestra doesn't fall for the old schmaltz—the tune gets played fairly and squarely but without blowing the roof clean off, thank goodness! It helps, it really does.

Of course, Sibelius' famed wandering construction, progressing amiably from one idea to another without visible or audible shape except for a occasional return, is as loosely unsymphonic. But nowadays it doesn't seem to matter particularly. Who said a symphony had to be rigidly structural in the German style of musical architecture? I think that, now, Sibelius can be taken by most of us without fuss or pretention just as he is, out of an earlier period that already has the nostalgia and quaintness of a vanished way of thinking. Fun, and very sonic in stereo.

Rimsky-Korsakoff: Scheherezade. New York Philharmonic, Bernstein.
Columbia MS 6069 stereo

I can characterize this recording very quickly. It is now getting to be fairly obvious that Lennie Bernstein, who does up a modern piece (particularly one with a bit of jazz or Broadway in it) with a superb modern verve, when he tackles a solid late-Romantic opus goes all-out to make it even more so.

Thus, this is no snazzy, zippy, modern "Scheherezade" at all. Instead, it goes all-out for big, pompous, super-Romantic effect. And, by golly, it works. Old Rimsky was hardly a satirist; on the contrary, his somewhat overblown works were conceived in deadly earnest and, to him at least, seemed not at all superficial. To treat this or any other Rimsky to a humorous or apologetic modernizing is a deadly sin.

So—you'll find this big, impressive, weighty "Scheherezade" just what Dr. Rimsky ordered, and incidentally—it's just what your new stereo outfit needs, too. Gahgeous.

Schubert: Trio, Op. 99. David Oistrakh Trio. **Angel S35713 stereo**

Russian-played recordings reach us now in a double stream, one source direct from Russia itself and the other in recordings made by traveling Russian virtuosos, mainly in England and in the U. S. The Russian school of performance, in either situation, is now getting to be well known on its own, and it stands out rather remarkably—still—from those interlocking ways and means of music-making that we lump together as "Western." Mainly, it tends to be high-tension for contemporary Russian music but low-tension for all other kinds. That includes Schubert.

Here you have three big, lumpy players (physically speaking) giving a powerful but relatively low-voltage performance, quite Romantic in an old-style way, strikingly without the enormous excitement and tension that, say, a trio with Rudolph Serkin would inject into this music. It is all done here on a very high plane, but I can't help feeling that, somehow, the electrical originality of Schubert's extraordinary harmonies—they were extraordinarily daring in his day and were so intended—are not projected, not particularly heard by the players. Similarly, the superb bits of melody, the familiar major-minor play of sunlight and shadow, are all treated in what I might call a Brahmsian style, solidly, authoritatively, musically, but not with excitement.

Who knows? Maybe Serkin is dead-wrong and these players more nearly right in terms of Schubert's own day. But if performance today means interpreting the basic *sense* of the music in ways we can understand, then this falls down for my ear. In the Twentieth Century we need a super high voltage to convey an electrical effect.

Music of Delius. Royal Philharmonic, Beecham.
Capitol-EMI G-7116

Tchaikowsky: The Nutcracker Ballet. Philharmonia, Kurtz.
Capitol-EMI SG-7149 stereo

Here are two nice brown Capitol imports (both covers are brown) and you can doubtless get them both in either stereo or mono; I happened to hit one of each.

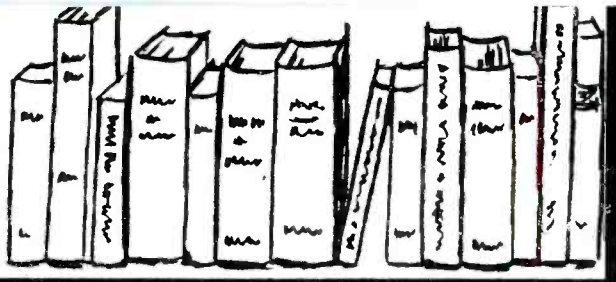
It's getting so that there's only one conductor who can get away with Delius (and who plays him at all regularly) and that is old Sir Tommy. He is an obstinate man and when he thinks something is good he will continue to promote it come H and high water. So we have more Delius—and after floating aurally through the two sides of this disc I'm inclined to thank Sir T. for the experience.

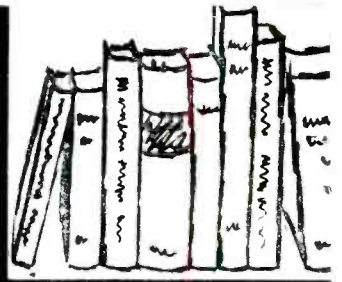
Delius, you see, is out of date in a big way. He represents a more or less dated British Impressionism, of a very saccharine sort (the English stand lots more musical sugar than we do), his harmonies are drippy and thick, he is starry-eyed, writes for big, lush orchestra—generally speaking, most moderns just don't dig this sort of thing. Delius, it appears, falls between stools: he's also too subtle, too icky, for the mood music people and the worshippers of Rachmaninoff or the "Warsaw Concerto."

But when Sir Thomas gets to work on an orchestra with Delius in hand, so to speak, the music comes through. It sounds right, natural, expressive, unforced; it *is* good music, when Beecham is there to bring out its best points in impeccable style.

Whichever side you play first, you'll like best. Two sides in a row, maybe, are too much. Just play one at a time. It all sounds much alike, but you can choose from Brigg Fair, A Song Before Sunrise, Marche Caprice, On Hearing the First Cuckoo, Summer Night on the River, Sleigh Ride, Intermezzo, most of these being items from larger groups of works; the Intermezzo is from an opera.

The Tchaikowsky "Nutcracker" is that new-style sort of ballet suite that is less than the whole ballet but much, much more than the old-time short suites which most of us grew up thinking were all the music fit to print in the various familiar scores of the sort. I like Kurtz; his playing is lean, economical, easy and naturally musical. That's enough for most of us, though ballet people will always be counting leaps and jumps and figuring whether the music is too fast or too slow. I wouldn't know—and for home listening minus ballet the actual dancing speed is not necessarily required. This is an excellent listening record. Æ





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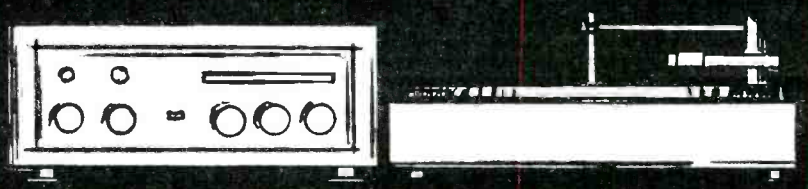

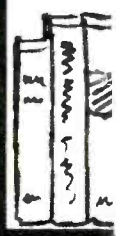

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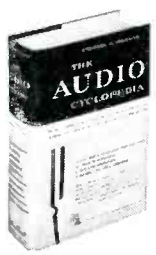

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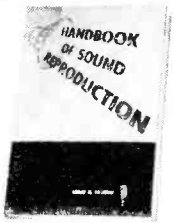

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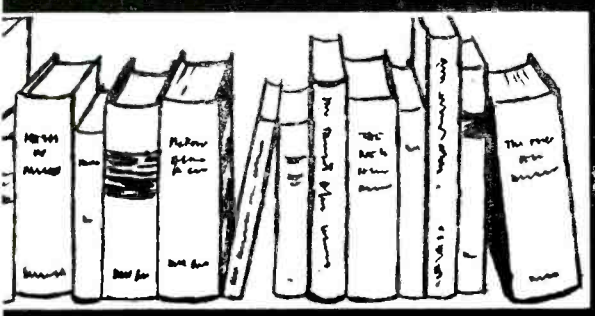

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DEFENSE & HI FI BACHELORS

(*from page 30*)

anything impressive in comparison with the acoustically well-nigh perfect sound the audience would hear during the live concert? The audiofans decided to try.

The entire installation, minus turntables and tuner, was set up at King Hall, the recorders and amplifiers in the wings, the three speaker systems on stage, placed quite as they had been in the BOQ room, but with, of course, greater distances between them. Test tapes sounded fine, more alive than in the small room.

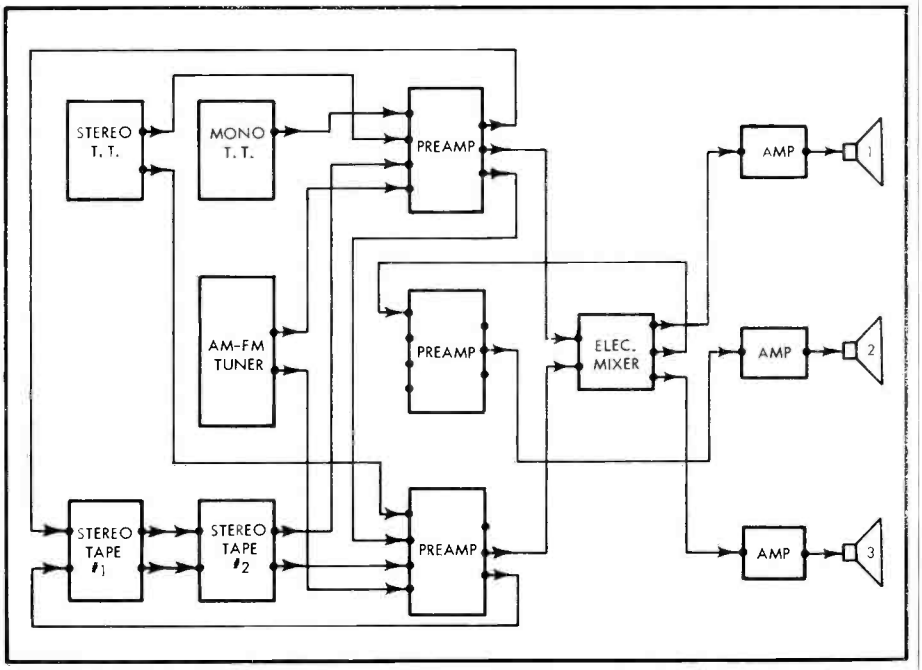
The three Altec M-20 microphone systems were now installed, two of the mikes suspended high at curtain point, equidistant from the center, the third at center, on the stage, for solo work, the three systems being then fed into the "series" recorders as in the BOQ room installation.

The results were fabulous. The live concert over, soloists, chorus and members of the orchestra had an opportunity to hear themselves. As the audience had heard them? Yes—but better. In many respects, far better; for without sound-reinforcing for the live concert there are always things that are not heard as they should be in all parts of an auditorium, and this applies even to those of the best acoustic design. With the three-speaker stereo playback on, there was *nothing* of the performance that could not be heard in all parts of the hall, in every seat and aisle and rear area. Those of the audience who had remained to hear the demonstration were lavish in their praise. Here, in stereo, was not only the total richness of orchestra and chorus but as well every minute detail of choral, instrumental and solo accents; not as things dominant but as one sees the beauty of individual flowers in the foreground of the deep, rich field. That is what makes the symphony, the concerto, the rhapsody, the overture.

The system had indeed proved itself. That, no one contested. Quite to the contrary, this product of the science of our day combined with a rich heritage of art, evoked, for many of those present, again the curtain time of this concert: a significant time of drama, for here were the contrasts of man's achievements. Slowly, with a suspenseful hiss, the electrically operated drapes on the side walls slid back, revealing expanses of glass and varnished, slotted wood. On stage, the conductor's baton came up, stood poised, then came down. Outside, beyond the glass, twisting trunks of giant oak trees stood gaunt in the night while between them, incongruous in a faint fluorescence, passed the figure of an armed, uniformed sentry in brisk military stride, but perhaps knowing, feeling, that inside the edifice beside him Brahms, a man long dead, had taken over by proxy—the inexhaustible prerogative of the immortal—while hundreds sat exposed to his dreams.

And what about the future of this hi-fi system?

"Well," says Lt. St. Ville, the BOQ's chief audiofan, "for my *permanent* shoreside system I'm now planning another Hartsfield, for the left channel, or maybe a Paragon and a———." Æ



Block schematic of recording-reproducing system.

AUDIO ETC

(from page 81)

that RCA's tape heads (and even the tape preamps in this model, SCP-2) are as good as they come and can do an excellent job on four-track tape at 3¾ ips. Since the basic RCA tape deck includes this sound quality, the last word is far from said as to what can be produced out of this excellent little chassis.

Yep, of course, it costs money to put out good sound. Tandberg's four-track recorder, minus stereo speakers, costs a good deal more than RCA's SCP-2 with speakers; its quality should be higher. But RCA has too much at stake; RCA has infinitely great resources. It seems clear that RCA can easily give us optimum cartridge sound whenever it has a mind to. I'm waiting.

Short P.S. Note that other companies are moving into cartridge tape, notably Bell. If you're interested, it might be good to take a look in Bell's direction. I haven't had a chance yet.

MORE PRESS STUFF

Last April, you may remember, I ran a little piece in this department which I called Press Stuff; it was all about the state of mind into which I was being driven by too much public relations, via the mail and in multiple doses. Also, on the side, I spoke of those hundred-word telegram invitations that wake me up at seven in the morning. . . . Well, I felt a lot better after getting that piece off my chest and I note that it has been setting off small explosions here and there, ever since. OK by me!

The *Billboard*, that august and influential sheet, was one of those I mentioned—the *Billboard* had been insisting for months that I was a record dealer and plastering me with special 10-day offers, for more $tereo Profit$. Well, after awhile a very nice letter came in from that source and it began in these very words: "This IS a personal letter and only one copy or it will be mailed to you." It was the Circulation Director himself and, pleasantly enough, he approved of my "Rules for Publicizing Publicists," believed that publishers should "see and heed them." Not a tomato in the whole letter, which just goes to show. But as for taking my name off the dunning list—I mean the mailing list—that might not be too easy; I was to understand that the filing system for such lists was very complex . . . something about looking for me under my postal zone number . . . but, anyhow, he would do what he could to de-record-dealerize me.

That was June 3rd. I sent him the very next *Billboard* 10-day special offer that came my way, mailing plate and all. The latest? In late September I got a fat letter from The *Billboard*. It was a special 10-day offer, for more $tereo Profit$. I haven't given up hope yet.

As for those enormously impressive telegrams that invite you to some lavish press party or other and invariably arrive in the wee hours, presaging doom, I groused in April that they either came three weeks ahead of time (at seven a.m.) or at the very last possible minute. One had actually

arrived the day after the big shindig. I can do more than quote you the following, which came just before the fall Hi Fi shows, with amusement on my part:

EDWARD TATTNAL CANBY 780 GCH ST NYK PRESS CONFERENCE TOMORROW TUESDAY HOTEL SHERATON EAST GOLD SUITE 11 AM LUNCHEON TO FOLLOW DEMONSTRATE NEW CONCEPT IN HIGH FIDELITY STEREOPHONIC COMPONENT . . . SORRY THIS IS SO LATE BUT AS NEWLY APPOINTED PUBLIC RELATIONS FOR THIS COMPANY WE ARE JUST DEVELOPING OUR PRESS LISTS TRIED PHONING YOU WITHOUT SUCCESS.

Apology accepted with pleasure—the only trouble was, I had another luncheon date. (Let's not bother about which company it was. Very reputable and very familiar.)

P.S. You can probably dig up a copy or two of the April AUDIO at the office, if you're lucky.

THE OOMCHA COMMODE

Somehow, when I get to grousing about the stuff I like to call *oomcha* music—that sticky sound they dole out in restaurants and banks and via wire and FM multiplex to supermarkets and what-have-you—I don't really feel I'm carrying my AUDIO audience along with me a full 100 per cent. After all, why should a large collection of engineers and technicians collectively dislike a product that uses so much of their own know-how and stock in trade?

In my blacker moods I can imagine each one of you with complete wired music purring softly in your private office, not to mention the bathroom and the front parlor. I can just see thousands and thousands of AUDIO readers basking happily in the sounds I hate, tingling with subconscious pleasure to the gentle, oomching massage upon the ears. Makes me want to get up and run.

Well, I'm not such a snob as I thought. I positively treasure a letter from a certain Paul Davis, AUDIO reader from Lawndale, Calif., that renewed my pristine faith in the old-fashioned ear, the kind that looks music straight in the face and takes it full force. I gotta quote from him or I'll bust.

". . . You hit the nail on the head, about that *oomcha* music. . . . The other day I went into a plumbers store to buy a new commode. He had *oomcha* music on, playing it thru a 6-in. speaker of about 80 per cent distortion. I should have suspected anyone that likes dishwater music as a phoney. I was ready to go stark, raving mad, I had to bear this for a full 10 minutes. Anyway, his prices were flukey. I went to the place that didn't play this distorted honkey-tonk hotel music.

"People call it hi-fi I hear it in the dentists, doctors, supermarkets—I can scream. Why can't they play classical music once in a while. Lucky I have many records at home and can get away from it all."

That's what happens, you see, when you push this *oomcha* business too far. The technical term for it is consumer resistance—but I'd call it justifiable mayhem. Moral: If you want to sell a good commode, DON'T wire it for sound.

Æ

tridge being loose in the tonearm. To rectify this condition, merely tighten the two holding screws.

The chatter tends to show up more on the outside of the disc in contrast to the center. The reason for this is that the angle of the tonearm with respect to the lateral vibration of the groove walls of the record is more favorable to the transmission of vibrations to the loose parts at this time.

Since many 78-rpm records are over-recorded, the arm and cartridge may be unable to cope with the excursion thus produced.

16- and 8-ohm Speakers

Q. Is there anything about the construction of an 8-ohm speaker which would make it superior to a 16-ohm speaker? Howard J. Murray, Philadelphia, Pa.

A. Because the 8-ohm speaker uses less wire on its voice coil than does the 16-ohm speaker, and is therefore likely to be lighter, the 8-ohm unit might possibly respond slightly better to highs. However, a 16-ohm speaker has an advantage that the voice coil can be made quite long. If compliances and magnetic circuits are carefully designed, such a unit will have greater cone excursion.

Such a speaker may have an additional advantage: A 16-ohm speaker usually makes use of the full secondary winding of the output transformer of the conventional power amplifiers, which means that the leakage inductance will be reduced and the efficiency of the output transformer will therefore increase slightly. Since the feedback is taken across the 16-ohm tap in most instances, the peculiarities of a particular speaker system can be more fully taken into account in terms of the over-all system.

I realize that these points may well be challenged, and I advance these possibilities for whatever interest may be created. Actually, the impedance should not have *any* effect on performance in any well-designed speaker. Æ

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TAPE GUIDE

(from page 38)

4. Metal storage cans and storage chests are also available. Some cans are made of special material to shield the tape from magnetic fields produced by motors, transformers, and so on.

5. The Tape-Time Ruler is manufactured by Ferrodynamics Corp., Lodi, New Jersey and is available—at least at the time of writing—free of charge. Not all tape machines contain footage counters or clear and accurate markings under the reel to indicate elapsed time and thereby help the operator locate a desired passage on the tape. The Tape-Time Ruler is placed on the supply reel spindle, and a reading is taken at the outermost layer of tape to indicate the number of feet and playing time left.

While the foregoing has sought to be a comprehensive account of the accessories available to the operator of a tape machine, it is quite possible that some have been inadvertently omitted. If so, the writer asks the indulgence of the manufacturers of such items and will attempt to correct the omission in the near future. Æ

ADVERTISING INDEX