AUDIO

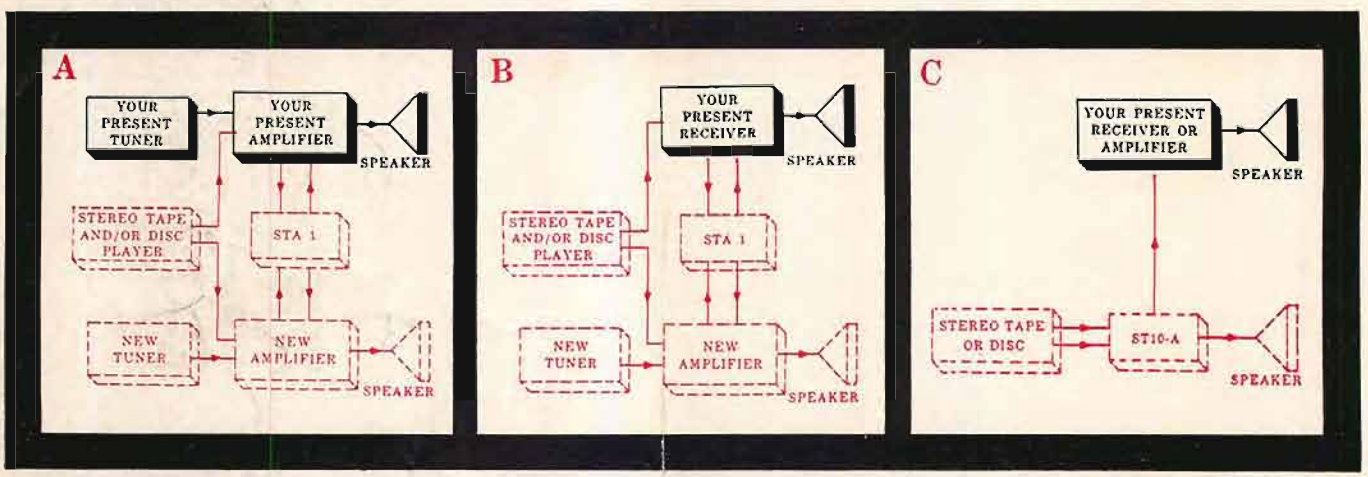
SEPTEMBER, 1958
50¢

...the original magazine about high fidelity!

YOU CAN CONVERT TO STEREO THE RIGHT WAY ...RIGHT NOW!

Even 18-year-old Bogen systems ADAPT EASILY WITH NEW SINGLE-KNOB VOLUME CONTROL

There's stereo in your future if you own a Bogen system (or plan to buy one). In fact, stereo conversion can be made right now on any Bogen high-fidelity system made since 1940! *Not just an added second channel,* but completely integrated, balanced-sound stereo. You pre-set tone and volume controls only once, from then on regulate volume of both channels simultaneously from a single volume control. That's the right way to convert to stereo. Here's how:



STA1 STEREO ADAPTER offers combined volume control plus a control for balancing output of both speaker systems; it permits channel inversion and provides for monaural listening as well. Price: only $13.50**

ST10-A STEREO ADAPTER-AMPLIFIER and a second speaker system give you an economical single-control stereo system. This superb new adapter-amplifier combines two-channel preamplifier and 10-watt amplifier, and of course it has simultaneous volume control. Accommodates stereo tape or the new stereo discs. Price: just $52.50 (with case as shown, $59.50)**

*Series B or later **Slightly higher in the West

A. You can convert to single volume control and easily balance your system with the Bogen STA1 Stereo Adapter if you own any of these Bogen or Challenger high-fidelity amplifiers: AC10*, DB10, DB114, DB125, DB130, PR100, PR100A, PX10, PX15. Simply add the STA1, your choice of speaker and a DB130, DB125, DB114 or AC10*.

B. If you own either the Bogen RB115* or the Bogen RB140, you can convert with the Bogen STA1 Stereo Adapter and the necessary second-channel components, including a DB130, DB125, DB114, or AC10* amplifier.

C. If you own any Bogen or Challenger high-fidelity amplifier manufactured since 1940 or a Bogen high-fidelity receiver, you can convert with the Bogen ST10-A Stereo Adapter-Amplifier and a second speaker system.

EASY AM-FM STEREO CONVERSION: To receive stereo broadcasts from simultaneous AM-FM transmission with your present tuner, add the following Bogen tuners: with any AM tuner, the new Bogen FM51; with any FM tuner, the new Bogen AM91. With any Bogen AM-FM tuner or receiver, add either the AM91 or FM51.

Your Bogen dealer is ready now with complete information on how to convert your system to stereo. See him today!

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SEPTEMBER, 1958 VOL. 42, No. 9
Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

COVER PHOTO—Stereo in the studio. Conductor Leonard Bernstein and violinist Isaac Stern confer during Columbia Masterworks recording session of the Bartók *Concerto for Violin*. Musicians are members of the New York Philharmonic orchestra.

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AUDIOCLINIC??

JOSEPH GIOVANELLI*

AM receiver alignment

Q. What is the correct procedure to be followed when aligning an AM superheterodyne receiver? William Clifford, Chicago, Ill.

A. No single procedure will satisfy the alignment requirements of all receivers. Therefore, the following information should be used only in an emergency. When possible, consult the service notes for the receiver to be aligned.

Figure 1 shows a top view of a typical superheterodyne receiver, including the locations of some of the trimmers and slugs needed for performing the alignment.

You will need an r.f. signal generator whose minimum coverage should be 455–1400 kc. It will be convenient if the generator can be tone modulated. If it cannot, you will need a VTVM, which should be connected across the a.v.c. line. Some receivers have a built-in v.t.v.m.—a tuning eye. If, however, you can use tone modulation, you may connect an output meter across the speaker terminals or you may use your ear to determine sound output. I have found that the ear gives as good results as the meter.

Alignment Procedure: 1. Connect the ground side of the generator to the receiver chassis. 2. Connect the hot side of the generator to the grid of the mixer through a low-value capacitor. 3. Ground the receiver to a radiator or waterpipe. (Omit this step if the circuit is one of the AC-DC types. Failure to observe this caution can result in a blown line fuse and/or damage to the receiver.) 4. Allow the generator to warm up for 15 minutes. 5. Short the oscillator stator to ground with a heavy wire. This will cause oscillations to cease, preventing beats which could result in aligning the i.f. stage at an incorrect frequency. 6. Set the generator to the correct i.f., which is probably 455 or 465 kc. If you guess wrong, the error will probably not show up at all. Advance the volume control of the receiver to its maximum clockwise position. 8. Set the r.f. attenuator on the generator to a point where deflection of the meter pointer or the tuning eye just begins or the tone becomes just audible. 9. Starting from the detector, adjust all i.f. trimmers or slugs for maximum reading on your measuring instrument. If the i.f. stage or stages are severely out of alignment, it may be necessary to reduce the gain on the r.f. attenuator in order to prevent overloading the receiver and the measuring instrument. This completes the alignment of the i.f. stages and we now proceed to the front end.

10. Before making any adjustments here, see that the pointer sweeps the dial scale properly. 11. Remove the hot lead of the signal generator from the mixer grid and loosely couple to the antenna terminal of the receiver through a 3-μμf capacitor. If the receiver uses a loop antenna and has no external terminals, place the hot lead of the generator close to the loop. In all likelihood, this will provide sufficient signal injection to enable you to complete the alignment. 12. Remove the jumper from the oscillator stator. 13. Set the receiver

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

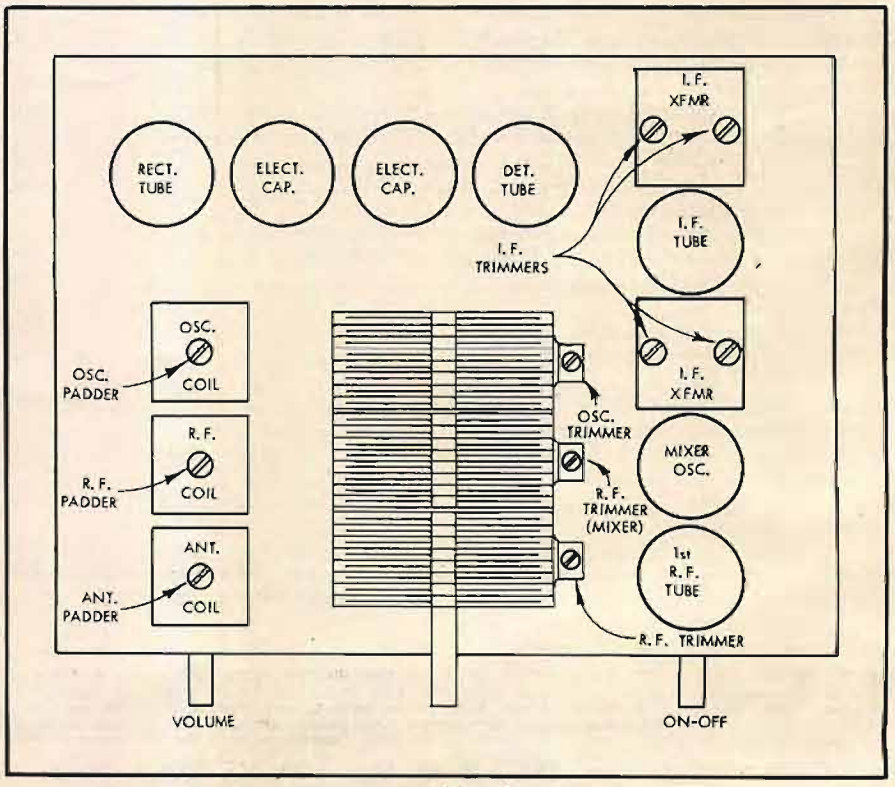


Fig. 1

THE Garrard PAGE

Serving the owners of Garrard—
world's finest record playing equipment...
and other discriminating listeners
interested in high fidelity.

Subject:

Your new records
—Monaural and Stereo—
played on the Garrard...
Changer • Transcription Turntable • Manual Player

Standard Garrard Tone Arm with Stereo Cartridge (underside view through a translucent record)

What records?
Any records... stereo or monaural.

How do they sound?
Uniformly excellent—on any Garrard Player.

Rumble (lateral and vertical), wow and flutter are inaudible, since motors and drives are entirely Garrard built; with pulleys concentric to .0001 of an inch; and rotors dynamically balanced to the remarkable accuracy of .0008 in/ozs. These characteristics, developed originally by Garrard to insure proper performance of very low gain magnetic cartridges, have now been even further refined, and make any Garrard an ideal stereo player.

Which Garrard model?
Any Garrard Record Player or Changer.

They all come wired and ready *now* for stereo *and* monaural cartridges... (Older Garrard models already have the triple pronged plug-in heads to facilitate rewiring.) And Garrard changers have been tested and enthusiastically endorsed by the leading stereo cartridge manufacturers.

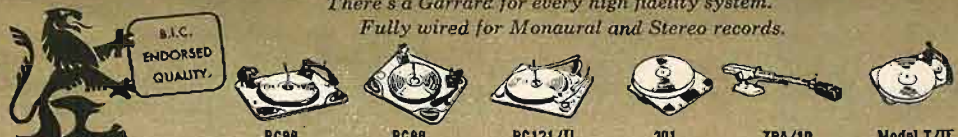
Transcription Turntable or Automatic Changer?
As long as it's a Garrard—this depends entirely on your preference, your budget, and your convenience.

Garrard builds all types... automatic changers, transcription turntables and manual players... all to the identical standards of quality in design, engineering and performance. Every Garrard is a high fidelity instrument; every Garrard automatic changer is a single record player as well. For this reason, it is a fact that most people, even the most critical, prefer the Garrard changer to *any transcription turntable.*

Considering the exciting (but sometimes confusing) developments now taking place in records and playing equipment, we repeat the Garrard policy:

Garrard models change. Garrard ideals do not. Meaningful new features are added. Time-proven features are carefully retained. Gadgets, for the sake of gadgetry, are sternly rejected. The all-important fact to remember is that thirty-five years of experience in designing, testing, and building fine record players, make possible the present Garrard models.

There's a Garrard for every high fidelity system.
Fully wired for Monaural and Stereo records.



RC98	RC88	RC121/II	301	TPA/10	Model T/II
Super Changer	Deluxe Changer	Intermix Changer	Transcription Turntable	Transcription Tone Arm	Manual Player
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and signal generator dials to 1400 kc. 14. Adjust the oscillator trimmer for maximum indication. 15. If your receiver has an oscillator padder or if the oscillator coil is slug tuned, set the dials to 600 kc and adjust the padder or slug for maximum deflection. 16. Repeat steps 14 and 15 until the dial is correctly calibrated at these points. 17. Reset both dials to 1400 kc and adjust all r.f. and/or antenna trimmers for maximum indication on the meter. 18. If there are adjustment screws, either padders or slugs, for the low end of the r.f. and antenna circuits, reset the generator and receiver tuning dials to 600 kc and adjust the r.f. and/or antenna circuits for maximum reading. 19. Repeat steps 17 and 18.

More often than not, the low end cannot be tracked except by bending stator plates of the variable capacitor. This tricky business will not be discussed in detail.

Shortwave Bands. No definite method of aligning these extra bands can be given here because many of them are tracked at one point in the center, others at the high end only, and still others, at both ends of the tuning range under adjustment.

Some engineers believe that it is best to align the receiver with a steady d.c. voltage substituted for the normal a.v.c. voltage. They hold that, because of the Miller effect, the receiver will be misaligned when weak signal generator voltages are used, together with the small amount of a.v.c. voltage which would be developed under these conditions. The d.c. voltage to be substituted must, therefore, be made equal to the normal a.v.c. voltage which would be created when receiving strong, local broadcast signals. I do not subscribe to this view since errors introduced by this method do not become significant until frequencies greatly in excess of those normally encountered in standard receivers are reached.

Fuses in B Plus

Q. Recently I constructed a power amplifier. It is conventional in design, except that, as an added safety measure, I included a fuse in the B plus lead, as well as fuses in each side of the a.c. line leading to the primary of the power transformer. The fuse in the B plus circuit is always burning out when the equipment is turned off. This is particularly strange when you realize that the current rating of the fuse is sufficient to handle the current drain in the amplifier, and that the unit is a Fusetron, designed to take momentary overloads. Why should these fuses blow? Victor Vine, Canandaigua, N. Y.

A. The following explanation is at least partially correct, but before assuming its correctness, make doubly sure about the amount of current drawn from the power supply. If it is more than the current rating of the fuse, it won't take much surge current to blow it. Finally, be sure to see whether the B current exceeds the combined drain of all the tubes plus that of any bleeders which are present in the circuit. If it does, you must find the reason for this extra drain.

Assuming everything is operating normally, the fuses go as a result of the following:

(*Continued on page 48*)

LETTERS

Who Hears 20 cps?

SIR:

As regards your question "Who hears 20 cps?" the answer is, of course, "Nobody"; but the point about testing speakers at this frequency is that those that cannot be heard are always the best. In other words, a poor speaker makes a very nasty noise at 20 cps, and this is one of the quickest ways of assessing the low-frequency performance of a unit or enclosure.

I am sure you do not want another letter from me to appear in your journal this year, but if you could find room just to refer to this explanation I should be much obliged.

G. A. BRIGGS,
Wharfedale Wireless Works Ltd.,
Idle—Bradford,
Yorkshire, England.

(He *may be so sure about his letters, but we aren't.* We *like 'em.* ED.)

Stereo Source on Mono Channel

SIR:

I have been hearing FM broadcasts of stereophonic tape on a monophonic FM station with usually magnificent results. I assume they are mixing the two channels. If the reproduction resulting from this method is superior to monophonic tapes, cannot this method of using stereo tapes or discs be extended to home use? Do you agree that playing both channels of a stereo tape monophonically is superior to the same recording on monophonic tape? If so, would you consider this a stepping stone whereby existing monophonic equipment can be utilized for the present? Assuming my conclusions have some validity, I feel that many enthusiasts would be more willing to take the first step toward stereo if some improvement in results from their present equipment could be anticipated.

J. PUSHKIN,
241 Front St.,
Hempstead, N. Y.

(*Mixing both stereo tracks into one channel should not* necessarily *be better than a good monophonic recording, since it would imply mixing both microphones together. Stereo mike pick-up technique is more demanding, however, and perhaps better overall results might be obtained in that manner. At least, a good stereo pick up—connected to cancel out vertical signals* *(see page 38)**—and fed to a single channel would not damage stereo records, so we would suggest the change to a stereo pickup as the first step toward a conversion.* ED.)

Kays and Emms

SIR:

In your EDITOR'S REVIEW in July you refer to the use of "K" as shorthand for 1000 and ask for comments.

Here are mine.

There is nothing imprecise about using K for 1000. It comes from the French word Kilo meaning 1000 and is well known in the Kilometer and the Kilogram.

If two cathode resistors are described as 1300ω and 1.3Kω respectively, they have (in theory) *exactly* the same value—one is neither more nor less than the other. Is therefore quite proper to use the symbol as an abbreviation for 1000, and it may well be used with any resistance value above 999ω and below 1 Meg.

From this, it is quite correct to describe a resistor of 270,000ω as 270Kω. There is nothing wrong in describing it as 0.27Mω instead, if preferred.

The writer, being an old timer, tends to think of grid leaks in terms of Megs. The modern equivalent of the ¼-Meg. leak is a 0.27-Mω resistor. Anode and screen resistors he thinks of in terms of thousands of ohms, and so, in a single diagram he might describe a 270,000-ω screen resistor as 270 Kω while a similar resistor used as a grid leak might be described as 0.27 Mω. Inconsistent? Well, perhaps, but with a reason and neither is wrong.

On occasion the writer teaches electronics and so has the duty of presenting concepts to the students in the way which will be beneficial to them. Since the use of K for 1000 is well established and internationally accepted, they are bound to meet it continuously during their (electronic) lives and so they are taught about it and use it right from the start. After all, it *is* easier to write 47 Kω for an anode resistance than 47,000ω.

At an international convention about 20 years ago or more, it was decided to drop the usage of "M" as a symbol for 1000, reserving it for Meg, and to use the K for 1000. One is still likely to bump into components on the continent of Europe, particularly on very old sets, in which the M stands for 1000 instead of having its present day meaning of 1,000,000. It is therefore always necessary to warn students about this trap, which with time should become rarer and rarer.

P. G. A. H. VOIGT,
31 High Park Gardens,
Toronto 3, Canada.

SIR:

I want to make a point for the use of rational abbreviations. In the metric system, decimal parts and multiples are named, as in the following tables. In normal usage, only those powers of ten are preferred that have as exponent a positive or negative multiple of three, as: kilo = 10^3, micro = 10^{-6}. For all practical purposes, the list reduced for resistors to milli, kilo, and mega, and for capacitors to micro and pico.

Using these prefixes, values can be printed in wiring diagrams without decimal points, as: 4k7 for 4.7kω; 2M3 for 2.3 Mω, and 220k (not: M22!) for 0.22 Mω.

This system is used in many European countries without creating confusion and I can see no reason why it could not be adopted here more generally and thus bring clarity where inconformity abounds.

A. VAN ROGGEN,
2 Ravine Road,
Wilmington 3, Delaware.

(*Substituting the letter for the decimal point would seem to clarify diagrams and printed material wherein the decimal points occasionally get lost. Hope this can be standardized. Also, we prefer "pf" to the more bulky "μμf" but it isn't usual in U.S. publications.* ED.)

PREFIXES

PREFERRED			OTHER		
Value	Name	Prefix	Value	Name	Prefix
10^{-12}	pico	p	10^{-2}	*centi*	c
10^{-9}	nano	n	10^{-1}	*deci*	d
10^{-6}	micro	μ	10	deca	D
10^{-3}	milli	m	10^{2}	hecto	h
10^{3}	kilo	k			
10^{6}	mega	M			
10^{9}	giga	G			
10^{12}	tera	T			

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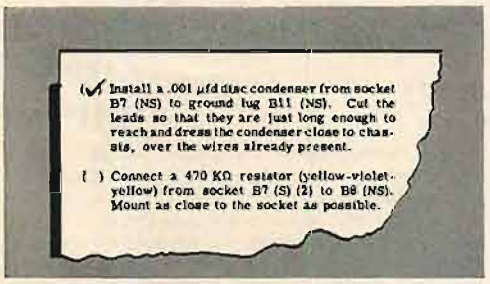

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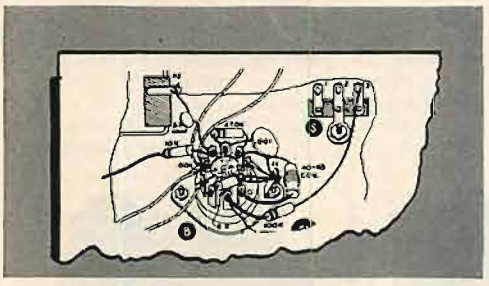

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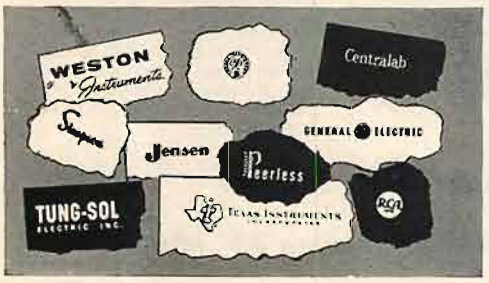

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NEW This beautiful equipment enclosure will make your hi-fi system as attractive as any factory-built professionally-finished unit. Smartly designed for maximum flexibility and compactness consistent with attractive appearance, this enclosure is intended to house the AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier, along with the majority of record changers, which will fit in the space provided. Adequate space is also provided for any of the Heathkit amplifiers designed to operate with the WA-P2. During construction the tilt-out shelf and lift-top lid can be installed on either right or left side as desired. Cabinet is constructed of sturdy, veneer-surfaced furniture-grade plywood ½" and ¾" thick. All parts are precut and predrilled for easy assembly. Contemporary available in birch or mahogany, traditional in mahogany only. Beautiful hardware supplied to match each style. Dimensions are 18" W x 24" H x 35½" D. Shpg. Wt. 46 lbs.

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CE-1T Mahogany
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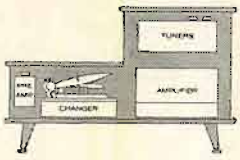

Be sure to specify model you prefer

$43.95 each

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MODEL FM-3A $26.95 (with cabinet)

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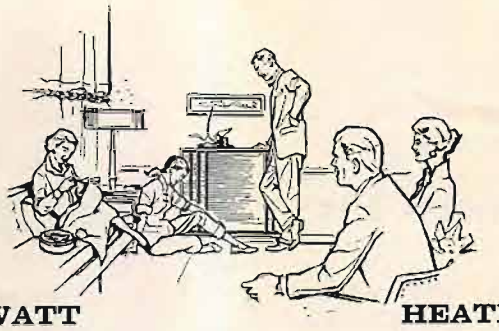


HEATHKIT 25-WATT **HEATHKIT 70-WATT**

MODEL W-5M

$59.75

high fidelity amplifier kits

MODEL W-6M

$109.95

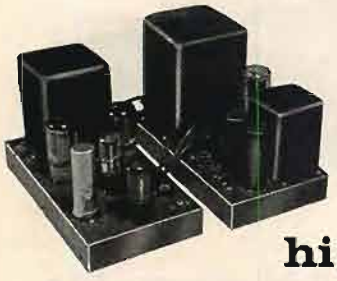
To provide you with an amplifier of top-flight performance, yet at the lowest possible cost, Heath has combined the latest design techniques with the highest quality materials to bring you the W-5M. As a critical listener you will thrill to the near-distortionless reproduction from one of the most outstanding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

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

HEATHKIT DUAL-CHASSIS

MODEL W3-AM

$49.75



HEATHKIT SINGLE-CHASSIS

MODEL W4-AM

$39.75

HEATHKIT

high fidelity amplifier kits

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

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

HEATHKIT

high fidelity amplifier kit

MODEL A-9C **$35.50**

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

HEATHKIT

electronic crossover kit

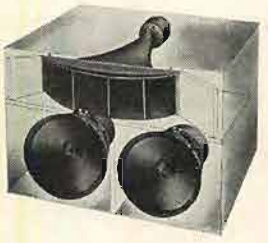
MODEL XO-1 **$18.95**

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

NEW LOW PRICE!

HEATHKIT "LEGATO"

high fidelity speaker system kit



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

MODEL HH-1-C
(Imported white birch)
MODEL HH-1-CM
(African mahogany)
$299.95 each

HEATHKIT BASIC RANGE

HEATHKIT RANGE EXTENDING

high fidelity speaker system kits

MODEL SS-2 **$39.95**

A truly outstanding performer for its size, the Heathkit model SS-2 provides you with an excellent basic high fidelity speaker system. The use of an 8" mid-range woofer and a high frequency speaker with flared horn enclosed in an especially designed cabinet allows you to enjoy a quality instrument at a very low cost. Can be used with the Heathkit "range extending" (SS-1B) speaker system. Easily assembled cabinet is made of veneer-surfaced furniture-grade ½" plywood. Impedance 16 ohms. Shpg. Wt. 25 lbs.

MODEL SS-1B **$99.95**

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

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Don't deprive yourself of the thrill of high fidelity or the pleasure of building your own equipment any longer. Our free catalog lists our entire line of kits with complete schematics and specifications. Send for it today!

NEW! "DOWN-TO-EARTH" HIGH FIDELITY BOOK

THE HOW AND WHY OF HIGH FIDELITY, by Milton Sleeper, explains what high fidelity is, and how you can select and plan your own system. This liberally-illustrated, 48-page book tells you the HI-FI story without fancy technical jargon or high-sounding terminology. **25c**

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AUDIO ETC.

Edward Tatnall Canby

1. CROSSTALK TALK.

Perhaps it's just as well that the new stereo tape magazine is taking its time about a public appearance. A good many of us have been fully occupied with the stereo disc, which finally became a commercial reality in force along in the middle of the summer. The problems inevitable in the first splurge of real, down-to-earth, practical disc stereo (as distinguished from advance hoopla, rosy demonstrations, tests, samples and so on) are now showing up and will continue to show up—I'll make a good guess—for at least a solid year before we reach the semblance of an even keel. It took a lot longer than that, remember, to stabilize the original LP development. More of this shortly. Meanwhile, back to the still-existing vacuum that is the stereo tape magazine.

The RCA Victor tape *magazine*—I hereby adopt that term for good, in place of the wholly confusing "cartridge"—was originally announced for release in June, more or less. My last unofficial checkup turned up the interesting thought (from sources usually reliable, etc., etc.) that the first of the stereo tape magazines would surely be in the stores somewhat after publication of this issue, in mid-September! The first magazine tape machines from RCA, on which to play the new tapes, are scheduled to make a nebulous debut at this point; I gather only that by Christmas time you'll be able to give the kiddies a magazine tape stereo record player without too much buying trouble. (Of course there are others than RCA Victor likely to offer tape magazine players in the near future; they may actually beat RCA to it.)

During the summer there were several repeat RCA Victor demonstrations, following up the excellent one that occurred in late May, as reported here in the July issue. There were only a few, I understand, because *the* tape player was constantly being shuttled back and forth from place to place and so was out of action, or elsewhere, most of the time.

Yep, I mean just that. The best of my guess is that there was exactly *one* RCA Victor tape magazine player in semi-public action during most of the summer. Commercial production of the product wasn't yet under way.

Now don't go jumping to wrong conclusions. I am not implying that there has been more than perfectly normal and expected launching trouble in the magazine tape project. I am *not* implying that things have gone wrong, in any but the usual minor and irritating ways. It's for this very reason that I throw out the above casual information.

What I mean is—do not allow the present slow-motion appearance of magazine tape to fool you into underestimating its coming importance and coming values. I'll stand by all I said in the July issue, perhaps even more strongly now, though no major new information has appeared since the first big publicity break and the stuff is still not available, at this writing, for home trial in person. What I wrote was, shall I say, interpretive speculation, based on the available information as released to the press and on brief press demonstration. What little I have learned indirectly since then has only bolstered me in my conclusions.

In this connection, I had an interesting letter from an Ampex official. (The four-track tape system is a joint enterprise involving both Ampex and RCA.) This official, who is on the inside, was "a little more than slightly disturbed"—as he put it—by the fact that I raised the question of possible cross-effects between the four channels on the new tape. There *is* none, he says, and describes his own Ampex demonstrations to the public, which I wasn't able to hear myself. He also gives technical reasons why there should be none, which I'll get to in a moment, since the idea is certainly interesting to all of us who work or play with magnetic tape.

I'll only suggest, for my own record, that I did raise the question of possible cross-talk between the four channels on one quarter-inch tape simply because it is the immediate and obvious question that will jump into any mind, professional or amateur, when the system is first described. *Four* tracks, on one skimpy little tape? No inter-action between the adjacent channels? Impossible! That is a logical thought, it seems to me, for anyone who is not directly involved in the highly technical area of principles and measurements and performances that are involved.

I suggested, rather circumspectly, that I didn't *hear* any cross-talk at the RCA Victor demonstration. That was at least a statement of fact, in the midst of a lot of speculation! I also suggested that neither RCA nor Ampex would be likely to embroil their respective reputations in a tape system where such an objectionable fault as this might occur in practice. The Ampex official—I'll omit his name merely to keep things for the time being on a plane of generalities—reiterated this idea, which I find thoroughly sound. Frankly, I think you can trust both RCA and Ampex not to have got themselves too far into a technical boo-boo in fundamental respects.

Barring a few inevitable preliminary bugs which we can expect as normal, the four-track magazine system will work, will work well, and will satisfy its "most discriminating" users, as the old phrase used to go. Not everybody—Heaven forbid. There are still lots of people who stick by the 78 as the best record (in its hi-fi micro-groove form—I'd go along with that, too, aside from the little matter of practicality) and who like to play their tape at 15 inches, or 30, for super perfection. But if you'll admit that some of the standard LP records are quite satisfactory and that at least a few 7½ ips commercial tapes are pretty good, then you will have no cause to expect less from the coming 3¾ ips tapes. That's my expectation. I can't say more, because I haven't done any first-hand home testing.

As to that cross-talk matter, Ampex points out a factor that I didn't know about and, I suspect, many tape users would not know about either. I'll quote directly from Mr. ———'s letter.

"It is *not* the proximity of the various tracks on the tape itself [that causes tape cross-talk between channels]. Cross-talk is a transformer coupling phenomenon between the windings on adjacent head stacks. In fact, in this new four-track system we have better isolation between channels than we have ever enjoyed in any previous type of equipment. This is because the tracks are narrower and the spacing between the heads is farther apart by one whole track width, thus allowing for more shielding between the heads."

"The RCA statement that cross talk just doesn't exist is correct. . . . This is no trickery; it is just good design. In fact, the technique of gaining the hitherto unheard-of quality which we have been able to come up with on 3¾ ips tape we consider to be a significant contribution to the art." That's just what I said, in July, you'll note.

In the space between the four dots, above, Ampex describes demonstrations of the system back in April for the recording companies, at which this question of cross-talk came up. The four-track tape, modulated on all four tracks, was pushed sidewise by hand on the heads, to prove that there was, indeed, sound recorded in both directions—that the two tracks not being played were silent until the tape was pushed off its proper alignment. I didn't hear this demonstration, again, but I don't doubt that it happened.

I think the points to note well, in the above account of cross-talk, are that it is not on the tape itself that cross-effects occur, but in the heads, after the signals have been picked up, and furthermore, that there is more space between playing tracks in this system than in the more conventional two-track system.

It would seem to me—speculating again—that this focusses the problem very nicely, on (a) stacked-head design and (b) mechanical alignment of tape motion. As to the first, Ampex would seem to have clinched the matter neatly as far as an outsider is concerned. There is more shielding possible between heads here than in the two-track system, due to the opposite-direction track that takes up space between each pair of tracks in use. Remember (to be simple-minded) that we *never* play all four tracks at once—there is always a blank or unused track next to a track in use. In the head configuration, this space can be given over to shielding. If cross-talk originates in the heads themselves, then Ampex certainly has a point very well taken.

As to the second point, mechanical tape alignment, I'm not quite so sure. I am sure as far as Ampex equipment is concerned. Obviously, Ampex will make its equipment so that the tape is held to accurate motion, minus any sort of side-play that might accidentally bring a piece of a wrong track—even a tiny fringe—under a playing head. I am reasonably confident that the RCA Victor equipment, on a lower price scale, will have licked this problem in principle, and probably in practice too, even at the beginning. But it is a problem.

Professional equipment for making com-

(*Continued on page 80*)

"Rooms 338 and 342, 1958 N. Y. Hi Fi Show"

STEREO
STEREO AND MONAURAL

the experts say... in HI-FI the best buys are

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NEW STEREOPHONIC EQUIPMENT

HF85: Stereo Dual Preamplifer is a complete stereo control system in "low silhouette" design adaptable to any type of installation. Selects, preamplifies, controls any stereo source—tape, discs, broadcasts. Superb variable crossover, feedback tone controls driven by feedback amplifier pairs in each channel. Distortion borders on unmeasurable even at high output levels. Separate lo-level input in each channel for mag. phono, tape head, mike. Separate hi-level inputs for AM & FM tuners & FM Multiplex. One each auxiliary A & B input in each channel. Independent level, bass & treble controls in each channel may be operated together with built-in clutch. Switched-in loudness compensator. Function Selector permits hearing each stereo channel individually, and reversing them; also use of unit for stereo or monophonic play. Full-wave rectifier tube power supply. 5-12AX7/ECC83, 1-6X4. Works with any 2 high-quality power amplifiers such as EICO, HF14, HF22, HF30, HF35, HF50, HF60. Kit **$39.95**. Wired **$64.95**. Includes cover.

HF81: Stereo Dual Amplifier-Preamplifier selects, amplifies & controls any stereo source—tape, discs, broadcasts—& feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Monophonically: 28 watts for your speakers; complete stereo preamp. Ganged level controls, separate focus (balance) control, independent full-range bass & treble controls for each channel. Identical Williamson-type, push-pull EL84 power amplifiers, excellent output transformers. "Service Selector" switch permits one preamp-control section to drive the internal power amplifiers while other preamp-control section is left free to drive your existing external amplifier. Kit **$69.95**. Wired **$109.95**. Incl. cover.

MONAURAL PREAMPLIFIERS (stack 2 for Stereo)

NEW HF65: superb new design. Inputs for tape head, microphone, mag-phono cartridge & hi-level sources. IM distortion 0.04% @ 2V out. Attractive "low silhouette" design. **HF65A** Kit **$29.95**, Wired **$44.95**. **HF65** (with power supply) Kit **$33.95**. Wired **$49.95**.

HF61: "Rivals the most expensive preamps" — Marshall, AUDIOCRAFT. **HF61A** Kit **$24.95**, Wired **$37.95**, **HF61** (with power supply) Kit **$29.95**. Wired **$44.95**.

MONAURAL POWER AMPLIFIERS (use 2 for STEREO)

HF60: 60-Watt Ultra Linear Power Amplifier with Acro TO-330 Output Xfmr.; **"One of the best-performing amplifiers extant; an excellent buy."** AUDIOCRAFT Kit Report. Kit **$72.95**. Wired **$99.95**. Cover E-2 $4.50.

HF50: 50-Watt Ultra Linear Power Amplifier with extremely high quality Chicago Standard Output Transformer. Identical in every other respect to HF60, same specs at 50W. Kit **$57.95**. Wired **$87.95**. Cover E-2 $4.50.

NEW HF35: 35-Watt Ultra-Linear Power Amplifier. Kit **$47.95**. Wired **$72.95**. Cover E-2 $4.50.

HF30: 30-Watt Power Amplifier. Kit **$39.95**. Wired **$62.95**. Cover E-3 $3.95.

NEW HF22: 22-Watt Power Amplifier. Kit **$38.95**. Wired **$61.95**. Cover E-2 $4.50.

NEW HF14: 14-Watt Power Amplifier. Kit **$23.50**. Wired $41.50. Cover E-6 $4.50.

MONAURAL INTEGRATED AMPLIFIERS (use 2 for STEREO)

HF52: 50-Watt Integrated Amplifier with complete "front end" facilities & Chicago Standard Output Transformer. **"Excellent value"**—Hirsch-Houck Labs. Kit **$69.95**. Wired **$109.95**. Cover E-1 $4.50.

HF32: 30-Watt Integrated Amplifier. Kit **$57.95**. Wired **$89.95**. Both include cover.

HF20: 20-Watt Integrated Amplifier. "Well-engineered" — Stocklin, RADIO TV NEWS. Kit **$49.95**. Wired **$79.95**. Cover E-1 $4.50.

HF12: 12-Watt Integrated Amplifier. "Packs a wallop"—POP. ELECTRONICS. Kit **$34.95**. Wired **$57.95**.

SPEAKER SYSTEMS (use 2 for STEREO)

HFS2: Natural bass 30-200 cps via slot-loaded 12-ft. split conical bass horn. Middles & lower highs: front radiation from 8½" edge-damped cone. Distortionless spike-shaped super-tweeter radiates omni-directionally. Flat 45-20,000 cps, useful 30-40,000 cps. 16 ohms. HWD 36", 15¼", 11½". **"Eminently musical; would suggest unusual suitability for stereo."**—Holt, HIGH FIDELITY. Completely factory-built: Walnut or Mahogany. **$139.95**; Blonde, **$144.95**.

HFS1: Bookshelf Speaker System, complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range. Capacity 25 w. 8 ohms. HWD: 11" x 23" x 9". Wiring time 15 min. Price **$39.95**.

FM TUNER

HFT90: surpasses wired tuners up to 3X its cost. Prewired, pre-aligned, temperature-compensated "front end" — drift-free. Precision "eye-tronic" tuning. Sensitivity 1.5 uv for 20 db quieting — 6X that of other kit tuners. Response 20-20,000 cps ±1 db. K-follower & multiplex outputs. **"One of the best buys you can get in high fidelity kits."** — AUDIOCRAFT KIT REPORT. Kit **$39.95***. Wired **$65.95***. Cover $3.95.

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EDITOR'S REVIEW

HERE WE GO AGAIN!

WITH THE FIRST of September, we begin to gird ourselves in preparation for the hi-fi show season. As a matter of fact, we rather enjoy shows—and there is always a feeling of being "let down" after each one of them closes. Unfortunately, we will not be able to attend all of them this year because there are just too many—eighteen in all scheduled for the U. S. during the months of September, October, and November, and all extending through weekends. Now there are only thirteen weekends in those three months, so there are naturally some duplications—five of the weekends have two shows each, one weekend has three, and only Albany, Rochester, New York, Cleveland, and Seattle have weekends all to themselves.

The Institute of High Fidelity Manufacturers has the New York Show from September 30 to October 4; Philadelphia from October 10 to 12; and Milwaukee from October 24 to 26. The Chicago Show, run by the International Sight and Sound Exposition, occupies the weekend of September 19–21, sharing the days with Syracuse and its Rigo show. Boston, St. Louis, and Detroit share October 17 to 19. Montreal shares October 30 to November 1 with Indianapolis, although Indianapolis starts a day sooner and lasts a day later. Detroit has two shows scheduled—the Rigo show from October 17 to 19 and an independent group from November 7 to 9.

This is ridiculous. The major shows are costing the larger exhibitors from three to five thousand dollars each, with proportionately lower costs in the smaller shows. Hardly a week passes in the late summer but what we receive a contract for another show with an invitation to exhibit. But while we would like to attend every show there is, it finally becomes prohibitive—and if it is prohibitive to us with relatively little material to transport around the country, (and lets face it, we generally have nothing left to ship back), what must it be to those exhibitors who have box after box of speakers, amplifiers, tape recorders, phono equipment, and so on, to say nothing of a large staff who must be in attendance.

We are heartily in favor of high fidelity shows—we should be, since we originated the idea 'way back in 1949. But we firmly believe there should be some agency which could serve as a "clearing house" for dates, with a more reasonable distribution of locations and times. To enable manufacturers to schedule their participation and budget expenses, it would be desirable to have a deadline for filing show plans for each coming season—say, March 1. Those dates in conflict could then be ironed out, amicably, we hope, and then with a definite schedule ahead to plan for, manufacturers could finalize their arrangements with the assurance that they wouldn't be required to juggle show plans a half dozen times during the year.

Most advertising is planned in advance for a year at a time, and budgets are made accordingly. Hi-fi shows are just another form of advertising, and should be treated the same way.

We still like hi-fi shows, but we would like to see a little more order in their planning and arrangement.

STEREO MULTIPLEX

With the granting of temporary authorization by the FCC, station WBAI in New York will begin stereo multiplex broadcast tests around the first of September. This is a temporary expedient to permit the station to evaluate the engineering aspects of multiplex operation as a medium for compatible stereo broadcasting—heretofore, multiplex operation has been solely for supplemental services such as background music, paging, and so on. The original objective of the Subsidiary Communications Authorizations was to allow the station to "draw financial sustenance from them."

There are at present two opposing camps as to what the FCC's final rulings should specify for the multiplex operation. One believes that in the interests of optimum quality only one sub-channel should be permitted—and that the sub-channel could be used *either* for stereo broadcasting *or* for background services. The other contends that a station should be permitted to use two sub-channels, allowing for both services simultaneously. Both sides present good arguments for their respective stands. Engineering tests of the degradation of quality resulting from two sub-channels as compared to only one will be studied carefully before any decision is made by the FCC.

Be that as it may, we will present next month the details of an adapter which will be commercially available within a few weeks.

ERRATA

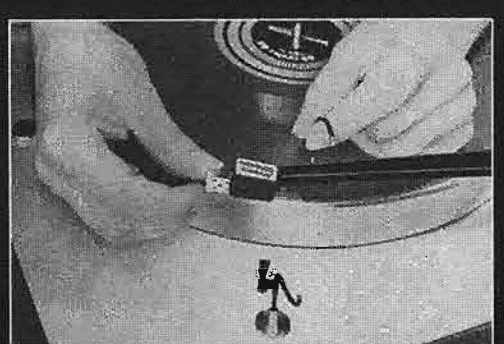
Mr. E. F. Worthen, author of the article on the Isodyne phase inverter in the August issue, calls our attention to two errors in the last column on page 27. Measured IM distortion on the amplifier is below *.02 per cent* at up to 30 watts instead of below 0.2 per cent —which is rather a big difference. Similarly, the distortion at 45 watts should have been listed as *.06 per cent*, and frequency response ±0.5 db from 10 to *100,000* cps—which is another big difference. Also, we note that our own article lists *EL34's in the* parts list on page 57, instead of the EL84's that should have been there.

Sorry, but those things do seem to happen.

Complete* Compatibility

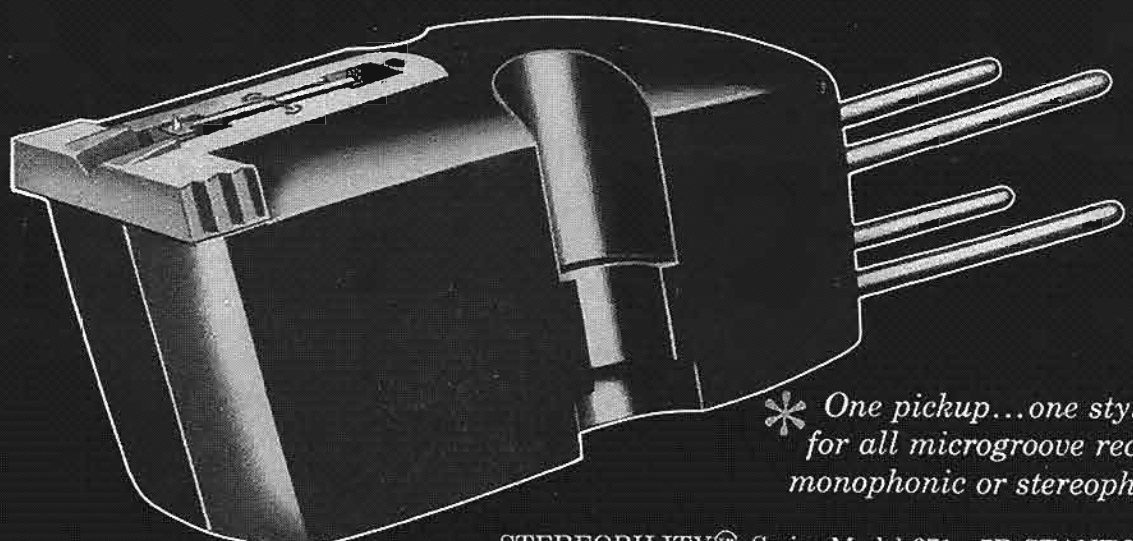
with no compromise in quality!

For the first time—a pickup with all of the compliance, frequency response and distortion-free performance required for the highest quality reproduction.



The *compatible* STANTON 45X45 Stereo-FLUXVALVE *defies obsolescence* . . . exclusive T-GUARD stylus assembly with .7 mil diamond will play all microgroove records . . . monophonic or stereophonic. No bothersome plugging, switching or other manipulations necessary when changing records, they can even be stacked on a record changer for fully automatic operation.

℠ STEREOBILITY—Pickering's trademark, established to serve as a quality mark which guarantees complete compatibility, stability and flexibility in operation and performance.



* *One pickup...one stylus... for all microgroove records, monophonic or stereophonic!*

STEREOBILITY℠ Series Model 371—.7D STANTON 45X45 Stereo-FLUXVALVE cartridge with .7 mil diamond in T-GUARD stylus assembly. **$29.85**

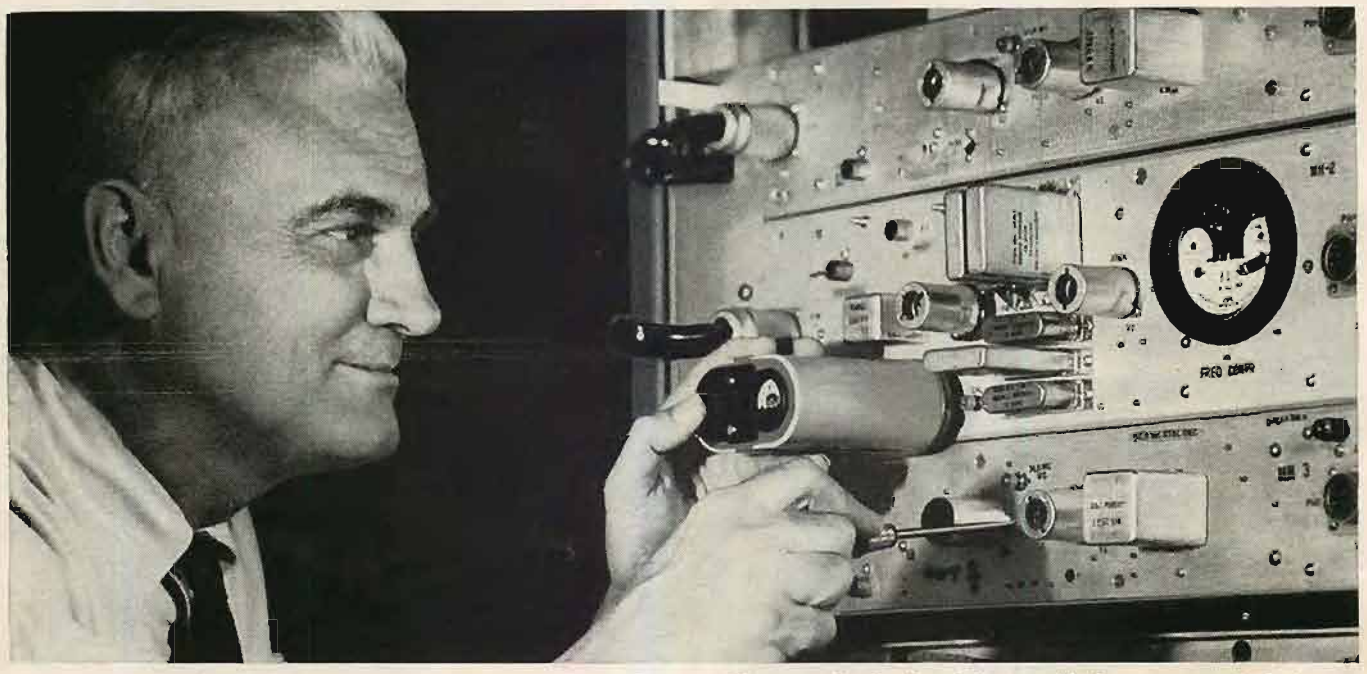
FREE—"IT TAKES TWO TO STEREO." Write today for your copy.

"For those who can hear the difference"

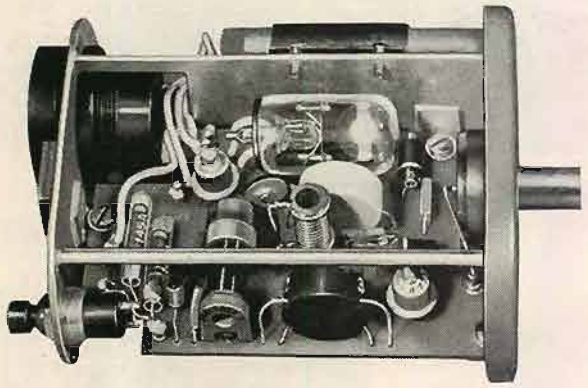
FINE QUALITY HIGH FIDELITY PRODUCTS BY

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

Bell Laboratories Announces Pocket-Sized Frequency Standard for Microwave Systems



Lawrence Koerner, who developed the portable frequency standard, demonstrates how the device can be plugged in at a radio relay station to supply a checking frequency. Battery-powered, the device maintains precision calibration for several months.



Inside the portable frequency standard. Four Laboratories-developed devices make it possible: (1) transistor, which converts the power from a battery to radio frequency oscillations; (2) voltage reference diode, which maintains constant voltage; (3) piezoelectric crystal unit of superlative stability; (4) thermistor, which corrects for temperature variations.

Microwave radio relay systems depend critically on the accuracy of their "carrier" frequencies. At scores of relay stations along a route, carrier frequency oscillators must be checked periodically against a signal from a precise standard.

In the past, the maintenance man has had to obtain his checking frequency by picking up a standard radio signal from a government station. This operation takes time—and requires elaborate equipment.

With a new *portable* frequency standard developed by Bell Laboratories engineers, the job is much simplified. To check an oscillator, the portable standard is plugged in, and a button is pressed. In seconds, it supplies a checking frequency accurate to one part in a million.

Until now, such precision in a frequency standard has been obtainable only in a laboratory. The new portable standard makes it available for routine use in the Bell System. First use of the standard will be to maintain frequency control in a new microwave system for telephone and TV, now under development at Bell Laboratories.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

A Simplified Control Unit

ROBERT G. CHAPLICK*

Believing it is not enough to propose simplicity in an audio system and then leave it at that, this author follows his own advice and describes a preamplifier unit designed in accordance with the principles presented some months ago

ALTHOUGH MANY CIRCUIT diagrams of preamplifier control units designed to be built by the user have been published, none has shown agreement with the philosophy of system simplicity proposed by the author ("System Simplicity in Audio," AUDIO, January, 1957). The object of this paper is to present further arguments on the advantages of simplification as applied to a reproducing system. Chief advantages are reduction of distortion and improvement of reliability. Reduction of the number of parts and of cascaded controls which duplicate each other not only decreases the distortion but, since reliability is inversely proportional to the number of parts, improves the reliability.

The philosophy of simplification includes the assumption that the user will not experiment with all types of input equipment but will settle on the best that he can afford. He will strongly resist the hi-fi dogma that equipment purchased at 12 noon is obsolete at 12:01 P.M. Quantitative and qualitative laboratory tests have shown that most of the current, better quality phonograph re-

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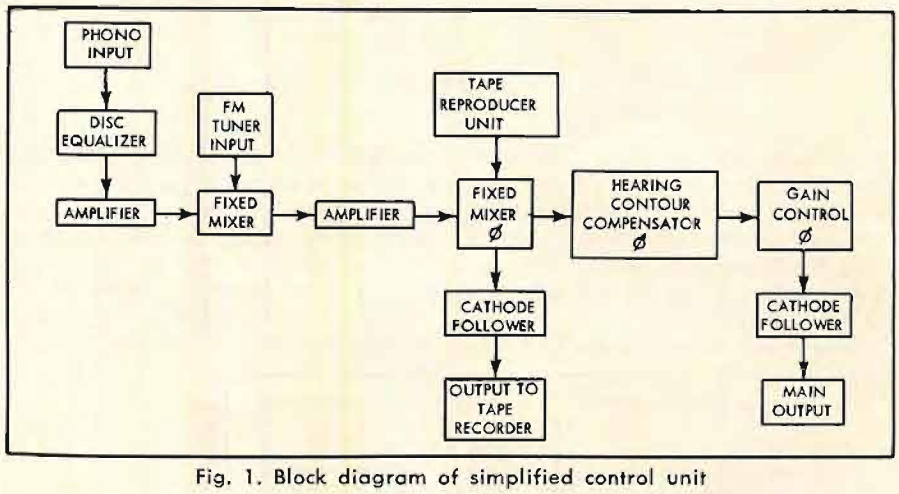


Fig. 1. Block diagram of simplified control unit

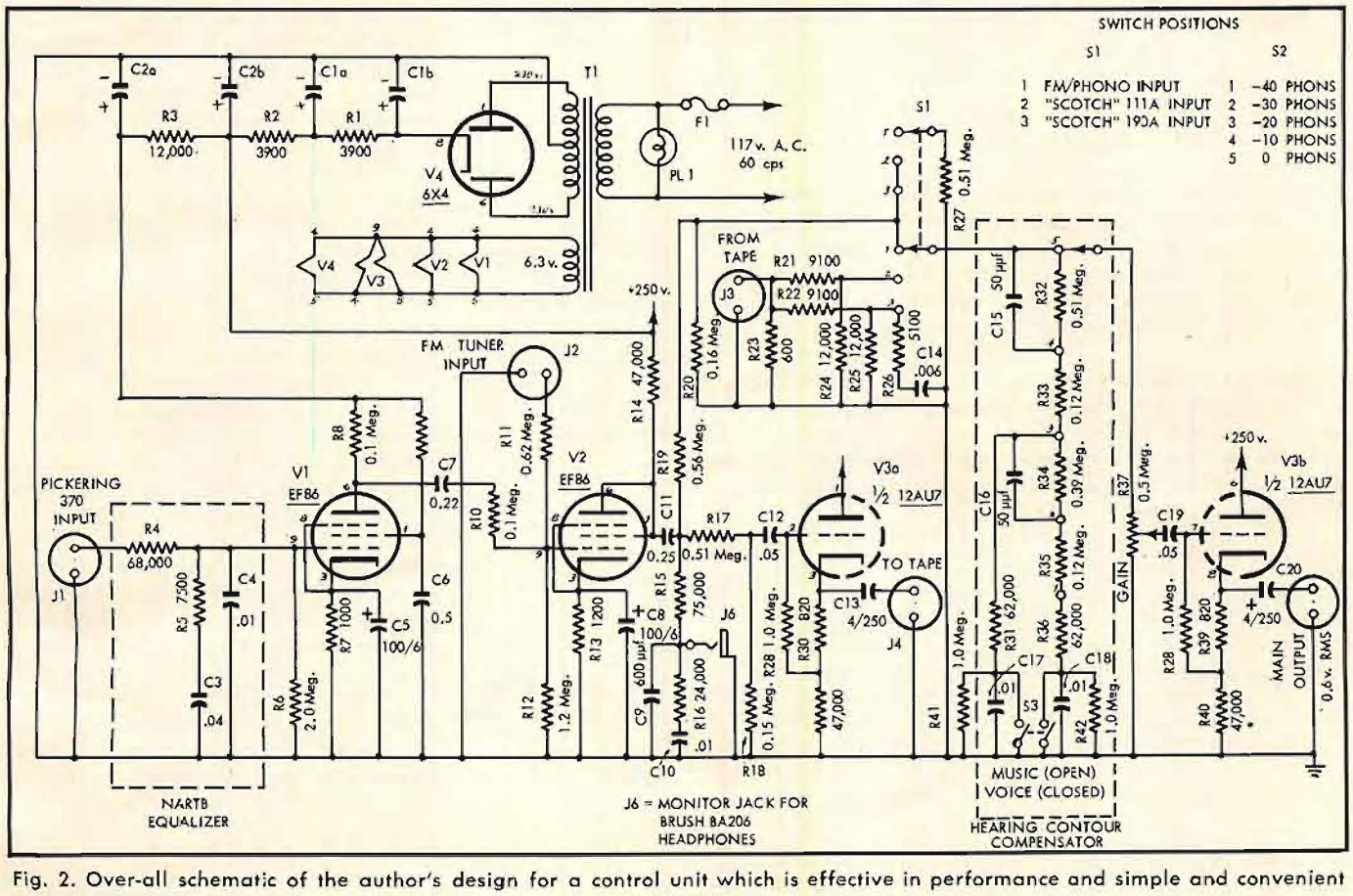


Fig. 2. Over-all schematic of the author's design for a control unit which is effective in performance and simple and convenient to operate

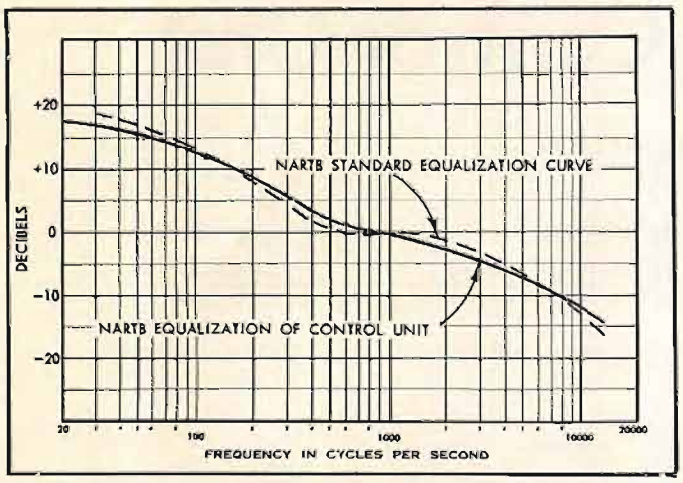


Fig. 3. Comparison between equalization provided and the standard NARTB (RIAA) curve

producers are about equal in excellence. The same is true for FM tuners using Armstrong circuits and also for professional-quality tape recorder-reproducers.

The components to be controlled by the author are a Pickering 370 cartridge, a Harman-Kardon FM-100 tuner, and an Ampex 601 tape recorder. The control unit is to have a minimum number of controls and adjustments and a fixed passive network wherever equalization is needed. In addition, the input signal should be able to be monitored continuously as a tape record is being made.

The phonograph cartridge has an output of 25 millivolts for a stylus velocity of 9 centimeters per second; the tape reproducer has an output of 1.228 volts (+4 dbm in 600 ohms); and the average peak output of the tuner, with its gain control fixed at its maximum position, is 1 volt at 30 percent signal modulation. A low-impedance output of 0.6 volts is required to drive the 30-watt power amplifier to half power (this allows 3 decibels for overdrive).

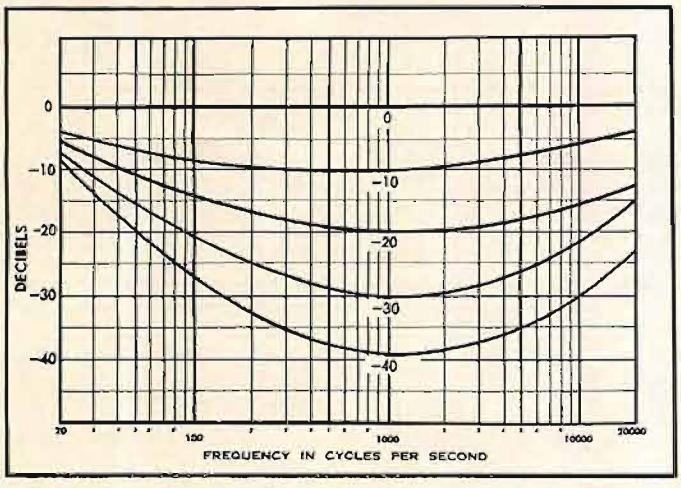


Fig. 4. Response curves of hearing contour compensator at various settings.

With the use of these design parameters a simple circuit was designed. A block diagram and an over-all schematic are presented in *Figs.* 1 and 2 respectively.

Conventional circuits are used exclusively, so detailed explanations are not necessary, but descriptions of certain portions are given in following paragraphs. To minimize the number of tubes, amplification is based realistically on actual needs. The amplification factor for design purposes is the difference between the average maximum voltage of each source and that needed to operate the power amplifier.

Essentially, the control unit is a two-stage amplifier with two cathode-follower outputs. Signal sources are mixed by means of resistive networks which assure the proper levels. Because each source has its own power supply, each input signal is removed by cutting off the power. Thus, a selector switch is not needed.

Disc Equalization. Although five equalization curves were formerly advocated, the RIAA curve has proved to be adequate for all long playing records, which are used exclusively. An RC network is used to obtain the equalization curve (*Fig.* 3). Values are first computed. The circuit is then built and corrected by component substitution in conjunction with frequency measurements to give desired equalization.

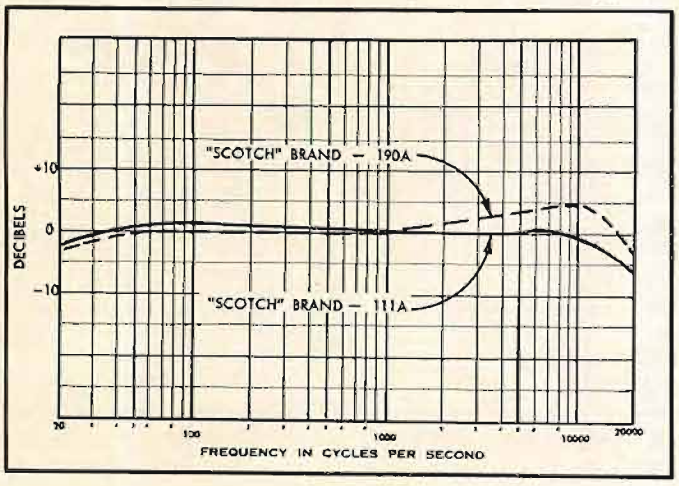


Fig. 5. Record-Listen frequency response of tape on Ampex 600 tape recorder

Hearing Contour Compensation

A "Hearing Contour Compensator" is being used with great success in place of separate bass and treble controls. Briefly, this Compensator improves the realism of reproduction by compensating for the difference in level between the intensity of the sound of the live orchestra at the recording session and that reproduced at a necessarily lower level in the living room. It compensates for the variations in human hearing sensitivity to sounds of different loudness. The principle of the Compensator is based on the study of the differences between Fletcher-Munson curves rather than on the contour of any one curve. The Compensator is designed to perform in fixed calibrated steps of 0, −10, −20, −30, and −40 phons, where the figures indicate the difference in phons between the original and reproduced program levels. The appropriate attenuation is designed into the Compensator. For speech reproduction a switch is provided to retain the attenuation but to remove the compensation. Music equalization is completely wrong for speech reproduction because speech, to provide naturalness, should be reproduced at about the same level as the original source, and hearing contour compensation is not needed. *Figure* 4 presents the response curves of the Hearing Contour Compensator. When compared with the characteristics of many commercial controls, these curves may seem to provide less emphasis to the middle low frequencies. This, however, is not the case. The Hearing Contour Compensator does not depart from the characteristic indicated as needed by the Fletcher-Munson curves.

Correction for deficiencies in the loudspeaker or any other component does not enter into the design. The bass response of the selected loudspeaker is adequate. More realistic sound is achieved by elimination of any booming juke box effect.

Tape reproduction. In his program of system simplicity the author uses only two types of tape: Scotch 111A and 190A, since the tape recorder equalization is set for these tapes. *Figure* 5 shows the frequency response of the Ampex 601 using these tapes. Although the response using 111A tape is essentially flat, the 190A tape causes a 5 db rise above 1000 cps. A loss network, added to the control unit so that 190A tape will be reproduced with a flat response, is located at the "tape-FM/Phono" switch. This switch is necessary to prevent a feedback loop during tape playback and to permit both wanted and unwanted program material to be heard so that undesired signals (such as commercials) can be eliminated. Also, the original source for a tape record can be monitored by either headphones or loudspeaker.

Gain Control. This control is actually unnecessary. Acoustic shocks, however, are avoided by fading in and out the signal. The operating procedure is to set the Hearing Contour Compensator to the desired listening level. Then the program is brought in by turning the gain control *FULLY* clockwise. Thus, maximum use of the gain control is realized by full rotation instead of that portion produced by the 10 per cent rotation common in most volume controls.

Power Supply. The power supply is extremely conventional. No trick circuits are necessary. An elaborate power supply to produce direct current for the filaments or the necessity for biasing the filaments "above ground" is unnecessary through the use of low-noise, nonmicrophonic tubes. The electrolytic capacitors are mounted on the phenolic wafers supplied, and the holes punched in the chassis are large enough so the can will not be grounded. A ground loop is thus eliminated, reducing the possibility of hum pickup.

Monitor Circuit. During recording the input signal can be monitored continuously by means of the loudspeaker. However, there are times when headphones are preferred. An equalizing circuit designed exclusively for the Brush BA-206 headphones is included. This circuit provides a fixed Hearing Contour Compensator and makes the sound from the headphones as much like the sound from the loudspeaker as possible.

Construction. The location of the various small assemblies is slightly unconventional for home equipment but standard for rack-mounted equipment. The tubes, electrolytic capacitors, and so on, are mounted on the rear of the chassis, and the controls are on the front panel. This design permits mounting the control unit with either a horizontal or vertical front panel.

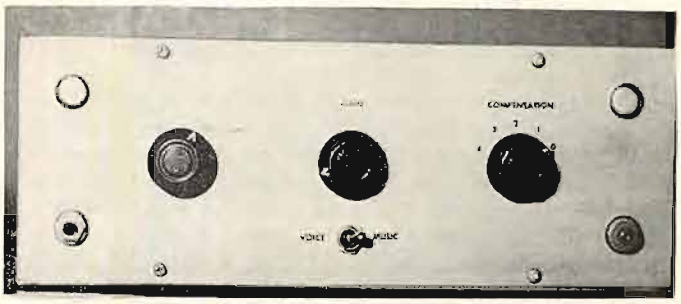


Fig. 6. Front view of control unit.

Figures 6 and 7 show the front and rear views of the assembled unit. The unit with the front panel opened is shown in *Fig.* 8.

The layout for drilling and punching the chassis is shown in *Fig.* 9. The dimensions should be followed closely in order to prevent the small assemblies from shifting and interfering with each other.

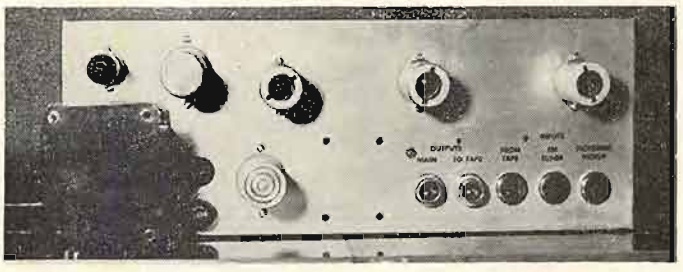


Fig. 7. Rear view of control unit. Tubes with shields from right to left are V_1, V_2, and V_3. Tube in upper left corner is 6X4.

Some remarks about the parts are necessary. Adherence to the suggested list is urged because all the parts are chosen from the standpoint of size, tolerances, and proved reliability.

Parts with larger tolerances may be necessary for tailoring equalizer circuits exactly; for other uses they are permissible, but many measurements and considerable substitution of parts could be necessary to achieve desired results. The parts list also reflects the experience acquired during the actual construction.

The design of the wiring is shown in *Fig.* 10 and should be followed closely. The individual parts are located for minimum hum. Standard telephonic techniques are employed. All parts are mounted on the Vector socket turrets, the electrolytic capacitors, or on switches. Thus, any small assembly can be replaced easily and without disturbing any other assembly.

The best method for assembly is as follows. All parts are mounted and soldered onto the Vector socket turrets. All resistors and capacitors should be checked to ascertain that the resistors are not open and that the capacitors have a high resistance. After the turrets are inside the chassis, substitution of parts is not particularly easy. Wires do not have to be wrapped around the terminals before soldering. Even the U. S. Navy has accepted finally the fact that solder has sufficient strength to support parts. After the turret assemblies are complete, they are mounted on top (yes, on top) of the chassis. Now the Vector socket turrets are completely wired. This top of chassis technique, which provides plenty of working room, offers the greatest accessibility and ease of wiring. Although these turrets are handy little gadgets, once they are loaded with parts and mounted within a chassis soldering at the tube terminals is very difficult.

Twisted pairs of color coded wires are used profusely. The color code removes

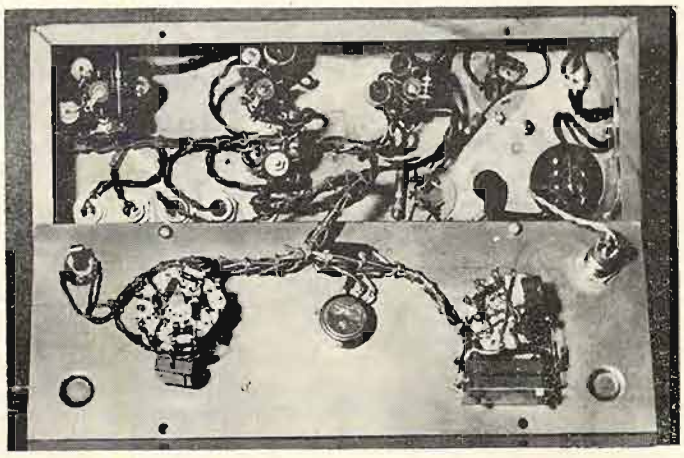


Fig. 8. Control unit with front panel open. On panel from left to right are headphone jack, tape/FM/phono switch, gain control, music-voice switch, hearing contour compensator, and pilot light. Vector turrets from left to right are V_1, V_2, and V_3.

the necessity for locating the end of a particular wire with an ohmmeter. A pair of wires should not be twisted by grabbing one end and twisting the other. The proper method is childishly simple. Two pieces of wire are cut to the desired length. One end of each is clamped together in a vise. A wire is grasped in each hand close to the vise. Then each wire is twisted clockwise with the fingers. At the same time the wrists are moved about each other counterclockwise. This action is repeated until the pair are twisted together. The twisted pair will be neat, tight and symmetrical. Describing the action is far more awkward than doing it.

The twisted pairs that go to switches should be soldered at the Vector socket only. The filament, plate and ground leads are laced at this time. The wired sockets are removed from the top of the chassis and relocated inside after all soldered joints have been inspected. After the remainder of the parts are mounted on top of the chassis, the power supply circuits are wired completely and laced into a cable.

Switches are assembled next. For reliability all active contacts are wired in parallel. Most of the resistors and capacitors require their leads to be very short. Extreme caution should be used in soldering so that the parts will not be overheated. An angle bracket (*Fig. 9*) is used to mount C_{17} and C_{18} on S_2. Switch S_2 and its bracket are mounted to the front panel and these capacitors are bolted to the inside of the bracket. Resistors R_{31} and R_{36} then complete the compensator circuit. The controls, monitor jack, and pilot light are mounted on the front panel. Once the twisted pairs of wires have been cut to length, the wiring can be completed. Lace as indicated. Those pairs of wires connecting the controls to the remainder of the circuit should be long enough so that the front panel can be opened at least 90 deg. without straining the wires.

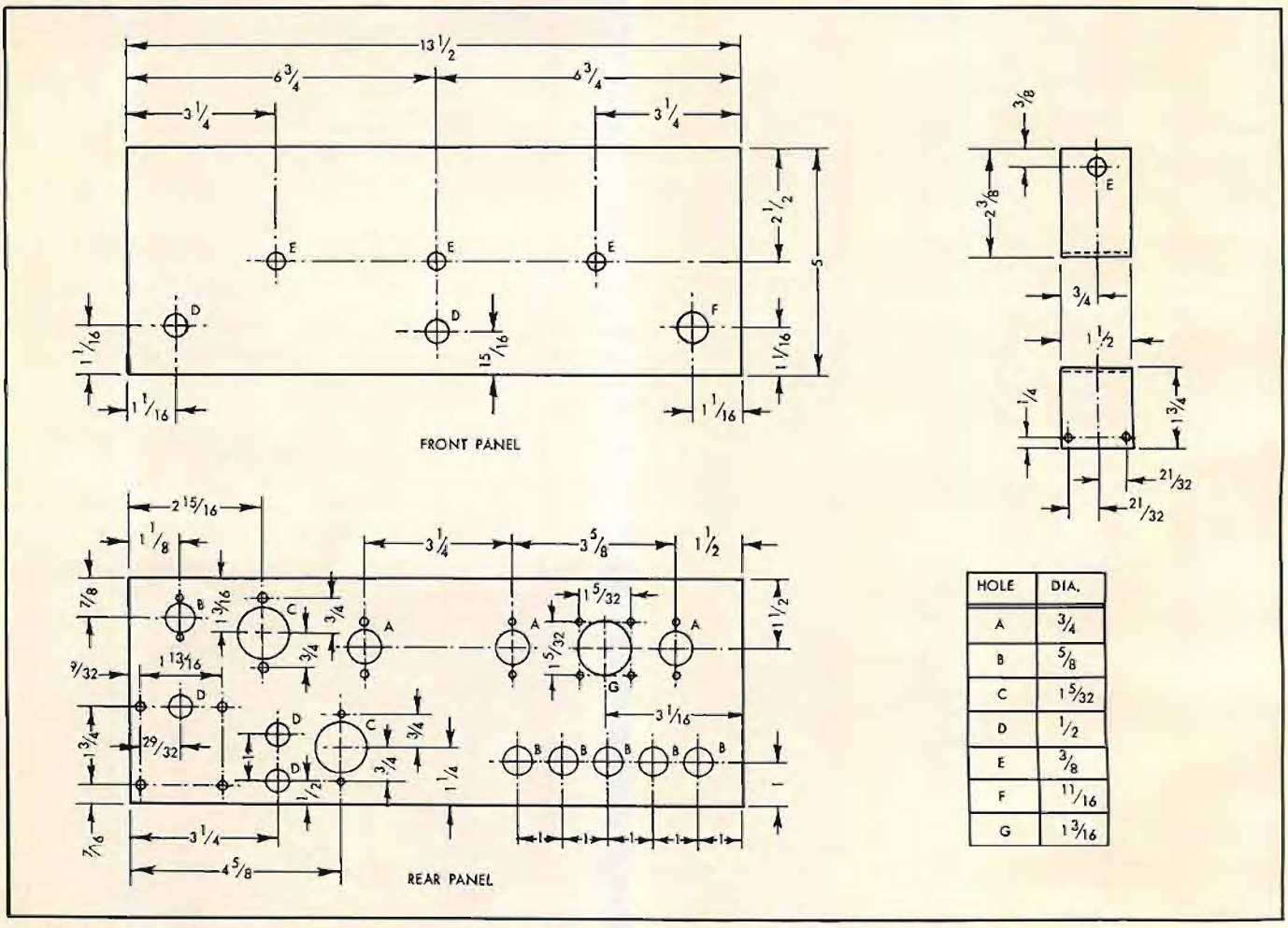
Each soldered joint should be reinspected. The filament and plate leads are checked for "shorts" to ground. If the unit passes a mechanical and electrical inspection, the front panel can be installed, the tubes and shields inserted, and the control unit is complete.

Construction of this amplifier was not without its problems. The proximity of the Hearing Contour Compensator to the power supply resulted in hum caused by electrostatic coupling. The electrostatic coupling can be removed by shielding which, in turn, can be accomplished by two methods. First and the more difficult of the two, the compensator switch can be completely enclosed in a metal box. In this case the switch recommended is Centralab PA-2002. Second and easiest, a shield can be mounted on the back of the switch, in which case Centralab switch PA-2010 should be used. This switch has two sections each having two poles and 2 to 6 positions. The rear section should be removed, and an intersection shield (Centralab catalog P-320) should be substituted. Although it is not shown in the photographs, the author employs the first method.

Observant readers will notice some discrepancies between the parts list and the parts visible in the photographs. The power transformer shown was employed because it was available. Unfortunately, male chassis connectors in the Amphenol type 80 series are no longer available. Anyone who wishes to duplicate this unit will have to employ short cables with male connectors (J_4 and J_5) for the outputs.

Results

The first model of the control unit did not have input transformer T_2. However, the noise level and gain of the first stage was unsatisfactory. The perform-



HOLE	DIA.
A	3/4
B	5/8
C	1 5/32
D	1/2
E	3/8
F	11/16
G	1 3/16

Fig. 9. Chassis layout. Screw-hole diameters for mounting of parts are left to discretion of builder. At right is shown bracket for S_2.

ance was improved by the addition of input transformer T_2 (Chicago Transformer WF-28) in conjunction with shield SH_1 (United Transformer shield A-33). The transformer is mounted between V_1 and V_2 with the name plate towards V_1. Then the shield is bolted to the transformer. During these tests considerable variation of hum pickup and microphonics was discovered in the EF-86. Therefore, three or four EF-86's should be purchased, and the one least subject to hum pickup and microphonics should be used for V_1.

The results of the construction of this control unit have more than compensated for the expense and time. The disc equalization is known to be within ±2 db of the standard curve. A more exact curve can be obtained by changing values of R_4, R_5, C_3, and C_4. However, the time involved to get an exact curve is not justifiable. Background noise is extremely low. With either FM tuner or disc input the noise is −61.8 db below the 0.6-volt output. With tape input the noise is even lower: −91.7 db below the 0.6-volt output. Compensation is provided for the differences between 111A and 190A tape. The Hearing Contour Compensation is the heart of the unit and audio system. Greater realism is achieved since the design is on a more scientific basis than that which depends upon the manipulation of bass and treble controls. The monitor circuit has another advantage besides being an aid in eliminating commercials. If one wishes to listen late at night without disturbing anyone, the power amplifier can be turned off and headphones used exclu-

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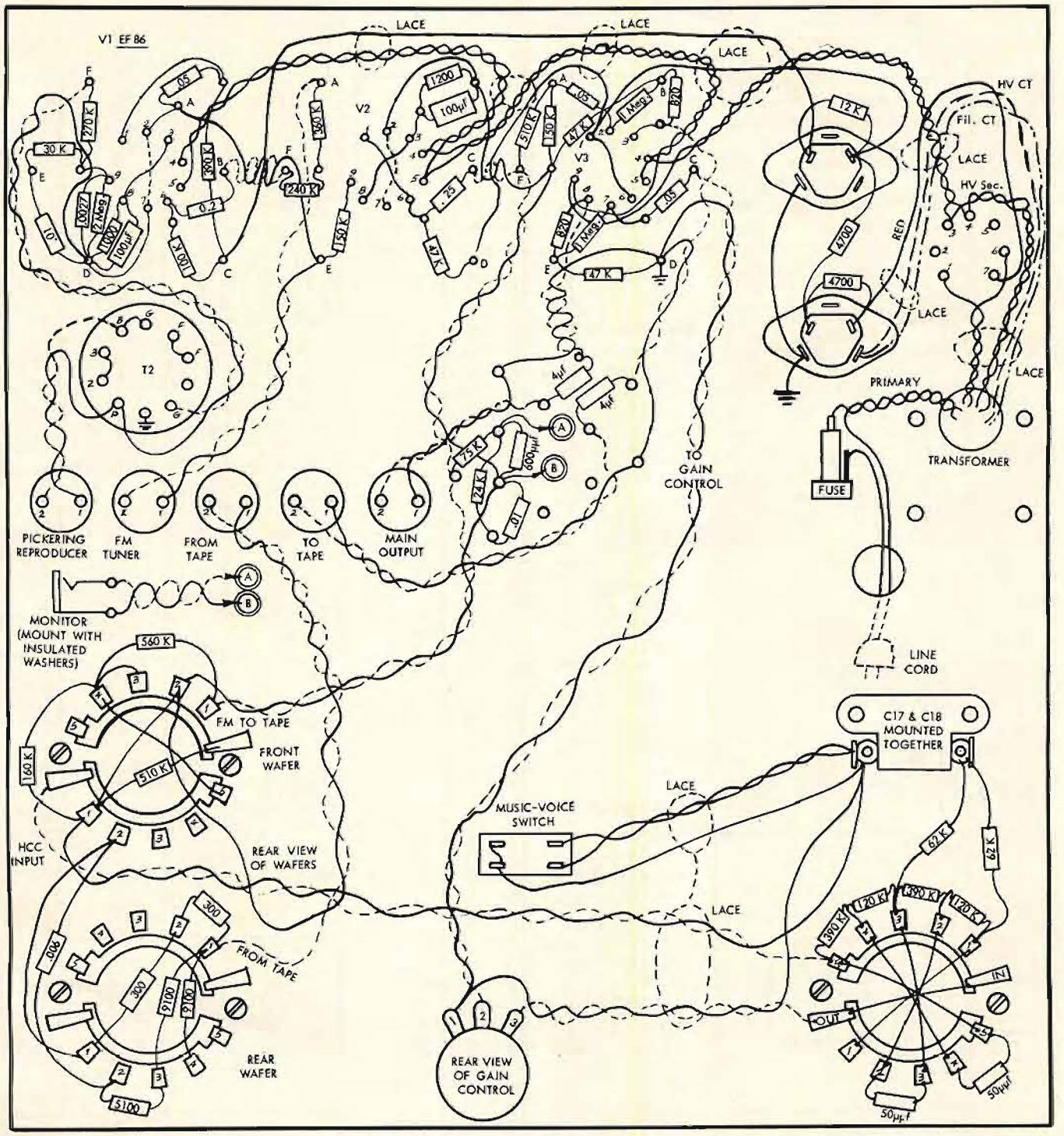

Fig. 10. Complete wiring diagram of control unit.

Measurement of Amplifier Internal Impedance

W. H. ANDERSON*

An analysis of the possible errors which may be encountered with various methods of measuring output impedance, and a suggested method which minimizes the errors.

NINETEEN FIFTY-FIVE will probably go down in automotive history as "Wraparound Windshield Year." For similar reasons it will likely be called "Controlled Damping Year" in audio circles. While not wishing to get involved in the controversy as to how much damping is optimum, it is surely safe to point out that the source impedance the speaker sees is important for two reasons:

1. It determines the terminal voltage behavior in the face of inevitable speaker impedance change accompanying frequency change.
2. It is the load when the speaker acts as a generator and releases stored energy.

The determination, on paper, of such source impedances generally presents no particular problem. When no feedback is present, the speaker looks back into the secondary ohmic resistance plus the resistance transformed down from the primary. This primary resistance includes the primary ohmic resistance plus the a.c. plate resistance of the tubes. For instance, *Fig.* 1 shows two 6V6 triodes (plate resistance about 2000 ohms each) feeding a 13-ohm load.

The source resistance seen by the load would be $1.0 + (2 \times 2000 + 1000)(13/13{,}000) = 6.0$ *ohms*. If negative voltage feedback alone is present from secondary back to the amplifier, this 6 ohms will drop by the same factor as the gain is reduced by the application of the feedback. For instance, if the input required when feedback is applied (for a constant output) is 5.5 times the input required when feedback is absent, the source impedance will drop to $6/5.5 = 1.1$ ohms.

If negative current feedback only were applied, the impedance would rise but not necessarily by any simple factor related to gain drop. The catch is that many feedback circuits are hard to exactly classify as voltage or current, negative or positive, and in such cases calculation is indeed difficult.

Taking a cue from Lord Kelvin, the obvious next step is to attempt a measurement. There seems to be no widely accepted standard and only two suggested methods could be discovered in the literature.

The first approach[1] is, briefly, to view the output circuit (*Fig.* 2) as a constant-voltage source which can be measured with the load terminals open circuited—that is, with $R_L = \infty$. Then if R_L is dropped in value until the output voltage drops to one half the open circuit value, R_L must equal R_{int}.

There seem to be two more or less related objections to this approach:

(1A) Since the load seen by the tubes may vary from a pure inductance to a very low resistance, the assumption of constant voltage, let alone constant waveform, is difficult to justify.

(2A) An amplifier with low source resistance has a very stable output voltage and it may be almost impossible to reduce the terminal voltage to one-half without encountering error related to resistance of the leads connecting the amplifier to its load.

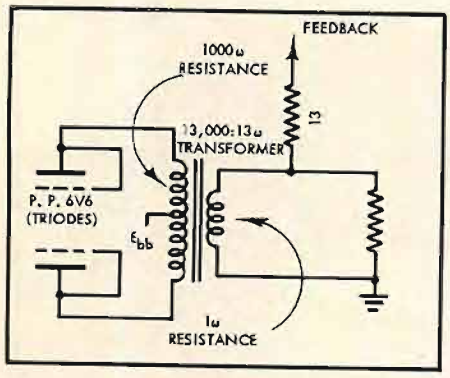

Fig. 1. Experimental amplifier output circuit.

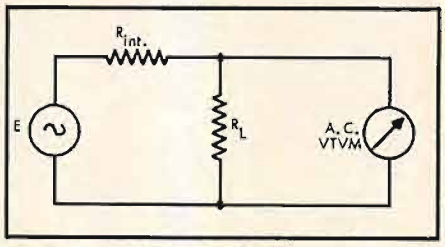

Fig. 2. Constant voltage equivalent circuit.

"Backward Driving" Method

The second method,[2] *Fig.* 3, is to drive a known current through the output terminals of the amplifier and ascertain the voltage drop it produces. There are two possible objections to this technique:

(1B) If feedback is being taken from the output terminals in some manner, care must be taken that the equipment involved in measurement does not disturb the feedback arrangements.

(2B) If the amplifier is being operated beyond straight class A, the plate resistances rise as the tubes become cut off for part of each cycle, (theoretically up to 2.0 times the class A value when operating Class B),[3] consequently the source impedances rise when going from class A to AB to B. This method would not reveal this change since there is no signal coming through the amplifier in the usual way.

It might be possible to run enough secondary current so that the primary voltage swing will exceed E_{bb} of the stage and in this way simulate normal operation. This would, however, require an external source of known internal resistance whose power rating would be at least the damping factor squared times normal power output of amplifier under test. In this instance,

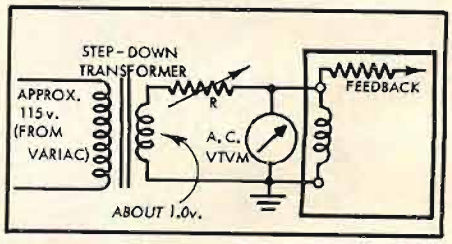

Fig. 3. "Backward driving" method of determining internal impedance.

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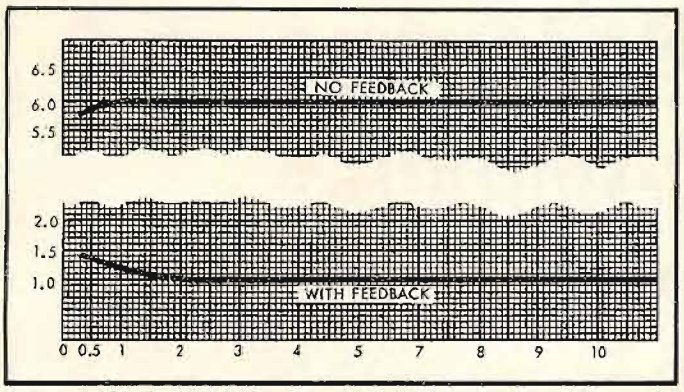

Fig. 4. Calculated internal impedance for various values of "R".

this would amount to $(6/1.1)^2 \times 4 = 119$ watts. Here again the lower the internal resistance, the greater the problem in measuring it.

Examples

A small push-pull triode 6V6GT amplifier of conventional class AB design was used for a number of tests described. About 15 db voltage feedback from the output transformer secondary was available but could be readily removed for comparison. The calculated source impedances were as outlined above—6 ohms without feedback and about 1 ohm with feedback. With the rated load of 13 ohms, about 4 watts power output could be obtained with tolerably small distortion throughout the range from 40 to 15,000 cps. Naturally, the power-frequency response was smoother when feedback was used.

The open circuit/half voltage method was tried first. It gave answers that were almost dead on the calculated values *provided* the level of measurement was kept quite low (a quarter of a watt or so) otherwise severe squaring was encountered as the load resistance was dropped. See (1A), preceding. If this distortion was disregarded, nearly any answer one wanted could be produced because the voltmeter reads the square root of the sum of the squares of the various frequency components and the reading is a function of the degree of distortion as well as the magnitude of the fundamental.

Figure 4 is an illustration of the point raised in (1B) regarding the *Fig.* 3 layout. Since the impedance of the step-down transformer secondary was negligible, the current metering resistor *R* becomes the amplifier load. The magnitude of this resistance is of substantial importance when feedback is used since the signal that goes back up the feedback path and is amplified sees the resistor as the load.

To get around objection (1A) if one makes only a *small* change in the load resistance, the internal voltage of the amplifier should only be slightly affected. If it then were possible to measure the *small* change in output voltage and divide it by the *small* change in current through the load, the quotient would be the internal impedance (see Appendix). Accordingly, the load was changed from 13 to 14 ohms, then from 13 down to 12 ohms (see Fig. 5), the internal impedance computed and the values averaged. Incidentally, the two values in each pair were always within ten per cent and usually much closer. This was done for several power levels, both with and without feedback and the results are shown in *Fig.* 6. Note that at low power levels the internal impedance drops down to the computed level, which after all did not take into account class AB operation.

The difficulty with this method (particularly when feedback was on) was that one was required to read extremely small voltage variations across the full load and then divide by the known resistance in both cases in order to find the current change and, subsequently, the source resistance. Some streamlining of the procedure may be effected by using the layout of *Fig.* 7. By the use of the voltmeter across the 1-ohm resistor alone, we have the current without further computation, only now it is necessary to multiply this voltage by the number of ohms total load in order to find the amplifier terminal voltage in each case. The simple advantage of this layout lies in the fact that with very low source impedances the output current rises sharply with a drop in load resistance and since the meter is essentially a current-measuring device, greater accuracy can be obtained than if we were trying to observe a total voltage change. The values obtained

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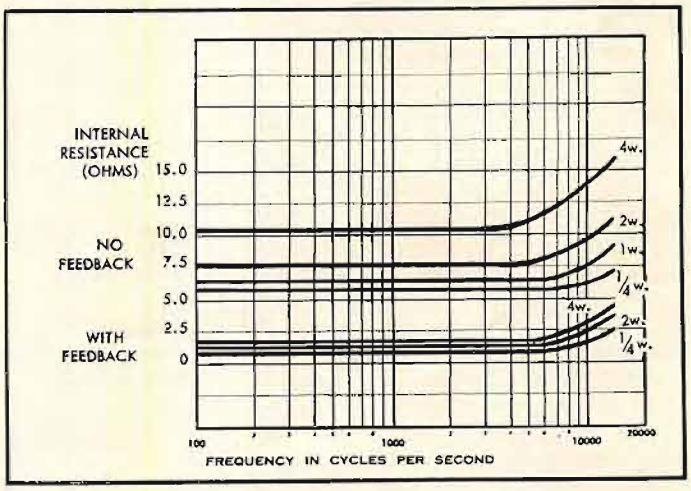

Fig. 6. Internal impedance vs. power level.

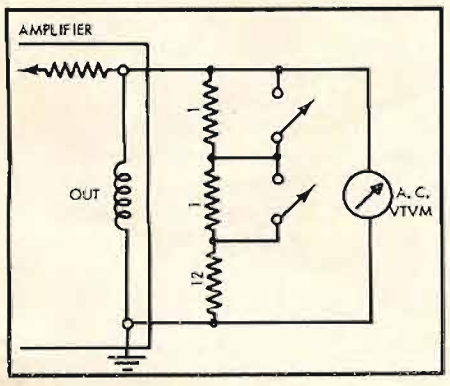

Fig. 5. "Small increment" method of measuring internal impedance.

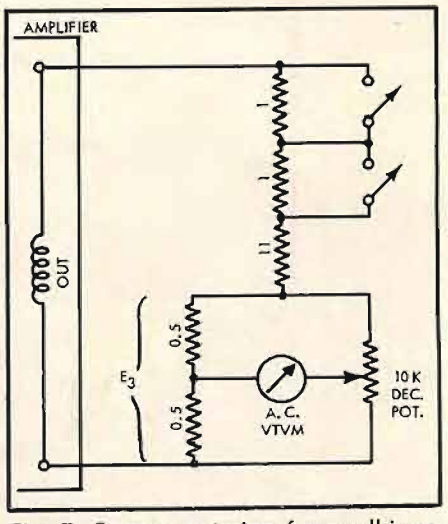

Fig. 7. Current metering for small-increment method.

Stereophonic Recording and Playback Amplifier

WAYNE B. DENNY*

Optimum performance may be had with many professional or semi-professional tape decks when employed with the amplifier system described here. Both stereo and monophonic uses are provided.

WITH THE ADVENT of stereo records the present popularity of recorded stereo tapes can be expected to diminish somewhat. Certainly the new discs are more convenient and the cost differential between the two is considerable. Nevertheless, the amateur recordist will find it simpler to use tapes for those cases where excessive duplication is not required. Although single-channel tape recorders have found wide public acceptance good two-channel machines are neither common nor inexpensive. Yet, the serious amateur can make excellent stereophonic recordings without undue financial strain if he is willing to work out a system employing one of the several tape-decks currently available which can be adapted to the purpose. One such deck is the *Viking* FF75SR machine and the system to be described was designed for use with this machine. Other manufacturers make similar machines which could be used with little or no modification of the electronics.

In the initial stages of design it was found difficult to incorporate both versatility and simplicity into the same system. Admittedly, simple and foolproof operation is desirable but an analysis of requirements showed that the inclusion of a "function switch" (as found in popular commercial units) would limit the usefulness of the amplifier, which is shown in *Fig.* 1. Consequently, a plug-and-jack system of interconnection was adopted and the experience of several months has shown the wisdom of this decision. Despite its seeming complexity, the sophisticated amateur who understands his circuits will find the construction and operation of this unit perfectly straightforward.

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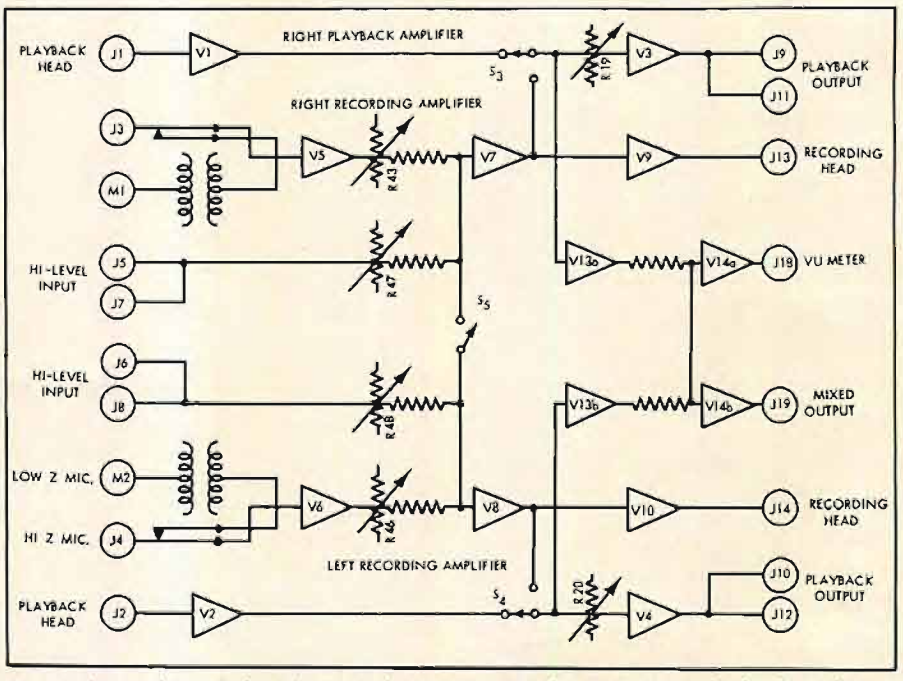

Fig. 2. Inspection of this functional diagram of the recording-playback indicates that it may be used for single channel recording and playback, two channel recording and playback, sound-on-sound recording, tape duplicating, and as a general purpose preamplifier and mixer. Bias supply and electronic level indicators are not shown.

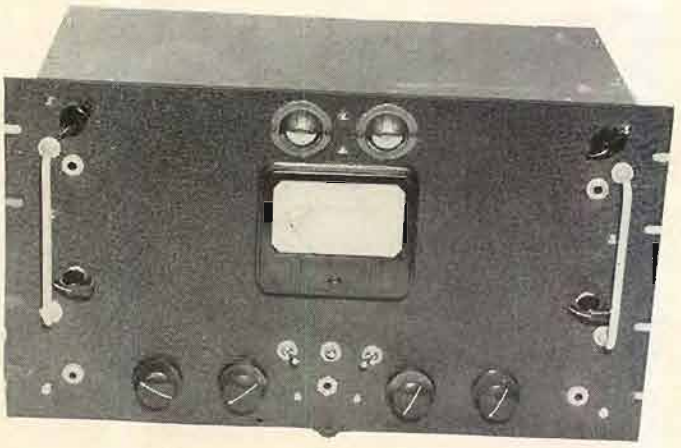

Fig. 1. Front view of amplifier.

System Philosophy

Although the present recording and playback amplifier is intended for amateur use this does not imply that quality of performance is compromised. The system employs the usual NARTB equalization in the recording sections and the playback amplifiers are adjusted for flat response from tapes using the NARTB characteristic. Noise is minimized by the use of an external power supply and by employing d.c. on the heaters of all tubes operating at low signal levels. Inherent amplifier noise is below tape noise under conditions of use. 120-cps hum is inaudible.

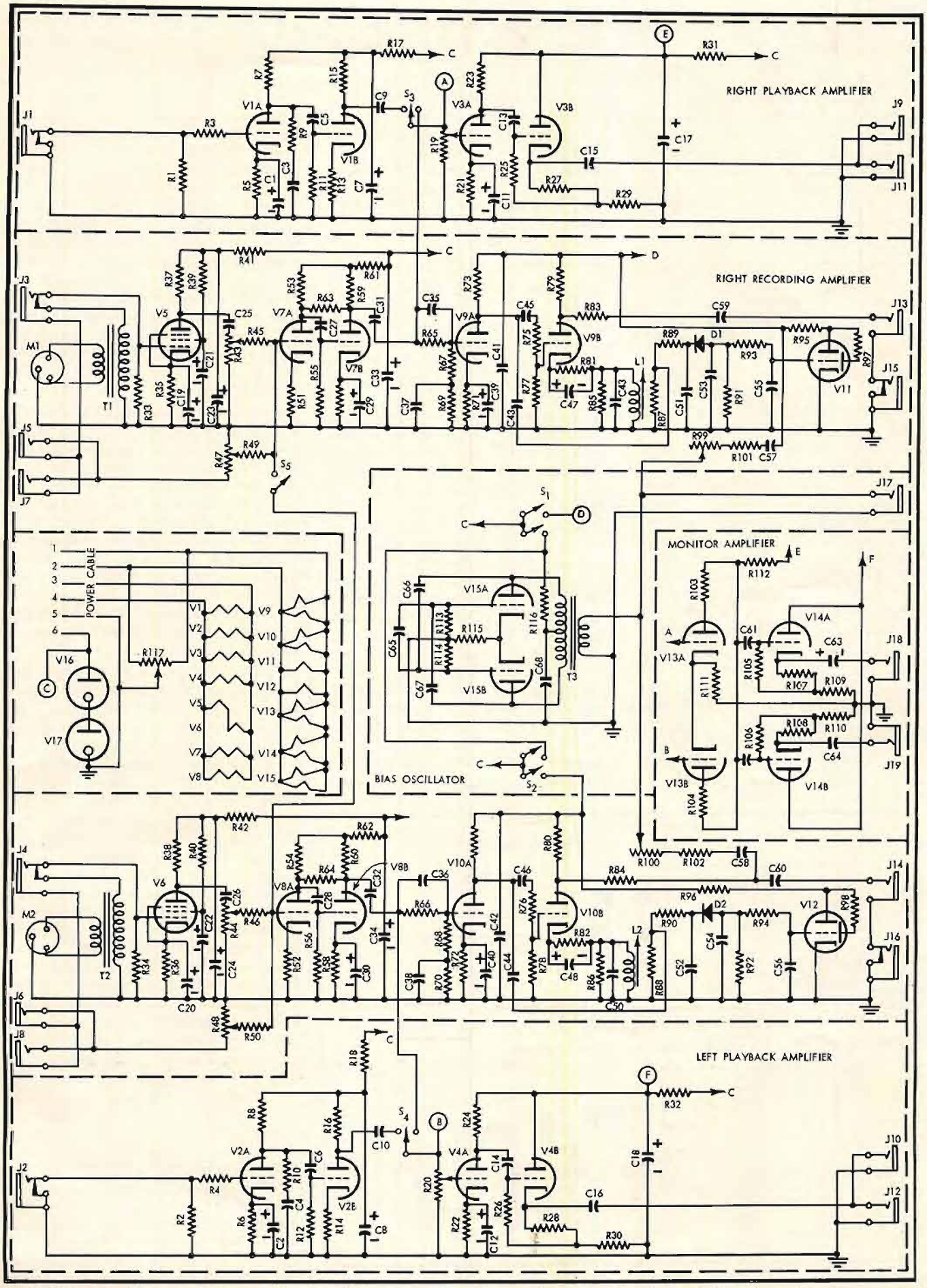

Fig. 3. Schematic diagram of the recording-playback unit. Although several chassis grounds are indicated the circuit is grounded to the chassis at one point only, preferably near the input jacks. Extreme care must be exercised to avoid ground loops.

It was desired that recorded material should be monitored both prior and subsequent to the actual recording process: switches permit listening comparison between incoming and recorded signals. Recording and playback facilities are provided in duplicate for single- or two-channel use. One rather novel feature of the system is the inclusion of a hybrid or monitor amplifier whose signal is derived from both right and left hand channels at all times. This hybrid channel is useful for feeding a "middle" amplifier and speaker: this procedure effectively rids the playback of that "hole in the middle effect" sometimes experienced with certain types of speaker placement. It does not correct for incorrect speaker phasing, however.

The system philosophy is best understood by reference to *Fig.* 2 which shows the system in block form. Examination of this diagram serves to indicate the versatility of the unit. A four-position mixer is provided. With switch S_5 closed all inputs are connected to each recording channel. When S_5 is open each channel is provided with two inputs for high- and low-level signals. Switches S_3 and S_4 select either the incoming program or the playback signal for monitoring. The single VU meter is connected to the hybrid channel at all times. This is a bit unusual and originally some doubts were entertained about the wisdom of this arrangement. However, it should be emphasized that separate visual monitoring of each channel is possible by the inclusion of two electronic level indicators: these are not shown in *Fig.* 2 but are used to indicate approximate recording level and balance between channels.

The two microphone-input circuits are arranged for either high- or low-impedance units. Regular three-wire receptacles are used for balanced low impedance connections. Switching from low to high impedance is automatic. It will be noted that several input and output circuits employ paralleled jacks: in each case one of the jacks is mounted on the front panel, the other on the rear of the chassis. The utility of this arrangement is obvious.

Circuit Details

Inspection of *Fig.* 3 shows a total of thirteen tubes not including voltage regulators and volume indicators. Although the circuit appears somewhat complicated it can be seen that the two playback amplifiers are identical as are the recording amplifiers. Circuits and component values are usual for amplifiers of these types—no tricks are employed. Probably other circuit arrangements could be used, but the ones shown operate efficiently and no revision is contemplated.

Hum is reduced to minimal values by heavy by-passing of cathode resistors in low-level circuits in addition to d.c. on the heaters. Measurements showed that some residual hum voltages remain in the output of the d.c. heater supply even though heavy filtering is employed.

Recording equalization employs both *RC* circuits and *LC* resonance. The resonant circuits are used in the cathode returns of V_{9B} and V_{10B}: a resonant frequency of 16,000 cps provides the opimum response at high frequencies. *RC* equalizers in shunt with the plate circuits of V_{1A} and V_{2A} are used for playback. Resistors R_9 and R_{10} are chosen for maximum flatness of high-frequency response when playing tapes recorded with NARTB characteristics. Some adjustment of values for R_9 and R_{10} may be necessary particularly if the head-gap width differs appreciably from those used in the Viking deck.

Resistors used in low level circuits—particularly plate and cathode resistors—should be selected with care if minimal noise levels are to be achieved. Except in the case of components used in equalizing circuits the values of resistors and capacitors are not critical. Plus or minus 10 per cent tolerance was found to be ample. Such components gave gain *vs.* frequency curves for the two recording amplifiers which differed by no more than 1 db; the same was true for the playback amplifiers.

With the exception of the heater supply, the power-supply circuit is entirely conventional. Details are shown in *Fig.* 4. A two-stage capacitor-input filter provides low ripple. The two voltage-regulator tubes shown in *Fig.* 3 are not required to reduce hum. However, their use does provide a constant plate-supply voltage when the bias oscillator and recording amplifiers are turned off and on. They also contribute to a low value of effective power-supply impedance at low frequencies where feedback (motorboating) can be a problem.

Two 6.3-volt heater transformers are connected with their secondaries in series to provide approximately twelve volts d.c. at the heaters of tubes operating at low single levels. A husky selenium rectifier is used in the conventional bridge arrangement. The associated filter removes most of the a.c. ripple. Actually, each 2400-μf capacitance consists of two 1200-μf units in parallel. Resistor R_{118} is adjusted to give the requisite heater voltage.

Returning to *Fig.* 3 it is seen that switch S_1 energizes the right recording amplifier, electronic volume indicator, and the bias oscillator. Switch S_2 operates in similar fashion for the left recording channel. A glance at the electric eyes immediately indicates whether the associated channel is operative and, more important, it shows whether the bias oscillator is on or off. This is important in preventing accidental erasure of prized tapes.

Cathode followers are employed in all output circuits. The hybrid, or monitor, amplifier uses two cathode followers so as to isolate the VU meter from the output. The relatively low impedance of the meter introduces some waveform distortion. This distortion has little effect on the meter indication but is most undesirable in the monitoring channel. This same low impedance requires a large electrolytic coupling capacitor. The leakage inherent in electrolytic capaci-

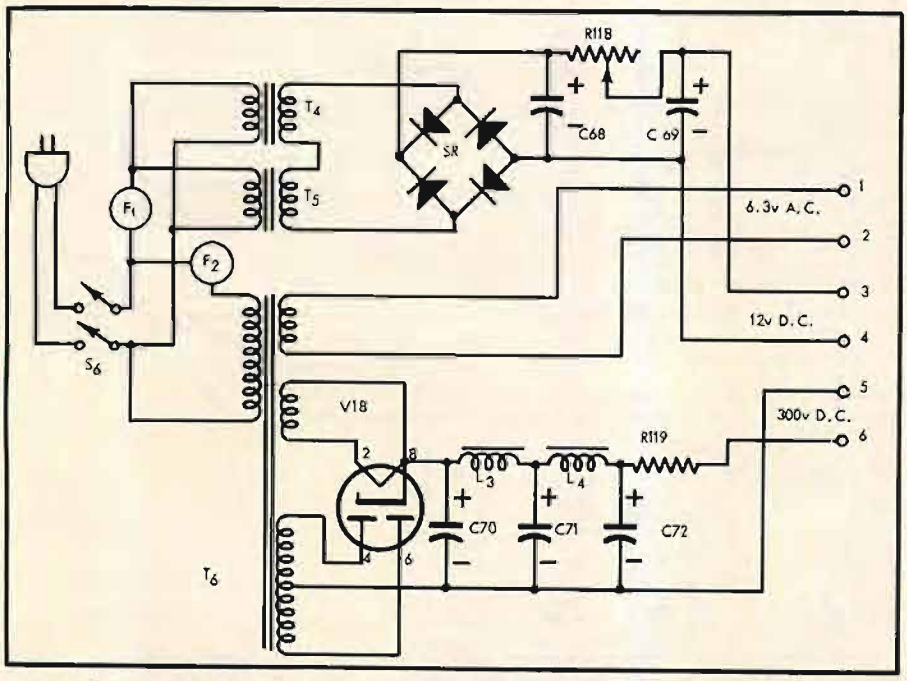

Fig. 4. The power supply is mounted on a separate chassis and connected to the amplifier by means of a six-conductor cable. Heavily filtered direct current is used for the heaters of tubes operating at low signal levels.

tors is undesirable in the monitoring circuit but has no noticeable effect on the meter indication. Separate cathode followers solve these problems nicely.

Recording bias adjustment is provided by variable resistors R_{99} and R_{100} which are mounted near the bias oscillator in easily accessible positions. Initial adjustment of bias currents is best accomplished by measuring the a.c. voltage across a known resistance in series with the recording heads. Then, the VU meter is inserted successively into jacks 15 and 16 and its indications noted. Thereafter, the VU meter is used to check bias current as required.

Mechanical Details

Inspection of *Figs.* 1 and 5 shows that the assembly consists of two sections, each employing a separate chassis. The bottom chassis contains the recording amplifiers, bias oscillator, and associated circuits; the upper chassis (which is inverted with the tubes projecting downward) contains the playback amplifiers, monitor amplifier, and volume indicators. (Logically, the latter belong "downstairs" since they are associated with the recording amplifiers but they were moved up because they are more easily observed in this position.)

Practically all the circuitry associated with the various amplifiers is mounted on subchassis. These subchassis are located inside the visible chassis and shock-mounted thereto by means of self-locking bolts and soft rubber grommets. The tubes project through the main chassis through holes cut sufficiently large to clear the tube shields with plenty of room for movement. This system for shock mounting is recommended—absolutely no trace of microphonism has been observed even under conditions of severe mechanical vibration. It is important, however, to proportion the moving mass to the stiffness of the mounting so that the natural frequency of oscillation is very low. Otherwise, the benefits of shock mounting are questionable. All heater wiring is run between the subchassis and the main chassis. The wires pass through small grommeted holes immediately adjacent to the heater terminals of the sockets. This arrangement effectively shields the heater wiring and reduces the shielding required on signal-carrying leads. This procedure improves high-frequency response.

The outer chassis assembly is stiffened by two hand-made brackets shown in *Fig.* 5. These are made of heavy aluminum stock. Weight is reduced by using aluminum for chassis and panels.

The tape deck can be fastened to the amplifier unit in a number of ways. After several arrangements were tried the one shown in *Fig.* 6 was found most suitable. Two aluminum "Tee" bars were drilled and tapped to standard rack dimensions. Then a couple of "adaptors" were fabricated of aluminum to hold the deck at an angle. This permits maximum ease in tape handling and retainers are not necessary to hold the reels in place as would be required if the deck were mounted vertically. Some form of shock mounting for the tape deck is desirable to minimize mechanical noise.

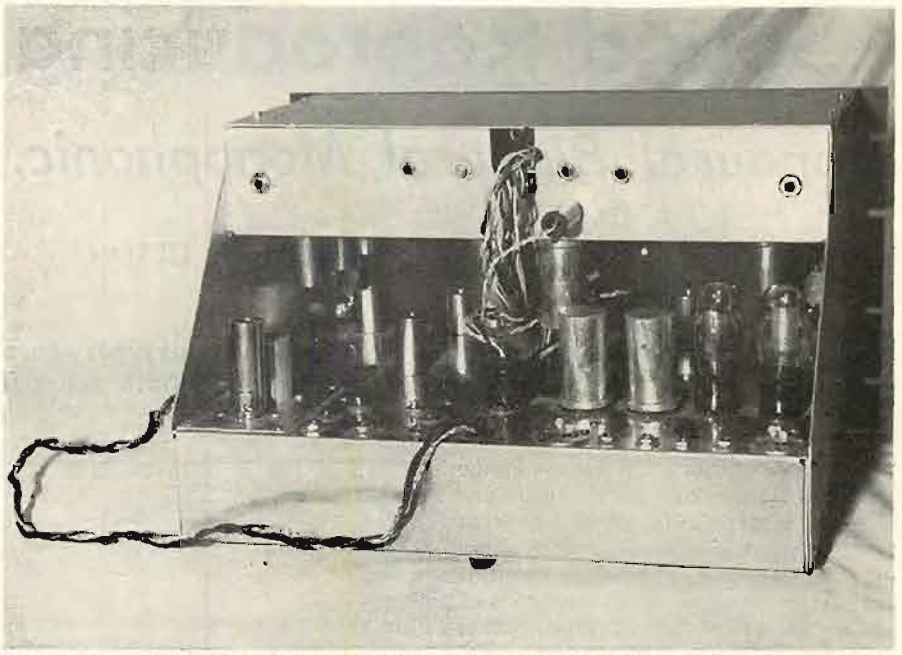

Fig. 5. Rear view of unit showing inverted chassis housing playback amplifiers.

The over-all package lacks the easy portability of some commercial recorders. Even though all aluminum construction is employed the amplifier, tape deck, and power supply weighs approximately fifty pounds. However, the unit fits nicely into the trunk of an automobile and no transportation difficulties have been encountered in the field.

Operation

The Viking FF75SR tape deck, like several other commercially available units, is fitted with a single-track erase head, a single-track recording and playback head, and a pair of heads mounted in-line for stereo recording and playback. In the case of single channel recording the erase and single track heads are connected in the usual fashion by means of suitable patch cords and the appropriate stereo head is used for playback. This arrangement is fine provided that material is recorded on only one side of the tape. Otherwise, adjacent track cross-talk is a problem. Where this

(*Continued on page 53*)

Fig. 6. The tape deck is attached to the amplifier by means of two "Tee" bars. Although the power supply is shown next to the amplifier it should be no closer than three feet when it is being used.

Sound Reproducing Systems—

Monaural, Binaural, Monophonic, and Stereophonic

HARRY F. OLSON*

A clarification of the definitions of the various types of systems encountered currently, as presented by a recognized authority in both acoustics and sound reproduction.

THE REPRODUCTION OF SOUND is the process of picking up sound at one point and reproducing it either at the same point or some other point either at the same time or some subsequent time. There are many different types of systems employed for the reproduction of sound. In this connection, sound reproducing systems in use today may be classified as follows: monaural, binaural, monophonic, and stereophonic. There appears to be considerable confusion in the proper use of these terms in designating the four fundamental types of sound reproducing systems. The result is an almost indiscriminate application of the terms to unrelated systems. For this reason it appears desirable to define and describe the use of the four terms. Therefore, it is the purpose of this paper to define and describe the characteristics of monaural, binaural, monophonic, and stereophonic sound systems.

Monaural

A monaural sound reproducing system is a closed circuit type of sound reproducing system in which one or more microphones are connected to a single transducing channel which in turn is coupled to one or two telephone receivers worn by the listener, as in *Fig.* 1.

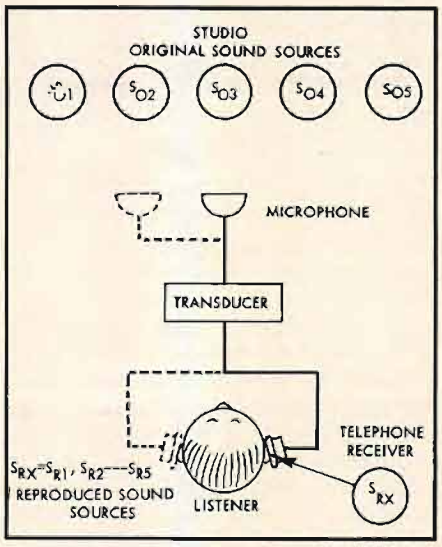

Fig. 1. Monaural.

Binaural

A binaural sound reproducing system is a closed circuit type of sound reproducing system in which two microphones, used to pick up the original sound, are each connected to two independent corresponding transducing channels which in turn are coupled to two independent corresponding telephone receivers worn by the listener, as in *Fig.* 2.

Monophonic

A monophonic sound reproducing system is a field type sound reproducing system in which one or more microphones, used to pick up the original sound, are coupled to a single transducing channel which in turn is coupled to one or more loudspeakers in reproduction, as in *Fig.* 3.

Stereophonic

A stereophonic sound reproducing sys-

(*Continued on page 56*)

* *RCA Laboratories, Princeton, N. J.*

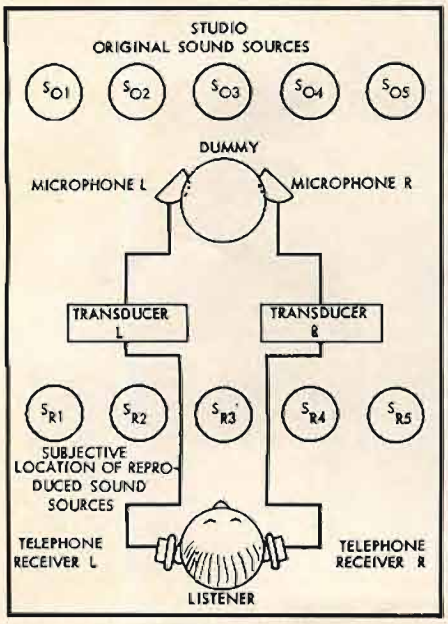

Fig. 2. Binaural.

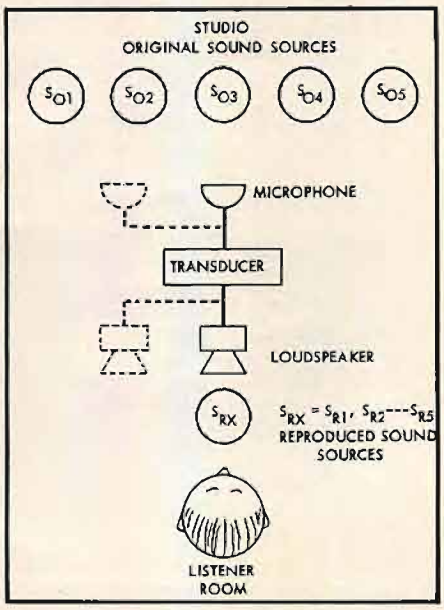

Fig. 3. Monophonic.

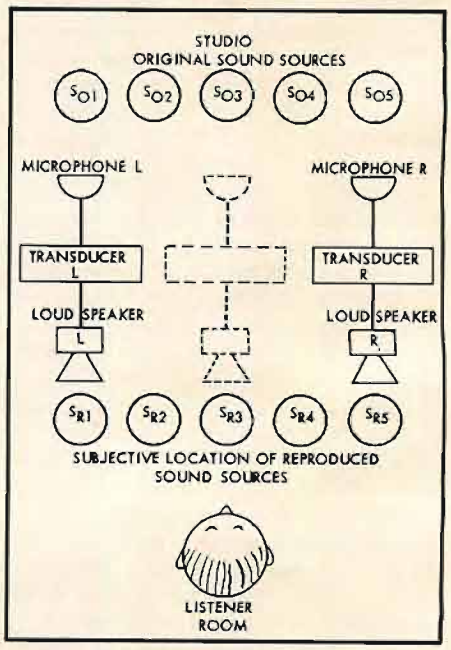

Fig. 4. Stereophonic.

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A new 12" 3-way system, the CN-100 reproducer gives a new small-scaled fine furniture look to the hi-fi speaker, ideally suited to small living spaces. The 12" Flexair superlow resonance woofer in Bass-Superflex enclosure gives full bass response to a low 20 cycles. Special 8-inch mid-channel and RP-103 h-f unit assure smooth clean response to 15,000 cycles. Crossover frequencies 600 and 4000 cycles. 32" H., 21" W., 18¼" D. Available in Walnut, Tawny Ash, and Mahogany. **Net Price.....149.50**

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In up-to-the-minute "Flair Line" styling, the BF-100 cabinet is ideal for all 12" speakers, and system kits including those with Flexair 12" woofers. Incorporates new acoustical design with tube-loaded port for unusual extension of the l-f range. Available in Walnut, Tawny Ash and Mahogany. **Net Price.....69.50**

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The new Jensen Flexair Woofers are designed to extend bass response down to very low frequencies. They have highly-damped superlow resonance at the very bottom of the audio range—16 to 20 cycles. They have an exceptional degree of linearity and are capable of a total movement of 1". In even a relatively small Bass-Superflex enclosure, they deliver their extreme low-frequency performance with a new low in distortion.

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Components used in the TP-250 Tri-Plex II reproducer. 15-inch Flexair woofer, new compression driver m-f unit, and new phase correcting supertweeter. Response from 16 cycles to upper limits of audibility in Jensen Bass-Superflex enclosure (Jensen BF-200 suggested). Complete with 400 and 4,000 cycle networks, wiring cables and instructions for building enclosure. Impedance 16 ohms. **Net Price $179.50**

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This latest version of the Jensen Tri-Plex reproducer incorporates the extreme bass capability of the 15" Flexair woofer, in combination with advances in midchannel and supertweeter design. This beautiful unit outperforms any speaker system of comparable size or cost. Excellent for superb monophonic reproduction or as one side of a stereo system. Response range, 16 cycles to beyond audibility. Components available also in kit form (see KT-34). 30½" H., 34½" W., 18¾" D. **Net Price.....294.50**

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Hybrid Feedbacks for Power Amplifiers

HERBERT I. KEROES*

While feedback in most amplifiers is partially dependent on the load impedance, it is possible to eliminate this effect to a large extent with a claimed improvement in over-all performance.

MUCH INTEREST has been evinced in the system of Hybrid Feedback[1] as developed and used in the Acrosound Ultra-Linear II power amplifier. This system prevents interaction between feedback circuit and load; consequently its use results in a feedback system inherently more stable than the conventional systems now used.

The circuit has been developed from a consideration of the unique properties of the hybrid coil, a device long used in telephone communication to permit amplification in both directions on a telephone line without interaction. This property of circuit isolation is put to use in a similar manner between feedback and output circuits of an amplifier.

In its usual form, the hybrid coil is a three-winding transformer composed of a primary winding and two series-connected secondary coils of equal turns, and is shown diagrammatically at (A) in *Fig.* 1. If power is fed to the primary, it is divided equally between each load resistor, the two load resistors being of equal value. Another resistor is used to supply balance, and is shown connected between the junction of the two secondary windings. When all circuit resistors are chosen in a certain relationship, the circuit has several unique properties. A voltage placed in series with one load will not be reflected into the other load. A voltage placed in series with the balancing resistor will not appear in the primary winding of the transformer. The hybrid arrangement can then evidently be used to divide output voltage between load and feedback circuit without interaction. It would not be economical to divide power equally between load and feedback circuit, hence the section of the secondary which energizes the feedback circuit is composed of just enough turns to supply the requisite amount of feedback voltage.

The solution of a hybrid circuit where the secondary winding is comprised of two series-connected coils of equal turns is well known, and to be found in most standard texts. Where the secondaries are not of equal value, the solution is not easily available, and will be developed here. Another property of the hybrid circuit will also be developed—one which, to the best of the author's knowledge, has not been previously disclosed.

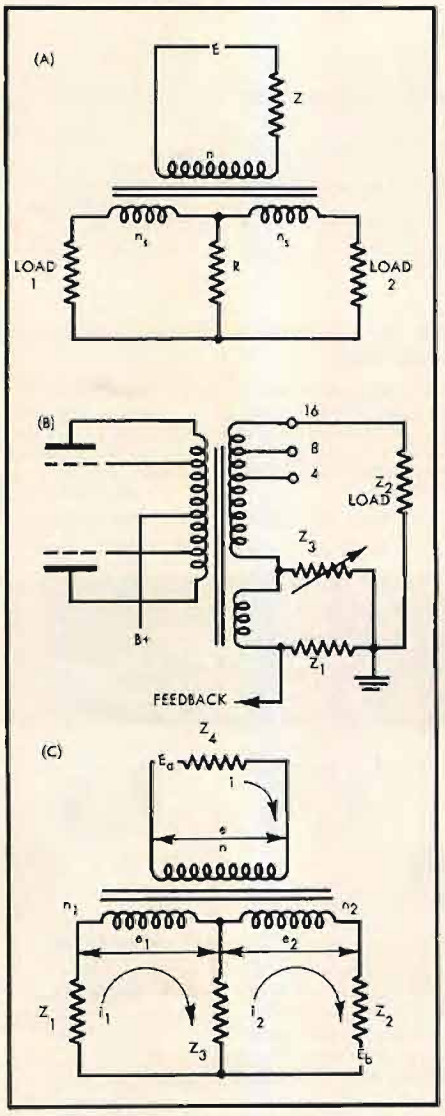

Fig. 1. Schematic of voltage and current relationships of the hybrid feedback arrangement.

As used in the Ultra-Linear II amplifier, the output transformer forms a hybrid coil, and the output circuit is shown at (B) in *Fig.* 1. The circuit of the output transformer alone is shown at (C). The voltages and impedances appearing across the various windings are as follows:

- E_a The open-circuit plate-to-plate voltage of the output stage.
- E_b A voltage introduced into the load circuit to determine its effect on the feedback voltage. It may be an equivalent voltage generated by a change in load impedance (an assumption valid by the compensation theorem), or a back emf generated by the load.
- e The voltage across the primary winding of the transformer, composed of n turns.
- e_1 The voltage across the winding section composed of n_1 turns and which connects to the feedback circuit.
- e_2 The voltage across the winding section composed of n_2 turns and which connects to the load.
- Z_1 The feedback load impedance.
- Z_2 The output load impedance.
- Z_3 The balancing resistor.
- Z_4 The plate impedance of the output tubes.

We may write the equations for the voltage drops in each loop in terms of the loop currents and impedances by Kirchoff's law, and these give relationships (a), (b), and (c) below. Equations (d) and (e) are relationships that exist in any transformer, the sum of the ampere turns in each winding being zero, and the exact proportionality between the open circuit voltage and turns in each winding.

$$\text{(a)}\quad e = E_a - Z_4 i$$
$$\text{(b)}\quad e_1 = Z_3 i_2 - (Z_1 + Z_3) i_1$$
$$\text{(c)}\quad e_2 = Z_3 i_2 - (Z_2 + Z_3) i_1 + E_b$$
$$\text{(d)}\quad n_1 i_1 + n_2 i_2 + n_3 i_3 = 0$$
$$\text{(e)}\quad \frac{e}{n} = \frac{e_1}{n_1} = \frac{e_2}{n_2}$$

The relationships of (a) and (e) may be substituted into (b), (c), and (d), to give the following three equations in which all currents are expressed in

* *Acro Products Co., Philadelphia, Pa.*
[1] Patent pending.

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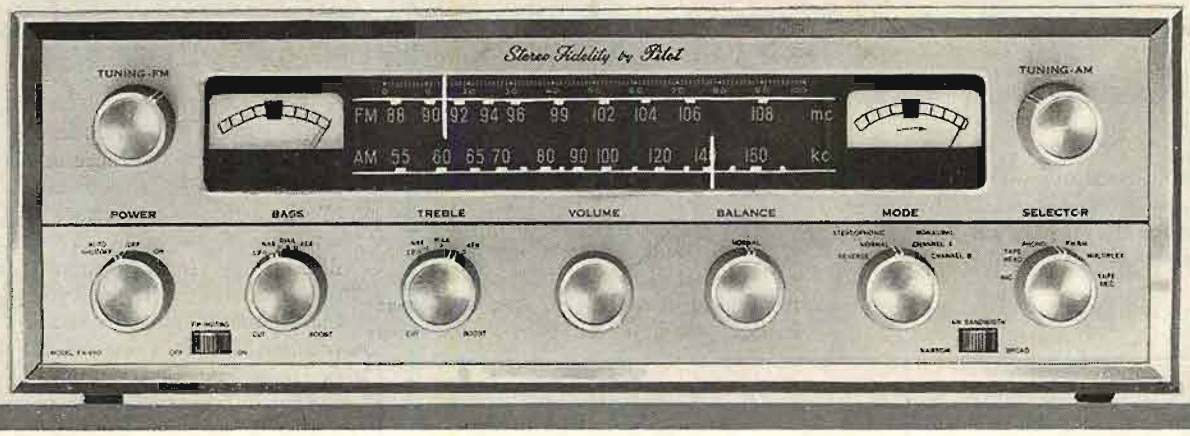

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The Model 690 is clearly the most original, the most versatile, and most brilliantly engineered stereophonic component to make its appearance to date.

Embodied in one chassis are two high quality *tuners*: FM and AM, with a complete stereo preamplifier. The FM and AM tuners operate independently of each other. Ideal for FM-AM stereo, this unique feature also permits two different broadcast programs to be played simultaneously in different parts of your home. It also enables you to record one program (AM for example) while listening to a simultaneous FM broadcast. The Model 690 also has an FM multiplex output jack for FM—FM stereo.

Two precision tuning meters are provided for accurate station selection, one for FM reception, and the other for AM.

Also featured in the AM section is a broad-narrow band-width selector.

The preamplifier section of the 690 consists of two identical preamp units. Volume, tone and stereo balance controls are included. The outputs may be fed to any basic stereo amplifier such as the Pilot SA-232 or SA-260.

The Model 690 provides inputs with equalization for stereo records, stereo tape heads, tape recorders and dual microphones. There is also an output for making stereo and monaural tape recordings. Housed in a modern, low silhouette metal cabinet with brass control panel, the 690 is priced at $269.50, complete.

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Electronics manufacturer for more than 39 years.

The Acrosound Ultra-Linear II amplifier discussed in this article.

terms of the applied voltages E_a and E_b. We may then solve these for the current in the feedback circuit, i_1, and the load current, i_2.

$$\frac{n_1}{n} E_a = -(Z_1 + Z_2) i_1 + Z_3 i_2 + \frac{n_1}{n} Z_4 i$$

$$\frac{n_2}{n} E_a - E_b = Z_3 i_1 - (Z_2 + Z_3) i_2 + \frac{n_2}{n} Z_4 i$$

$$0 = n_1 i_1 + n_2 i_2 + n_3 i_3$$

The easiest method of solving these equations is to effect a solution by means of determinants. We obtain the following solutions for i_1 and i_2.

$$Di_1 = \frac{n_1}{n} E_a \left[n(Z_2 + Z_3) + \frac{n_2^2}{n} Z_4 \right] + \left(\frac{n}{n} E_a + E_b \right) \left(Z_3 n - \frac{n_1 n_2}{n} Z_4 \right)$$

$$Di_2 = \left(\frac{n_2}{n} E_a + E_b \right) \left[n(Z_1 + Z_3) + \frac{n_1^2}{n} Z_4 \right] + \frac{n_1}{n} E_a \left(Z_3 n - \frac{n_1 n_2}{n} Z_4 \right)$$

where

$$D = (Z_1 Z_2 + Z_2 Z_3 + Z_1 Z_3) n + \frac{n_2^2}{n} Z_1 Z_4 + \frac{n_1^2}{n} Z_2 Z_4 + \frac{Z_3 Z_4}{n} (n_1 + n_2)^2$$

If we now specify the condition that E_a is zero and E_b is not equal to zero, we find that i_1 is zero when Z_3 is equal in value to $n_1 n_2 Z_4 / n^2$. If then Z_3 is put at this value, a voltage injected into the load circuit will not produce a current flow in the feedback circuit.

An impedance variation in the output circuit or a back emf generated by the load impedance will therefore not be transmitted into the feedback circuit. We shall now show that Z_2 may have any value from zero to infinity, and will not affect the proportionality of voltage induced by E_a in the feedback circuit, or change the phase of the induced voltage. To prove this we will take the relationship $Z_3 = \frac{n_1 n_2 Z_4}{n^2}$ and transpose Z_3 and Z_4. This becomes $Z_4 = \frac{Z_3 n^2}{n_1 n_2}$ This is then inserted into the expression for i_1. Also let $E_b = 0$.

$$i_1 = E_a \frac{n_1 Z_2 + Z_3 (n_1 + n_2)}{Z_1 Z_2 + Z_2 Z_3 \left(1 + \frac{n_1}{n_2}\right) + Z_1 Z_3 \left(1 + \frac{n_2}{n}\right) + Z_3^2 \frac{(n_1 + n_2)^2}{n_1 n_2}}$$

The denominator may then be factored, and we find that one factor cancels with a similar expression in the numerator, giving the following solution for i_1.

$$i_1 = E_a \frac{1}{\frac{Z_1}{n_1} + \frac{Z_2}{n_1} + \frac{Z_3}{n_2}}$$

Note that the only impedance terms in this expression are those of the resistor in the feedback circuit and the value of the balancing resistor. If these are set at a fixed value, the current that flows in the feedback circuit is constant, therefore the voltage developed across the feedback load is constant and independent of the value of the load impedance Z_2.

The hybrid system is normally operated so that the nominal value of Z_2 produces a load current equal in value to i_1. No current then flows in the balancing resistor Z_3 and it consumes no power. To find this relationship, E_b is put equal to zero and the expressions for i_1 and i_2 are equated. This gives the relationship $Z_1/Z_2 = n_1/n_2$. The turns ratio between the feedback and load sections of the secondary winding is adjusted to this value.

Finally, we note that if no current flows in the balancing resistor, the complete secondary of n_1 plus n_2 turns feeds a secondary impedance of Z_1 plus Z_2 ohms. The turns ratio between secondary and primary is then $n_2/(n_1 + n_2)^2 = Z_4/(Z_1 + Z_2)$. Z_4 is made equal to the correct plate-to-plate impedance of the output tubes and the turns ratio computed.

In the Ultra-Linear II amplifier, Z_3 is made variable. This provides a variable damping control which changes the ratio between voltage and current feedback. With the control adjusted to

(*Continued on page 51*)

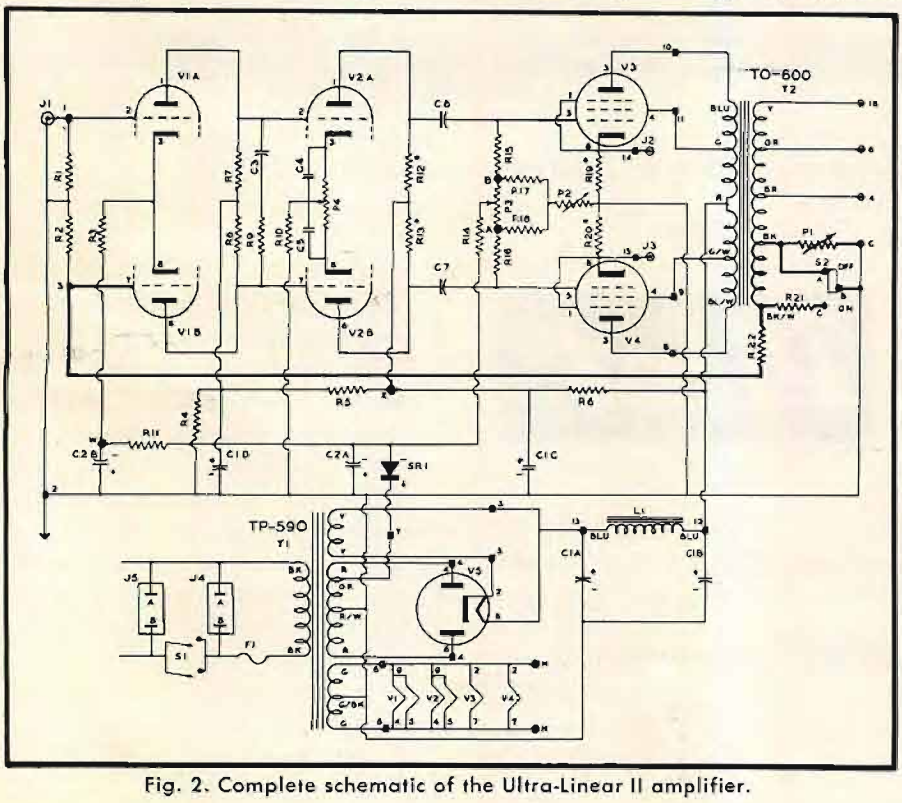
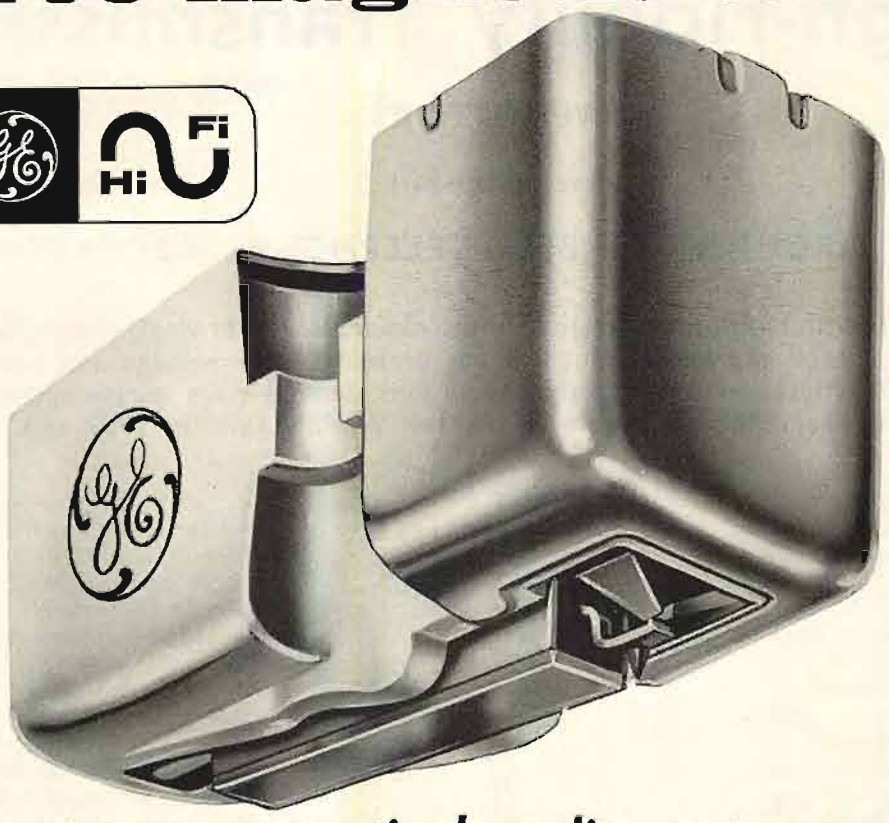


Fig. 2. Complete schematic of the Ultra-Linear II amplifier.

New G-E "Golden Classic" stereo-magnetic cartridge

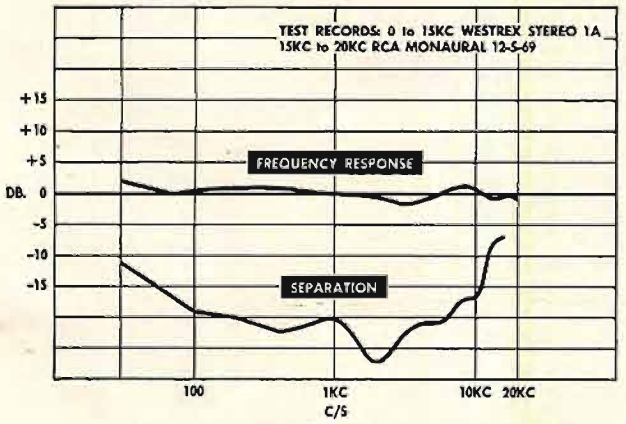


"GOLDEN CLASSIC" Model GC-7 (shown) with .7 mil diamond stylus $23.95*
"GOLDEN CLASSIC" Model GC-5 (for professional-type tone arms) with .5 mil diamond stylus $26.95*
"STEREO CLASSIC" Model CL-7 with .7 mil synthetic sapphire stylus $16.95*
*Manufacturer's suggested resale prices

makes stereo a practical reality—at a realistic price!

- Fully compatible with both stereophonic and monaural records
- Frequency response 20 through 20,000 cycles
- "Floating armature" design for increased compliance and reduced record wear. Effective mass of stylus approximately 2 milligrams
- High compliance in all directions—
  Lateral compliance 4 x 10^{-6} cm/dyne
  Vertical compliance 2.5 x 10^{-6} cm/dyne
- Recommended tracking force with professional-type tone arm 2 to 4 grams
- Consistently high separation between channel signals

(Specifications for Model GC-5 with .5 mil diamond stylus)



Smooth response on both stereo and monaural records. Consistently high separation between stereo channels.

Stereo is here! General Electric makes it official —with the new "Golden Classic" stereo-magnetic cartridge, a fitting climax to the famous line of G-E cartridges. For matchless reproduction, hear it with G.E.'s new "Stereo Classic" tone arm. Ask your dealer for a demonstration soon. Write for complete specifications. *General Electric Company, Specialty Electronic Components Dept., Section 598, W. Genesee St., Auburn, N. Y.*

GENERAL ELECTRIC

Hearing, the Determining Factor for High-Fidelity Transmission*

HARVEY FLETCHER

In three parts—Part 3

FROM THE ARCHIVES OF BELL TELEPHONE LABORATORIES

This is perhaps the first authoritative study of the requirements for ideal systems for the transmission of speech and music. Much of our present-day knowledge and practice stems from this article, which presents conclusions derived from measurements of hearing on more than 500,000 people during the World's Fairs in 1939 and 1940.

If loudness were the criterion of judged quality of reproduced speech, the effect of limiting the band has been measured. The loss in loudness due to frequency-band limitation depends upon the level at which the speech is reproduced. In Table VI the values are given for two loudness levels. The upper half of the table gives values for an initial loudness of 215,000 loudness units corresponding to a loudness level of 110 decibels and the lower half of the table gives values for an initial loudness of 4000 loudness units corresponding to a loudness level of 59 decibels. When it is realized that under the most favorable circumstances the ear can detect loudness differences only when they are greater than 3 or 4 per cent then it is seen that the elimination of frequencies above 5000 or below 100 would not be detected as any loudness difference. It would be useful if we had a relation such as that exhibited in Tables IV and V obtained from judgment tests of the artistic qualities of the speaking voice. From all these data then it is seen that the frequency range can be considerably more restricted for transmitting speech than for transmitting music, before serious impairment results.

TABLE IV

MUSIC—JUDGED QUALITY

Judged Quality	High-Pass Filter Cutoff	Low-Pass Filter Cutoff
100	40	15,000
97	70	12,000
93	80	9,000
90	90	7,800
85	100	6,500
80	120	5,600
70	140	4,800
60	180	4,000
50	220	3,600
40	270	3,000
30	325	2,500
20	500	1,700
10	850	850

TABLE V

SPEECH—ARTICULATION

Articulation	High-Pass Filter Cutoff	Low-Pass Filter Cutoff
per cent		
98	40	15,000
98	100	12,000
98	250	7,000
96	570	5,000
94	720	3,900
90	960	3,100
80	1,500	2,300
70	1,920	1,970
60	2,300	1,700
50	2,600	1,500

It was seen that the range from the peak value of the loudest phonetic sound to the faintest was 56 decibels but for usual conversation this is reduced to about 40 decibels. One would not expect any degradation in transmitted speech until the intensity level range is decreased below 40 decibels. Measurements on the articulation of conversational speech for smaller ranges have been made.[11] These were given in terms of the level of the speech above threshold and masking of the noise. The noise used produced a uniform masking between 250 and 10,000 cps, dropping off at either side of these limits. First let us consider conversational speech of men and assume the listener wishes to hear it at levels he would obtain if he were 2½ feet from the speaker instead of 20 feet. The values in Table I would then be raised 18 decibels. From these values then we must deduce the level of the speech above the standard threshold if we are to apply the data referred to above.

Experiments in our laboratories have shown that the threshold level, for observers with acute hearing of conversational speech which is undistorted, is at a long root-mean-square level of 5 decibels. Now the long root-mean-square level for speech was found by Dunn and White to be 10 decibels below the maximum root-mean-square level in ¼-second intervals. Consequently at 2½ feet from the speaker the men's conversational speech will be 63 decibels above threshold. The articulation values given in Table VII are taken from *Fig.* 148 of "Speech and Hearing."[9] The noise levels corresponding to the various values of masking were obtained directly from the curve in *Fig.* 3 of the paper, "Relation between Loudness and Masking."[4] In computing the range the highest level was considered to be the maximum root-mean-square value in ¼ second, namely, 78 decibels. If we used long root-mean-square values of both speech and noise these ranges would all be reduced 10 decibels. These range values will of course depend upon the spectrum of the noise but the values given here are enough to show that when the range of a system for single-frequency tones is 40 decibels from 100 to 7000 cps very little

[11] Loc cit., p. 298.

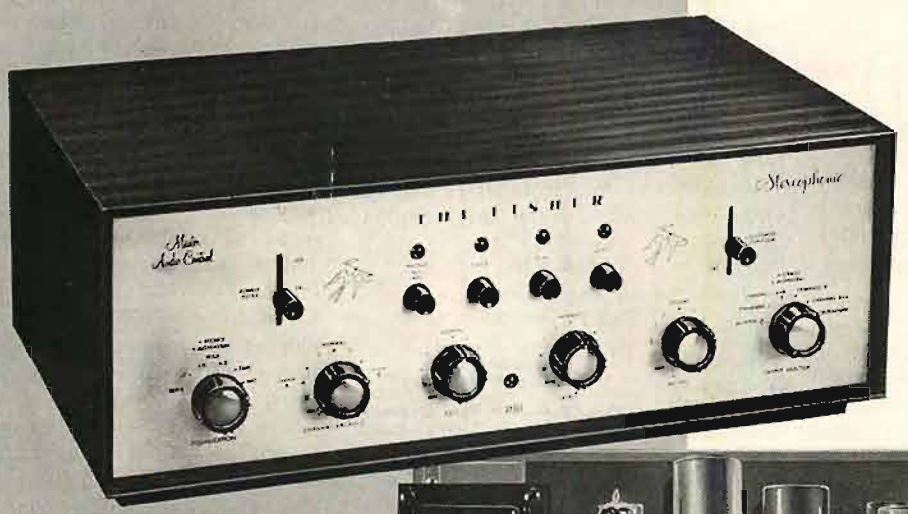
[9] Harvey Fletcher, "Speech and Hearing," D. Van Nostrand Company, New York, N. Y., 1929, p. 75.

TABLE VI

SPEECH—LOUDNESS

Loudness	High-Pass Filter Cutoff	Low-Pass Filter Cutoff
per cent		
215,000 = 100	40	15,000
98	100	5,000
90	200	3,500
80	300	2,100
70	450	1,500
60	600	1,100
50	800	800
4,000 = 100	40	15,000
98	200	4,000
90	500	2,500
80	770	2,000
70	950	1,700
60	1,125	1,450
50	1,250	1,250

Only THE FISHER 400 has all of these features



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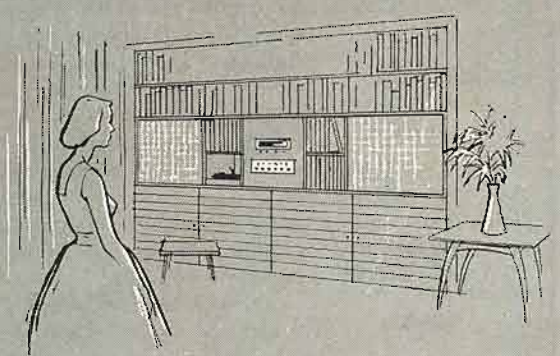

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TABLE VII

CONVERSATION SPEECH—SPEAKER 2½ FEET FROM LISTENER

Level of speech above threshold	= 63 db
Long root-mean-square intensity level	= 68 db
Peak level in ⅛-second intervals exceeded 5 per cent of the time	= 85 db
Root-mean-square level in ⅛-second intervals exceeded only 1 per cent of the time	= 78 db

Articulation Masking		Noise Level	Range
per cent			
97	0	10	68
95	10	36	42
88	20	46	32
77	30	57	21
55	40	67	11
28	50	77	− 1

or no distortion is produced when speech is transmitted. However, if we wish the noise from the system to be inaudible, the levels must be below the curve of *Fig.* 3. This means a range of 48 decibels, that is, from 78 to 30 decibels in the frequency region where the maximum speech levels occur.

Multiple Channel Transmission

The third way in which the quality of the transmission can be improved if there are no economic deterrents is by using more than one channel for the transmission. We have found that the quality of reproduced music is very much improved by using two or three channels. As stated above, such transmission makes it possible to produce apparent motion of the sound and provides much greater possibilities in dramatic productions.

Some preliminary tests to determine in a quantitative way the increased quality due to using just two channels instead of one have been made in our laboratories. In one of these a dramatic skit used very simple program material and was designed to tie together smoothly a number of sounds rich in high frequencies. It opened with a man's voice dictating a letter to a woman on right. Then the man walked from right to left and back and engaged in a short conversation. The typewriter started and the man walked to the center and made a phone call. After another conversation between the man at center and the woman at right, the man walked to the left jingling keys and opened a steel cabinet at left, and so on.

For the single-channel condition the plot was the same but the props were shifted in position and the action was adjusted to the restricted space. For each judgment the observers listened first to the single-channel full-frequency-range version, and then with the smallest possible interval to the filtered two-channel version.

In the two-channel system filters were introduced and a number of observers indicated which system they preferred. In Table VIII are shown the results. When the cutoff for the low-pass filter was somewhere between 5500 and 7000 then one half the group preferred the two-channel system with filters and the other half preferred the single-channel

TABLE VIII

ONE-CHANNEL VERSUS TWO-CHANNEL TRANSMISSION

Low-Pass Cutoff	Speech and Noise Per Cent Preference	
	One Channel Full Range	Two Channels Limited Range
15,000	3	97
11,000	10	90
8,000	27	73
7,000	39	61
5,500	71	29
3,800	85	15
High-Pass Cutoff		
125	3	97
250	19	81
500	47	53

which transmitted all frequencies from 40 to 15,000 cps. Also it is seen that according to these tests the two-channel system filtering all frequencies below 500 was considered as good as the wide-band single channel. Similar tests were made in a very preliminary way on a 45-piece orchestra during a boadcast and the single channel was found to be equivalent to a two-channel with a low-pass cutoff of about 5000 cycles. These

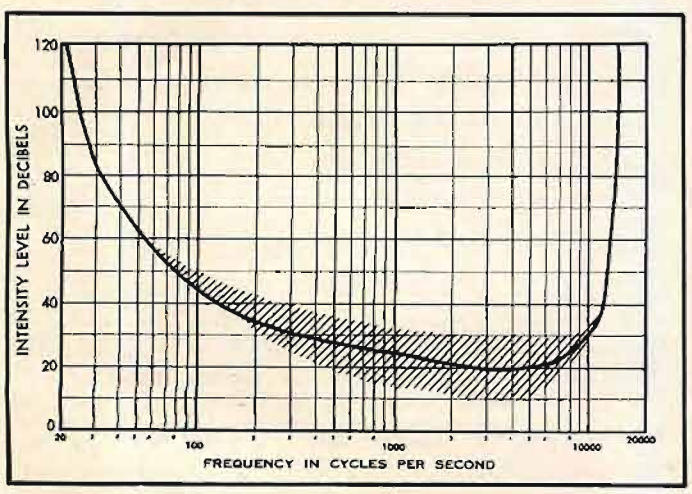

Fig. 3. Hearing limits for pure tones—typical listener in typical residential room noise.

TABLE IX

Low-Pass Cutoff	Preference	
	Binaural	Diotic
	per cent	per cent
8,500	68	32
5,500	58	42
4,510	70	30
3,750	50	50
2,850	42	58

tests are very preliminary and are only indicative of what more accurate tests might show. No direct judgment tests of a quantitative nature have been made between a two- and a three-channel system but comparison between them indicates that three channels are definitely better. This is particularly true when the sound is reproduced from a stage into a large hall.

Although head receivers are seldom used as receivers to listen to music, it may be interesting to describe some tests made in our laboratories to test the judged quality of music transmitted by a binaural system versus that transmitted by a diotic system. In these tests the listener had a pair of high-quality headphones clamped on his ears. He could listen under condition *A* (binaural) where two high-quality circuits and microphones were used to transmit music to him; condition *B* (diotic) where one channel and one microphone were used to transmit to his pair of headphones. In the diotic system the full-range of frequencies from 40 to 15,000 cps was transmitted. In the binaural system low-pass filters were introduced to eliminate a part of the upper range. Twenty-five engineers took part in the preference tests. The Philadelphia Orchestra, playing various selections, was used as the music for the test. The results are shown in Table IX. The percentage of persons preferring the binaural system with limited range is shown under the title BINAURAL. These results show that a binaural system which transmits a frequency band greater than 3750 cps was preferred to a diotic band transmitting the entire range. In other words, if a band 8000 cps wide or greater is available for a transmission channel, this indicates that better results may be achieved by using two channels binaurally than one diotically. It is rather remarkable that one half of the observers preferred a binaural system having all frequencies above 3750 cps eliminated rather than a single-channel diotic system transmitting all frequencies between 40 and 15,000 cps.

Before definite conclusions can be drawn as to the improvement of one versus two versus three channels for various purposes, much more data must be collected. It may not be economically feasible to use more than one channel in

(*Continued on page 53*)

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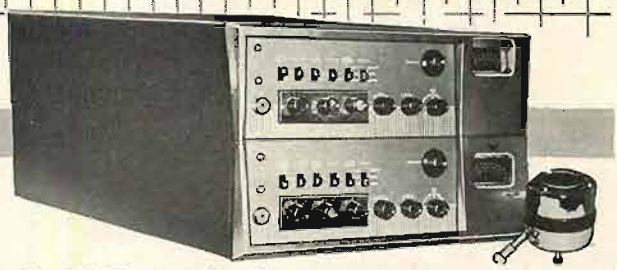

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The Stereo Phasing Problem

C. G. McPROUD

The techniques of stereo recording have not yet shaken down sufficiently that we are completely sure of the phasing of the two groove walls. This may help explain some of the inconsistencies which many readers have mentioned in letters.

IN AUDIO ETC for this month, Mr. Canby brings up a question which has engaged the attention of many others during the past few months—"When I am set up to play records with a stereo pickup, I find that if the system is properly phased for monophonic records, it is out of phase when I play a stereo record; why is this?"

The writer first encountered this condition last February at the Los Angeles High Fidelity Show. In the Pickering exhibit room, a system was set up with the speakers phased correctly for monophonic records, with the sound apparently coming from a virtual speaker directly in the center. Shortly afterward, during the playing of the Capitol Stereo Demonstration Record, Ed Uecke, Capitol's chief engineer, came in and the first thing he said was, "That's out of phase."

Since Mr. Canby had discussed this problem with us recently, we set out to find out why this should be—for we had already noticed it ourselves on several occasions. To begin with, let us consider the stereo pickup. For the purposes of this discussion, we are using a magnetic cartridge, although the same conditions obtain with ceramic or crystal types.

Figure 1 shows the hookup of a typical magnetic cartridge with four terminals. For a movement of the stylus as shown by arrow A, the moving elements are carried as shown by the arrows B and C. The convention used here is that a movement of the element in the direction of the arrow generates a signal of positive polarity at the end of the coil by the head of the arrow. Thus for a lateral movement of the stylus, positive signals are generated at terminals 1 and 3, and negative signals at terminals 2 and 4. For lateral records only, therefore, terminals 1 and 3 can be connected together, and terminals 2 and 4 can be connected together. If the two coils are paralleled in this manner, any vertical components in the record will be cancelled out, which will reduce any rumble that may be present.

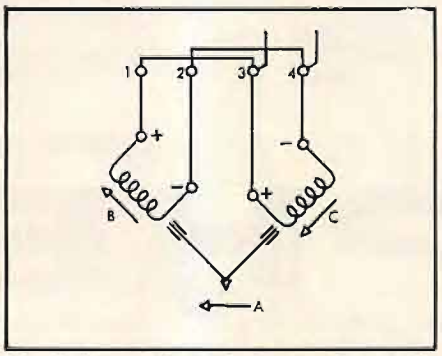


Fig. 1. Connections of stereo pickup coils for reproduction of lateral records.

Figure 2 shows the same pickup actuated by a vertical movement of the stylus, arrow D, producing positive signals on terminals 1 and 4 as generated by the movements of the elements indicated by arrows E and F. With this hookup, lateral movement of the stylus generates two signals which are cancelled out, and only the vertical signal will appear at the output.

Figure 3 shows a three-terminal pickup, such as Stereotwin and ESL, which have the coils connected so that the two "hot" leads are in phase on lateral signals. This is, of course, the same condition that would exist if terminals 2 and 4 of the four-terminal pickup were connected together as a common terminal, as is generally the case. When lateral records are played with a pickup so connected, the output should be about equal to that from either coil alone; if the coils are improperly phased, there will be very little output when the two are paralleled.

In the original presentation of the Westrex cutter, the arrangement was like the coils in *Fig.* 1 without the coils being connected in parallel as they are shown in the figure. Using the same convention for polarity, it will be noted that to cut a lateral record the two signals had to be out of phase with respect to the tops and bottoms of the two coils. It seems to be the concensus of recording engineers that the stereo groove should be cut so that the predominant modulation of the groove is in the lateral direction, which means that the signals were fed to the coils out of phase. This has since been corrected by an RIAA standard which defines the polarity such that when two identical signals are fed to the cutter in phase, the groove will have lateral modulation only. It is quite possible, however, that before this standardization many records were cut with the polarities reversed, which results in the difference in phasing between monophonic and stereo records.

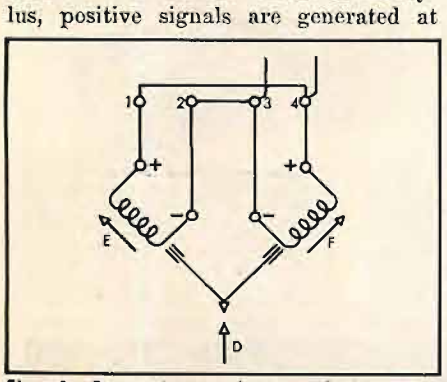


Fig. 2. Reversing polarity of one coil provides reproduction of vertical records.

How to Tell Phase

It is difficult to explain how to detect the proper phase. With monophonic records, a system should be set up so that the sound appears to come from a point half way between the two speakers. This is easily detectable by anyone. But on stereo, the two speakers are reproducing different signals, even though some components of the signals are the same. Mr. Canby describes the out-of-phase sound as like hearing it through vertical venetian blinds, giving a sound like a ripple as you walk back and forth in front of the speakers. John Bubbers of B&C Recording Company says the room seems to have standing waves in it, which is an engineer's way of saying just what Mr. Canby says. Our suggestion is that you walk back and forth in front of the two speakers—if the sound is smooth, with only a gradual changing effect from one speaker to the other, the system is in phase; if the sound seems to jump back

(*Continued on page 79*)

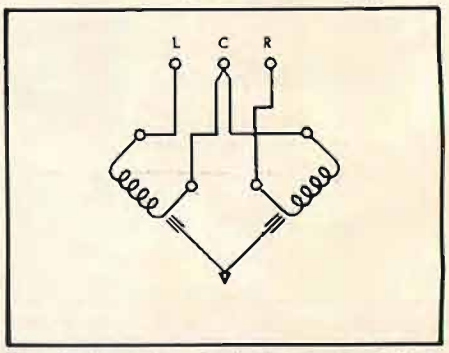
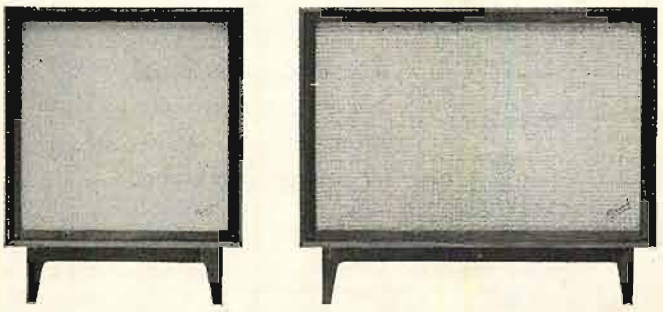


Fig. 3. Three-terminal pickup should be polarized so that shorting "hot" leads will reproduce lateral discs.



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Audio Engineering Society

TENTH ANNUAL CONVENTION

September 29—October 3, 1958

HOTEL NEW YORKER

34th Street at Eighth Avenue, New York City

Program of Convention Papers

RETURNING to the theme of the first audio show ever held in the U. S., —Professional Audio Equipment—the Audio Engineering Society is this year holding its own show, concurrently with the New York High Fidelity Show, with all of the exhibits devoted to non-consumer equipment. The growth of the high-fidelity industry has so greatly overshadowed in magnitude the market for professional audio equipment that the shows—which were originally designed for the engineer —now have little attraction for the manufacturers of test and measurement gear. This year they have their own show, and engineers will welcome the change.

The convention of the Society brings a wider range of papers than ever before, and the complete program follows:

Monday, September 29.

9:30 a.m. THE TRANSISTOR IN AUDIO CIRCUIT APPLICATIONS

F. M. Dukat, Raytheon Manufacturing Company, Chairman.

Direct Coupled Transistor—Tube Audio Amplifier for Radio and TV.
William F. Palmer and G. Schiess, Sylvania Electric Products, Inc.

Applying the Transistor in a Stereophonic Tape System.
Dwight V. Jones, General Electric Co.

A 25-Watt High-Quality Transistorized Audio Frequency Power Amplifier
R. Minton, RCA.

Design of a Stereo Control Center
Paul A. Grace, Raytheon Mfg. Co.

1:30 p.m. STEREO PERCEPTION

H. E. Roys, RCA Victor, Chairman.

Physiological and Psychological Aspects of Stereo
Dr. Fred P. Beguin, G.E. Co.

Psychological Factors Governing the Binaural Effect
John A. Cooley, Georgetown University.

Stereo as an Integral System
Norman H. Crowhurst, Audio Design Services.

Determining the Arena of Stereo Perception
A. B. Cohen, Advanced Acoustics Co.

7:30 p.m. MUSIC AND ELECTRONICS

Prof. Vladimir Ussachevsky, Dept. of Music, Columbia University, Chairman.

Several Problems in Musical Acoustics
Prof. Melville Clark, Jr., Massachusetts Institute of Technology.

Specialized Equipment used at Columbia University Studio for the Production of Tape Music
Peter Mauzey, Dept. of Electrical Engineering, Columbia University.

Sound Synthesis By The Use of Magnetized Arrays
A. H. Frisch.

Musical Timbre Mutation by Means of the "Klangumwandler," a Frequency-Transposition Device
Professor Vladimir Ussachevsky, Dept. of Music, Columbia University.

Generation of Music by a Digital Computer
H. V. Mathews and N. Guttman, Acoustics Research Dept., Bell Telephone Laboratories, Inc.

Possibilities For Combining Electronic Music, Tape Music, and Musique Concrete with Traditional Music
Prof. Otto Luening, Dept. of Music, Columbia University.

Tuesday, September 30.

9:30 a.m. DISC RECORDING AND REPRODUCTION.

H. E. Roys, RCA Victor, Chairman.

From Stereo Tape to Stereo Disc
Albert B. Grundy, Jr., International Electro-Acoustic Corp.

A New Master Disc Recording Lathe for Stereo-disc Use
Stephen F. Temmer, Gotham Audio Development Corp.

Recent Developments in Stereophonic Disc Recording
C. C. Davis and Dr. John Frayne, Westrex Corporation.

Checking the Axes of Operation of Stereo Cutter Channels
H. G. Redlich, Teldec, Berlin, Germany.

The Ortofon Stereo Recorder
H. A. Arentzen, Ortofon Industries, Copenhagen, Denmark.

1:30 p.m. DISC RECORDING AND REPRODUCTION.

Benjamin B. Bauer, CBS Laboratories, Chairman.

Some Thoughts on Geometric Conditions in the Cutting and Playing of Stereo Discs and Their Influence on the Final Sound Picture
C. R. Bastiaans, N. V. Philips, The Netherlands.

A Stereophonic Variable Reluctance Phonograph Cartridge
Peter E. Pritchard, G.E. Co.

The Development of a High-Quality Stereophonic Pickup Cartridge
Walter O. Stanton, Pickering & Co.

A Single-Element Stereo Cartridge
John F. Wood, Electro-Voice, Inc.

A Constant-Displacement Stereo Cartridge
William S. Bachman, Columbia Records.

A Moving Coil Stereo Cartridge
Rein Narma, Fairchild Recording Equipment Corp.

Wednesday, October 1.

9:30 a.m. MAGNETIC RECORDING—TAPE, THE MEDIUM.

Walter H. Erikson, Radio Corporation of America, Chairman.

An Investigation of Magnetic Drop-outs
Robert H. Carson, U. S. Naval Research Laboratory.

50 Mylar T-A Film Especially Designed for Use as a Magnetic Tape Base
Lester R. Barton, E. I. DuPont de Nemours Co., Inc.

Magnetic Tape Recording with Longitudinal or Transverse Oxide Orientation
Richard F. Dubbs, MMM.

The Noise in Magnetic Recording which is a Function of Tape Characteristic
Philip Smaller, Ampex Corporation.

Signal to Noise Problems and New Equalization for Magnetic Recording in Music
John G. McKnight, Ampex Corporation.

A New Device for the Reduction of Print-Through
Frank Radocy, Audio Devices, Inc.

1:30 p.m. MAGNETIC RECORDING TECHNIQUES AND EQUIPMENT.

Walter H. Erikson, Radio Corporation of America, Chairman.

Evolution of a Successful Spring-Driven Broadcast-Quality Tape Recorder
Albert C. Travis, Jr., Broadcast Equipment Specialties Corp.

Magnetic Recording of Audio Frequencies
Chester E. Beachell, National Film Board of Canada.

Optimum Recording Conditions for Low Tape Speeds
Harold A. Johnson, Jerre L. Papier, and Verner Ruvalds, Shure Brothers, Inc.

Electromagnetic Efficiency of Magnetic Recorder Heads
Marvin Camras, Armour Res. Fdtn.

A Special Technique Applicable to Slow-Speed Tape Recording
R. J. Youngquist, MMM.

Thursday, October 2.

9:00 a.m. ANNUAL BUSINESS MEETING

9:30 a.m. MAGNETIC RECORDING—NEW DEVICES.

Walter H. Erikson, Radio Corporation of America, Chairman.

High Quality Reproduction of Magnetic Tape in a Cartridge
D. R. Andrews, RCA Laboratories.

A Magnetic Head for Stereo or Half Track on ¼-inch Tape
H. R. Warren, RCA.

Professional High-Speed Duplication of the New Four-Track Stereo Tapes
R. J. Tinkham, Ampex Corporation.

A Magnetic Disc Recorder for Broadcast Use
George Singer, RCA.

A Magnetic Head for Grooved Magnetic Recording Discs
H. R. Warren, RCA.

Properties and Performance of Magnetic Rubber Recording Belts
William Fabing and R. R. Hartel, Clevite Corporation

1:30 p.m. MEASUREMENTS AND STANDARDS IN AUDIO.

Sheldon I. Wilpon, New York Naval Shipyard, Chairman.

The Automatic Plotting of Cartridge Response
C. P. Germano, Clevite Corporation.

Standards — Stepchild in the Laboratory
Charles E. White, The Avco Manufacturing Company.

The ARP2 — A New Instrument for Sound Measurement
Louis W. Erath, The Southwestern Electronics Company.

Determination of Absolute Recording Sensitivity of Magnetic Tape
E. D. Daniel and I. Levine, N.B.S.

7:00 p.m. TENTH ANNUAL BANQUET.

Friday, October 3.

9:30 a.m. STUDIO EQUIPMENT AND AUDIO APPLICATIONS.

Philip Erhorn, Audiofax, Inc., Chairman.

A Three-Channel Stereophonic Sound Reinforcement Mixing Console
Philip Erhorn, Audiofax, Inc.

An Audio Console Designed for the Future
A. C. Angus, General Electric Company.

Multi-Channel Stereophonic Mixer Console
William H. Miltenburg, RCA Victor.

A Packaged Equipment for the Production of True Reverberation
Wilhelm Franz, Elektromesstechnik, Lahr, Schwarzwald and V. J. Skee, Electronic Applications, Inc.

The Development and Application of Synthetic Reverberation Systems. (Demonstration).
Lewis S. Goodfriend. John H. Beaumont, Vanguard Recording Society

7:30 p.m. LOUDSPEAKERS—DESIGN AND APPLICATION.

Abraham B. Cohen, Advanced Acoustics Company, Chairman.

Two New Horns and Drivers (Covering High Frequencies)
Messrs. Levy, Matsuoka, and Brociner, University Loudspeakers, Inc.

Analysis of a L-P Loudspeaker System
Peter W. Tappan, The Warwick Mfg. Co.

New High-Efficiency P. A. Speakers
Messrs. Levy, Sioles, Carlisle, and Sharp, University Loudspeakers, Inc.

A New Approach to Vented Cabinet Design
Messrs. Sioles and Brociner, University Loudspeakers, Inc.

A New Wide-Angle Direct-Radiator Tweeter
Adelore F. Petrie, G.E. Co.

A Novel Compact Stereo Speaker System
Emanuel Berlant, Stephens-Trusonic, Inc.

A Definitive Loudspeaker System for Monitoring in Control and Audition Rooms
Wilhelm Franz, Elektromesstechnik, Lahr, Schwarzwald and V. J. Skee, Electronic Applications, Inc.

Every part of every *Collaro* changer is precision-engineered to meet the rigid demands of Stereo

The new stereo records require a higher standard of performance from your record changer than do standard LP's because stereo cartridges are extra-sensitive to noise. That's why, in planning your stereo system, you begin with the Collaro. Every part of every Collaro changer is precision-engineered to meet the rigid quality demands of stereo.

The motor (see A above) is dynamically balanced, so rigidly mounted that wow and flutter specifications are superior to any changer.

The spindle assembly (B) reflects this precision quality in every part. The spindle itself is micro-polished for complete smoothness.

The sensitive velocity trip mechanism (part shown in C) has been designed so that the changer can trip at extraordinarily light tracking pressures.

The exclusive Collaro transcription-type tone arm (D) with the new plug-in head (E) is designed to eliminate all resonances in the audio spectrum. The new four-pin head—the only high fidelity changer with this feature—provides the ultimate in noise-reduction circuitry.

There are three Collaro changers ranging in price from $38.50 to $49.50. No matter which you select, you're sure to start your system off right when you choose Collaro—the turntable that changes records.

For new Collaro catalog write to Dept. A-9, Rockbar Corporation, Mamaroneck, New York.

ROCKBAR Corporation

Rockbar is the American sales representative for Collaro, Ltd.

Equipment Review

Madison-Fielding Series 330 Stereotuner and Series 320 Stereo Amplifier—Harman-Kardon F-10 FM Tuner

MADISON FIELDING SERIES 330 STEREOTUNER

With the growing number of FM-AM stereocasts, demand has increased for stereotuners—separate AM and FM tuners on a single chassis. Today in approximately two dozen cities there are affiliated FM and AM stations that are stereocasting on schedules ranging from one-half to 20 hours a week. One of the newcomers to the still slender ranks of stereotuners is the Madison Fielding Series 330 shown in *Fig.* 1. This unit has four output jacks, which supply the following signals:

1. FM, for feeding the FM signal into the left channel of a stereo amplifier.
2. AM, for feeding the AM signal to the right channel of a stereo amplifier.
3. AM/FM, for feeding either the AM signal or the FM signal into a single-channel amplifier.
4. Multiplex, which takes the FM audio signal prior to the treble de-emphasis circuit for the purpose of supplying a multiplex adapter, which will be on the market when multiplex broadcasting becomes a reality.

The Series 330 is neat and simple in appearance, with only three operating knobs, one for AM tuning, one for FM tuning, and the third a selector switch with four operating positions, as follows:

1. OFF.
2. AM: The AM signal is connected both to the AM/FM output jack and to the left channel output jack, marked FM. Moreover, although the instructions make no mention of this, the FM signal is connected to the right channel output jack, marked AM. In others words, in the AM position of the selector switch the channels are reversed.
3. STEREO: Here the FM signal is connected to the FM output jack and the AM signal to the AM output jack.
4. FM: The FM signal is fed to the left output jack, marked FM and to the AM/FM output jack. There is no signal present then at the AM output jack.

It would seem that the above variations as to the signals that may be obtained at the various output jacks would take care of most needs of most stereofans. Moreover, there are level controls for the two output jacks at the rear of the chassis, permitting output levels to be brought at least approximately into balance. Exact balance cannot be achieved, except for two specific FM and AM stations because levels differ among stations and, in the case of AM, with signal strength.

FM sound is clean and, when A-B'd with a comparison tuner of known characteristics, seems to have the correct amount of treble de-emphasis. An appreciable number of manufacturers of FM tuners succumb to the temptation of using less than the required amount of de-emphasis, thereby imparting a false brilliance to the sound, a brilliance which often does not wear very well upon protracted listening.

The FM circuit is on the whole simple and conventional, with a few departures from convention that make a favorable difference. It employs a tuned grounded-grid r.f. stage, a triode mixer and separate triode oscillator, a triode a.f.c. circuit, two i.f. stages, a limiter, and a ratio detector, which is no longer looked upon with disdain for use in first-rate tuners. One of the things that sets the Series 330 apart is the unusually wide i.f. bandwidth, which is 355 kc at the 3-db-down points. This helps keep distortion low and accounts at least in part for the clean character of the sound. Alignment can be performed without removing the bottom plate, so that this does not raise the problem of alignment changing when the bottom plate is put back. Sensitivity is high, and a 3-foot strand of wire appeared to work quite satisfactorily at a distance of 30 miles from a number of FM stations. A.f.c. action is quite moderate, just enough to overcome drift but not so much as to complicate seriously the problem of selecting a weak station adjacent to a strong one. Use of a tuning eye—half of a 6AF6 (the other half is used for the AM section)—facilitates tuning, and the point where a station comes in best coincides with maximum closure of the eye.

All in all, the FM tuner appears to be a very satisfactory unit.

While in the main the same can be said of the AM tuner, the latter does raise one serious question, that of adequate treble response. Many AM stations transmit a wide range signal, extending in a number of cases to 10,000 cps, 12,000 cps, or even higher. The limitation on frequency response, therefore, often lies in the AM tuner. The Series 330 appears to have what is often called "typical AM sound" so far as frequency response is concerned. This reviewer tuned the AM section of the Series 330 to a New York City AM station known to transmit a wide-range signal, and there was a very decided difference between the signal received on the AM section of the tuner and the signal received on the FM section, which was tuned to the FM adjunct of the station.

Otherwise, there appears little if anything to criticize. Within the limitations of frequency response, sound is clean, attributable in part to the use of a separate diode for a.v.c., thereby minimizing distortion. Also, the use of a separate diode makes the a.v.c. action more effective, so that the volume level is more constant from one AM station to another.

Cathode-follower outputs are used for both the FM and AM sections, permitting long runs of cable to the stereo amplifier. Flywheel tuning facilitates station selection. The unit has a low silhouette and, as previously remarked, is good looking; it becomes even more handsome when installed in the natural wood finish cabinet available at extra cost. **K-25**

Fig. 1. Madison-Fielding Series 330 Stereotuner.

MADISON FIELDING SERIES 320 STEREO AMPLIFIER

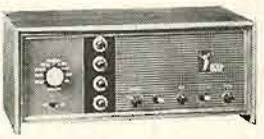
The sudden onrush of stereo due to the emergence of the stereo disc doubtless has caused amplifier manufacturers to do a good deal of deep thinking. In designing an amplifier for stereo, there is much room for the display of imagination, originality, and ingenuity, for there are many ways in which the amplifier can provide for controlling the stereo channels, coordinating them, and permitting their use for monaural as well as stereo sources. The Madison Fielding Series 320 amplifier reflects a good deal of serious and imaginative thinking as to the problems that the audiofan—or rather stereofan—is apt to encounter.

The Series 320 includes a control amplifier (tone, gain, loudness, selection) and a power amplifier, rated at 20 watts, for each channel.

The 320 is as much interested in providing monaural[1] service as stereo service—after all, most of us will still want to keep playing our treasured LP's and to keep listening to single-channel FM until multiplex comes along. To this end, the selector switch has duplicate sets of positions, one set to the left of the center position, and the other to the right. When turned to the left (where there are three positions marked tape, tuner, and preamp), the amplifier becomes a monophonic device, causing any input fed to the left channel also to be fed to the right channel. Inputs to the right channel are then disconnected. When the selector switch is turned to any position to the right of center (again there are three positions marked tape,

[1] The term monaural is used here instead of monophonic because the former is the term used on the panel of the Series 320.

Enjoy stereo high fidelity now or plan for it later using the versatile ALTEC 344A Quartet  monaural amplifier.

With the ALTEC 344A the conversion to stereo is simple and inexpensive. All you need is ALTEC's ingenious, new  S40 Master Stereo Control and a second  Quartet amplifier.

The remarkable ALTEC Master Stereo Control, priced at just $12.00, simply plugs in to the 344. It provides master channel control for both Quartet amplifiers which can be used together for 40 watt stereo high fidelity from tape, records or radio, or singly for 20 watt monaural play. If you already own an ALTEC 344A Quartet you can use it for stereo conversion anytime. All Quartets have been pre-engineered to accept the ALTEC S40 Master Stereo Control.

You have all of these control features for each channel with the ALTEC 344A Quartet stereo amplifier system.

Six Inputs – V.R. phono, tape deck, microphone, radio tuner, tape machine, high level phono.

Four Major Source Volume Controls allow you to pre-set and balance the level of any major program material and change from input to input or turn the power on and off without readjustment.

D.C. powered program indicator lights for completely hum-free operation.

4 Position Contour Control for undistorted listening without loss of extreme high and low frequencies at low levels.

Separate bass and treble controls.

Three Position independent rumble and scratch filters.

Tape Recording Output – provided so material from any input may be selected for recording.

Guaranteed Performance Specifications: 20-22,000 cps range, 20 watts (40 peak), 138 db gain, 32 db bass control range, 35 db treble tone control range.

Prices: S40 Master Stereo Control $12.00
344A Quartet $111.00
Walnut, blond, or mahogany cabinet $19.50

Learn how you can convert simply and inexpensively to stereo high fidelity with the S40 Master Stereo Control at your local ALTEC dealer or write:

ALTEC® LANSING CORPORATION

ALTEC LANSING CORPORATION, Dept. 9A-A
1515 S. Manchester Avenue, Anaheim, California
161 Sixth Avenue, New York 13, New York

12-30

tuner, and preamp), then the inputs to each channel are normalled through; that is, inputs to the left channel go through the left channel amplifier, and inputs to the right channel go through the right channel amplifier. In short, when the selector switch is right of center, the Series 320 is a stereo amplifier.

Unlike the majority of stereo amplifiers —although there are other exceptions in the same respect—the Madison Fielding Series 320 does not have a balance control. Instead it relies upon separate gain controls for each channel to achieve balance. Concentric with each gain control is a switch that converts the former into a loudness control. Like all stereo amplifiers (at least all this reviewer has come across), the Series 320 has a master gain control that governs both channels simultaneously.

One of the most intriguing and novel features of this amplifier is the means provided for achieving balance between channels, employing the aid of a dual magic eye tube, a 6AF6, each half of which is similar to the familiar 6E5. A built-in tone generator is switched to each power amplifier by means of a control marked CALIBRATE. The output from each power amplifier goes to half of a 12AX7 and thence to one of the grids of the 6AF6, causing the eye of each half of the electron ray tube to close partially or fully. The extent to which the eye closes is determined by a potentiometer marked POWER, which is concentric with the switch marked CALIBRATE. There is a set of power and calibrate controls for each channel. The power controls are set to the same position, according to panel markings for 1 watt, 5 watts, 10 watts, 15 watts, and 20 watts. The listener may choose any panel marking he desires, provided both power controls are turned to the same position. This means that each half of the 6AF6 will respond in the same fashion for equal amounts of power supplied by each power amplifier. Then the gain control of the left channel is advanced until the left eye shadow of the 6AF6 barely closes. The gain control of the right channel is similarly advanced until the right eye shadow barely closes. With the eye producing equal indications in each section, there should be equal power output by each amplifier.

The tone controls are separate for each channel instead of being ganged, as is more frequently the custom. For the left channel there is a concentric pair of bass and treble controls; and the same for the right channel. There are opposite schools of thought as to whether ganged or separate controls are most desirable, and this reviewer is on the fence between. Ganged controls make for simplicity of appearance and operation, and since matched speakers are necessary for optimum stereo results, there is a good case for the ganged control. On the other hand, many stereofans will be using different speakers for the right and left channels, at least initially, and in this case separate tone controls may well be desirable in order to allow for the variation in frequency response of each speaker system. Even when matched speakers are employed, it is quite possible that differences in their room location will call for different amounts of tone correction.

Although the Series 320 is rated at 20 watts, it was found that at 1000 cps it clipped at about 14 watts on each channel. This may be due to the use of EL84's in the output tube sockets instead of the 6BQ5A's designated on the chassis. According to the manufacturer, the 6BQ5A's will produce somewhat higher power under the same operating conditions. In any event, the difference between 14 and 20 watts is a matter of only about 1.5 db, which is far from serious. It was found that each channel could turn out a good deal of power at very low frequencies, which is not true of all amplifiers that turn out 14 watts or so at 1000 cps. Thus at 30 cycles, clipping was not observed on an oscilloscope until output reached 12 watts.

The sound of the Madison Fielding Series 320 may be described as sweet and clear. The quality of the sound is confirmed by IM distortion measurements, using 60 and 5000 cps respectively in 4:1 ratio. Measurements for the left channel showed IM of about 0.2 per cent at 1 watt equivalent sine wave power, 0.3 per cent at 2 watts, 0.4 per cent at 3 watts, 0.8 per cent at 5 watts, 1 per cent at 8 watts, 1.4 per cent at 10 watts, and 3 per cent at 15 watts.

Sensitivity of the Series 320 appears to be quite adequate for all inputs. As measured on the left channel at 1000 cps with all gain controls full on, the tuner and tape amplifier (high level) inputs required 270 mv for 10 watts output, the tape head input required 2 mv, and the magnetic phono input required but 3.6 mv. The right channel had about 2 db more sensitivity, but of course the user would correct for this by means of the individual gain controls for each channel.

Equalization appeared to be quite accurate on the magnetic phono input at the low end, being within 1 db of the RIAA curve at 50 cps; at the high end, however, treble cut was some 4 db less than stipulated by RIAA. In the case of a signal taken directly from a tape head, bass equalization was considerably short of the NARTB curve, with only 15 db boost supplied at 50 cps instead of 23 db, using 1000 cps as the reference point. Above 1000 cps the NARTB curve exhibits about 10 db cut out to 15,000 cps, and the Madison Fielding appeared quite accurate in this respect.

It would be unfair to omit from this extensive discussion of the Series 320 some mention of the very handsome cabinet which is available for the amplifier at moderate extra cost. The cabinet is in a natural wood finish. The amplifier complete with cabinet has a low silhouette that makes it attractive and suitable for tabletop or bookshelf use, assuming adequate ventilation is provided in the latter case.

K-26

HARMAN-KARDON F-10 FM TUNER (THE TEMPO)

At a high enough price almost anything can be had in the way of audio equipment —for example, a power amplifier producing 200 watts at less than 0.1 per cent distortion. But the commonsense approach is to draw the line for a particular component, a line above which no significant increase in pleasure or convenience results from additional dollars spent. Of course the line varies with the individual, depending upon his tastes, hearing acuity, pocketbook, and the quality of the rest of his audio equipment.

For those living in urban and suburban areas within easy distance of FM stations, there is little or no need for an extremely sensitive FM tuner. A tuner of normal sensitivity can save them money. Additional savings can be had if they are willing to sacrifice some of the features found in higher priced tuners, such as variable a.f.c., variable sensitivity, tuning meter, and so on. On the other hand, no compromise should be tolerated with respect to the essentials, namely clean sound and stable operation.

The individual seeking good FM reproduction but willing to accept some compromises in order to keep cost down will find the Harman-Kardon F-10, *Fig.* 2, of interest. The design is along sound, straightforward lines, and the tuner correspondingly offers clean sound and simple operation. Six tubes and a selenium rectifier are used. The front end has a tuned triode amplifier of grounded grid configuration for low noise. There are two i.f. stages, one limiter, and a Foster-Seeley discriminator, such as usually found in the higher-priced tuners. The discriminator has fairly wide bandwidth, 600 kc, to minimize the consequences of drift and off-station tuning. In conventional manner, a dual triode is used as an oscillator and as a variable reactance for a.f.c., which is not defeatable.

Due to a.f.c., flywheel action of the tuning knob, and a 0–100 logging scale, tuning is facile. Stations snap in and out with very little uncertainty as one goes along the dial. One or two twirls of the tuning knob take one clear across the dial. On the other hand, the dial is somewhat on the small side, so that in sections of the country with a good many FM stations, some stations may appear quite crowded on certain parts of the dial. Nevertheless, even though AFC is not defeatable, no difficulty was experienced by this reviewer in dialing close-together stations of considerably different signal strength, provided one tuned slowly. A.f.c. action is broad enough for tuning ease, yet not too broad.

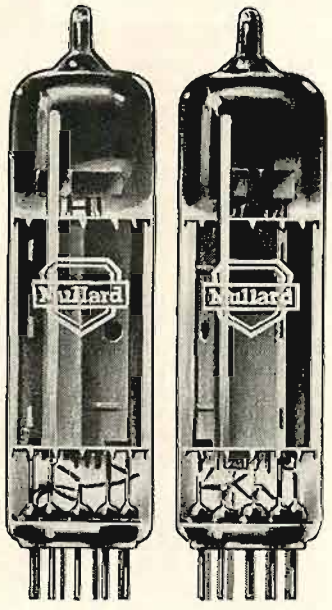
Sensitivity is good, adequate for all but the fringe area listener or the DX'er, with the high end of the dial somewhat the more sensitive. Compared with a high gain tuner having three i.f. stages and two

(*Continued on page 47*)

Fig. 2. Harman-Kardon Model F-10 FM Tuner.

ELECTRONICS
IN
BRITAIN

STEREO STEREO STEREO STEREO



EL84

12W high slope miniature pentode

This medium power, high fidelity tube is particularly suitable for stereo equipment. Its high slope of 11,300 μmhos allows two EL84s in push-pull to give over 10W output power at less than 1% distortion —all achieved for only 16V of grid to grid drive.

The EL84 may also be used for the more economical higher powered equipments. Two tubes will provide an output of up to 17W at an overall distortion of 4%.

A single EL84 will provide an output of nearly 6W. It has a maximum plate dissipation of 12W.

Typical performance details for this tube are given here—for further information and supplies write to one of the distributors listed below.

MEDIUM POWER

Distributed load conditions (screen grid taps at 43% of primary)

V_a	300	V
V_{g2}	300	V
$I_{k(o)}$	2×40	mA
I_k (max. sig.)	2×45	mA
R_k (per valve)	270	Ω
$V_{in\ (g1-g1)r.m.s.}$	16	V
R_{a-a}	8.0	kΩ
P_{out}	11	W
D_{tot}	0.7	%

HIGHER POWER

Two valves in class AB push pull

V_a	300	V
V_{g2}	300	V
R_k	130	Ω
R_{a-a}	8.0	kΩ
$I_{a(o)}$	2×36	mA
I_a (mag. sig.)	2×46	mA
$I_{g2(o)}$	2×4.0	mA
I_{g2} (max. sig.)	2×11	mA
$V_{in(g1-g1)r.m.s}$	20	V
P_{out}	17	W
D_{tot}	4.0	%

Supplies available from:

In the U.S.A.
International Electronics Corporation
Dept. A9, 81 Spring Street, N.Y.12,
New York, U.S.A.

In Canada
Rogers Electronic Tubes & Components
Dept. H1, 116 Vanderhoof Avenue,
Toronto 17, Ontario, Canada.

Mullard

ELECTRONIC TUBES used throughout the world

"Mullard" is the Trade Mark of Mullard Limited and is registered in most of the principal countries of the world.

MULLARD OVERSEAS LTD, MULLARD HOUSE, TORRINGTON PLACE, LONDON, ENGLAND

Seventh Annual

Chicago High Fidelity Show and Music Festival

First major show of the season bows in at the Palmer House on Friday, September 19, for a three-day stay. Radio Station WBBM-FM cooperating with suitable demonstration programs.

FOR THE FIRST TIME in Hi-Fi Show history, a local radio station is co-operating with the show management with programming designed especially to serve as excellent demonstration material for the high high fidelity equipment on display. WBBM-FM, Columbia Broadcasting System affiliate in Chicago, will feature a "block concept" of programming during the show, alternating light and classical music, with hourly news broadcasts, and program listings will be distributed in advance so exhibitors may demonstrate their equipment with the type of music they choose, according to information received from S. I. Neiman, Show manager. Advance publicity over the station itself has resulted in over 5000 inquiries from interested listeners as to the Show and the equipment to be exhibited.

In addition to its programming co-operation, WBBM-FM—which, with its television and AM radio affiliates blankets the Chicagoland trading area—plans a hospitality suite and various demonstrations at the Show. A special staff of engineers and announcers, independent of the AM and TV affiliates, has been set up by WBBM-FM to best serve the more-critical requirements of the typical FM listener.

Selling "Before and After"

Another form of co-operation is being developed to merchandise high fidelity aggressively "before, during, and after" the Show itself. *The Chicago Tribune*, the Show management, trade groups, and local radio and TV stations are working together to promote high fidelity—as well as the Show—to the thousands who will attend, long after they have seen and heard what the exhibitors have to offer.

"While we have been successful at each of our annual shows in bringing huge crowds to the Palmer House, there has always remained the question of following through and selling these prospects after the show is over," said Neiman. "Last year, one exhibitor used a full-page advertisement in *The Tribune* to illustrate many of the products displayed at the Show, listing prices and details. Sales were phenomenal, the firm reported.

The plan for this year is for the newspaper to run a supplementary section immediately after the Show—sort of a "Post Hi-Fi Show Section"—to say in effect, "Now you've seen and heard everything in hi fi—here's where to buy it and here's what it costs."

Dealers have thus three fronts in which to clinch the interest in hi fi—the pre-show sections in *The Tribune* and advance programming on radio and TV, the Show itself, and the follow-up which tells the people where they can purchase the items they saw and heard. With this technique, Chicagoland is likely to be much more hi-fi conscious after the event than it was before.

Show a Sellout

As of August 15th, a total of 134 rooms were under contract, with only four suites and a scattering of individual rooms still available. As of press time, the following exhibitors are scheduled:

AUDIO Magazine
ABC-Paramount Records
Acoustic Research, Inc.
Admiral Radio
Allied Radio Corp.
American Electronics, Inc. (Concertone)
Amperex Electronic Corp.
Ampex Audio, Inc.
Audio Fidelity Records
Audiocraft and *High Fidelity* Magazines
Bell Sound Systems
Bercraft
David Bogen Co.
R. T. Bozak Sales Co.
British Industries Corp.
Custom Hi Fi
De Haan
EICO
Electro-Voice, Inc.
Extron
Fisher Radio Corp. (Fellieson)
Glaser-Steers Corporation
Grado Laboratories, Inc.
Grundig Majestic
Harman-Kardon
Heath Company
Hi Fi Co. and Electrola (Magnavox sponsored)
International Electronics
Jensen Manufacturing Company
James B. Lansing Sound, Inc.
Lyon & Healy
Don McGohan
McIntosh Laboratories, Inc.
Magna Electronics
Magnavox
Master Electronics
Mercury Records
Newark Electric Company
North American Philips Co., Inc.
Olson Radio Warehouse
Oxford Components
Petersen Co.
Philco Corp.
Pilot Radio Corp.
Precision Electronics (Grommes)
Radio Corporation of America
Radio-Electronics magazine
Radio Station WBBM-FM
Radio Station WEFM
Record Distributors
Rek-O-Kut Co., Inc.
Revere Camera Co.
Sampson Company
Sargent-Rayment Co.
Schwartz-Woodlawn
H. H. Scott, Inc.
Sherwood Electronic Laboratories
Oren H. Smith
Sonotone Corp.
Stromberg-Carlson
Superscope, Inc.
Telefunken
Thorens Company
Umbenhuer Co.
University Loudspeakers, Inc.
Viking of Minneapolis
V-M (Voice of Music)
Welleor
Westinghouse Electric Corp.
Wilcox Gay
Wollensak Optical Co.
Zenith Radio Corp.

EQUIPMENT REVIEW

(*from page 44*)

limiters, it brought in all the stations in the New York City area (at least 16) just as well from a distance of 30 miles, using an outdoor antenna. Only when reaching for stations considerably more than 30 miles distant did the FA-10 show signs of falling behind the comparison tuner.

A 36-in. piece of wire is supplied with the FA-10 as an indoor antenna, and it performed surprisingly well in picking up stations 30 miles away, leaving no doubt that it would be quite satisfactory in an urban location. However, much better results were obtained with an outdoor antenna. Although the instructions state, "Your TV antenna is not recommended," excellent reception was obtained by connecting to a TV *wideband* antenna. Apparently it is the narrowband TV antenna, cut for one particular channel or group of adjacent channels, that is not recommended. True, still better results can probably be obtained by the fringe listener if he follows the manufacturer's suggestion that "A good FM dipole or yagi is worth the investment." At the same time, he should not be frightened away from use of his TV antenna, if it is a wideband type, which he can easily connect to the tuner by a simple switch and a few feet of 300-ohm flat wire.

Noise and hum of the FA-10 appear to be as low as one could ask for. At reasonable volume levels when receiving stations of normal strength, noise and hum produced by the tuner were not discernible—such noise and hum as were heard could be traced to the station. Between-station noise is quite moderate at reasonable levels, without great rushes of sound as stations suddenly come in or go out.

Stability is excellent. Harman-Kardon claims drift of only ±5 kc, and this observer has no cause to dispute it. A station would come in at the same point on the dial when the tuner was first turned on as when it had been on an hour.

The inherently good design and construction of the FA-10 is evidenced by its low distortion, which the manufacturer claims to be less than 1 per cent harmonic and less than 1 per cent IM at 30 per cent modulation. On a signal of normal strength, this reviewer measured only 1.2 per cent IM distortion at *full* modulation (he has measured 4 or 5 per cent on much higher priced tuners); and only 0.25 per cent at 30 per cent modulation.

However, these are minimum IM figures obtained by tuning for lowest distortion as observed on the IM meter. Since there is no tuning indicator, the user cannot tune exactly to the station for minimum distortion. About the best that he can do is to tune to a spot on the dial half way between the points where the desired station snaps in and snaps out. Thus at full modulation, by this "half way" method, 2 per cent IM was obtained instead of the possible minimum of 1.2 per cent; at 30 per cent modulation, the "half way" method resulted in 0.45 per cent IM instead of 0.25 per cent. All in all, careful tuning can produce very good results on normal signals, probably indistinguishable from the sound obtained with the aid of an accurate tuning indicator.

The sound of the FA-10, already described as clean, has a light, incisive quality which may be ascribed to the use of appreciably less than the 75-μsec deemphasis stipulated by the FCC. Utilizing

a 22K resistor and a .002-μf capacitor, the deemphasis network has a time constant of only 44 μsec. Adding the capacitance of the cable supplied for connecting the tuner to an amplifier and of the probable input capacitance of the amplifier, the time constant rises to about 50 μsec, resulting in treble droop with a turnover frequency (3 db down) at about 3200 cps instead of 2120 cps. The result is treble boost, reaching somewhat more than 3 db at 10 kc and larger amounts at higher frequencies. Sufficiently accurate deemphasis could be obtained by placing a .001-μf capacitor across the signal either at the output jack of the tuner or the input jack of the following amplifier. Æ

AUDIOCLINIC

(*from page 4*)

When an amplifier is turned off, the lines of force collapse about the turns of the secondary of the power transformer, causing the voltage across this winding to rise momentarily to a value considerably higher than that of normal operation. This causes the amplifier to draw more plate current. At the same time, the higher voltage allows the filter capacitors to take a greater charge, which means that even more momentary current flows. Although these fuses are designed to handle momentary surges, they nevertheless have their limits. I recommend, therefore, that you use a large fuse. Since the ratings of these Fusetrons are graduated in small steps, I'm sure you can find one which is sufficient to handle the overload peaks, and still provide protection. Æ

AMPLIFIER

(*from page 23*)

from this technique were as close to those displayed in *Fig.* 6 as resistor accuracy and meter reading ability would permit, in other words within about 5 per cent.

The "Unbalanced Bridge" Method

In an attempt to refine this method still further and measure the voltage change more accurately, an unbalanced bridge arrangement was used (see *Fig.* 8). The philosophy here is that the voltmeter reads $E_3[0.5 - R_2/(R_1 + R_2)]$. Furthermore, if the two half-ohm resistors are not exactly equal, their relative value may be established by initially balancing the bridge and noting the reading on the decade potentiometer. This reading is then used in place of 0.5 in the foregoing formula. One-ohm increments of the total load are taken as above and each time the bridge is unbalanced enough to produce, say, .01 volt. E_3 is then computed and handled in the same manner as the voltmeter reading in the preceding method. This setup is perhaps the most accurate but requires more elaborate equipment.

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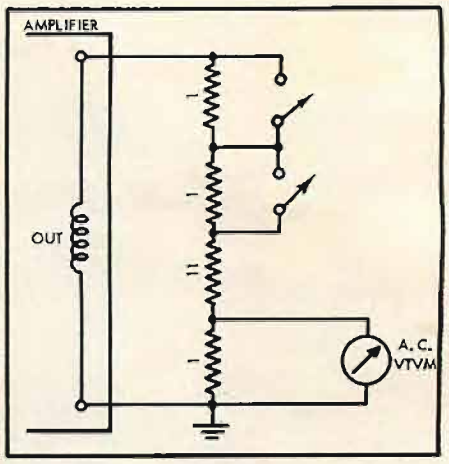

Fig. 8. Bridge method for accurately measuring small voltages.

No significant differences from previous results were recorded here.

Seeking a somewhat more direct technique and noting that internal resistance determines the *power* change when the load is changed, an accurately calibrated power output meter of the General Radio 583A or 783A and Daven OP961 types were utilized. Two output powers were recorded with two different loads—in this case, 12.5 and 15 ohms were the closest to the rated load. If we assume that load R_{L1} gives greater power output that R_{L2} (and thus $P_R > 1$) we can write:

$$\frac{\left(\frac{E}{R_{int}+R_1}\right)^2 R_1}{\left(\frac{E}{R_{int}+R_2}\right)^2 R_2} = \frac{\textit{Power output with load } R_{L1}}{\textit{Power output with load } R_{L2}} = P_R$$

Performing the necessary algebra

$$R_{int} = \frac{R_1 R_2 (P_R - 1) \pm \sqrt{P_R R_1 R_2}\,(R_1 - R_2)}{R_1 - P_R R_2}$$

Use the negative sign in the numerator when the denominator comes out negative—positive when the denominator is positive. The only difficulty with this system (other than the thorny formula above) is that the power meter indications tend to become unreliable at the higher frequencies, but below 10,000 eps results tallied with *Fig.* 6.

As a final check, it was decided to use two frequency components—one coming through the amplifier and one being run through the output circuits—and measure them separately by means of a wave analyzer (see *Fig.* 3). Make $R = 13$ ohms and substitute a low-output-impedance signal generator for the Variac. Note that the amplifier is correctly terminated as the impedance of the step-down transformer secondary is extremely small. This now corresponds

to a stored-energy transient situation as encountered in audio amplifiers. The impedance seen by the signal being fed back into the amplifier may be determined by simple voltage-division principles since we know the magnitude of the voltage supply and the drop across a known resistance. As long as we keep within reasonable frequency bounds, there will be no appreciable phase shift. Suffice to say that the impedance seen by this "backward" component is almost entirely a function of the magnitude and frequency of the signal coming through the amplifier in the normal way. "Almost entirely" because it is possible to create transformer saturation with this driven current, but this is scarcely likely to happen under normal amplifier usage. This, too, produces a set of values within normal measurement error of those displayed in *Fig.* 6.

Since many of these calculations involve small differences between relatively large quantities, it is mandatory that the resistors, voltmeters and other paraphernalia be accurate to one-half of one per cent or better. Æ

References

[1] Richter, "Measuring amplifier internal resistance. Audio Engineering, October, 1948.

[2] Mitchell, "Audio amplifier damping." *Electronics*, September, 1951.

[3] W. L. Everitt, *Communications Engineering* (second Ed.). McGraw Hill, p. 568.

Appendix

(Refer to Fig. 2)

$$I_1 = \frac{E}{R_{int} + R_{L_1}}; \qquad I_2 = \frac{E}{R_{int} + R_{L_2}}$$

$$E_{out_1} = I_1 R_{L_1}; \qquad E_{out_2} = I_2 R_{L_2}$$

$$E = I_1 R_{int} + I_1 R_{L_1} = I_2 R_{int} + I_2 R_{L_2}$$

$$I_1 R_{int} + E_{out_1} = I_2 R_{int} + E_{out_2}$$

$$R_{int}(I_1 - I_2) = E_{out_2} - E_{out_1}$$

$$R_{int} = \frac{E_{out_2} - E_{out_1}}{I_1 - I_2}$$

FEEDBACK

(*from page 32*)

nominal value, the damping factor of the amplifier is 4, a value which provides good operation with most speakers. However, other damping factors can be used, and while absolute isolation between load and feedback is not obtained, a sufficient degree is realized to be of positive benefit. For example, a capacitive load will not display ringing at any setting of the control. Moreover, the system has the beauty of supplying variable damping with insignificant increase in distortion, and maintains a constant amount of feedback so that output level is independent of the setting of the damping control. The complete schematic of the amplifier is shown in *Fig.* 2. Æ

NEW LITERATURE

• **Lafayette Radio,** 165-08 Liberty Ave., Jamaica 33, N.Y., is now mailing its new 1959 general catalog of electronic parts and equipment, including a complete section devoted to high-fidelity components. Highlighting this section is a comprehensive listing of the newest stereo equipment, including components for conversion of monophonic systems to stereophonic sound. A complete selection of major-label stereo discs and recorded tapes is also listed. An extensive public-address section lists components as well as complete systems from all major manufacturers. The catalog contains 64 pages in color, and has the large 8" x 10" page Lafayette format. Your copy will be mailed free upon request for Catalog 590. **K-15**

• **Pickering & Company,** Sunnyside Blvd., Plainview, N.Y., is making available a new booklet written by Jean Shepherd, well-known radio personality and hi-fi hobbyist. "ISOPHASE—A New Kind of Sound" is a basic story of the electrostatic speaker, written for the non-technical reader in the erudite style for which Shepherd is noted. It offers delightful reading for the engineer and layman alike. Your copy of this excellent booklet will be mailed free upon request to Department IB at the address shown above. **K-16**

• **James B. Lansing Sound, Inc.,** 3249 Casitas Ave., Los Angeles 39, Calif., describes and illustrates the entire line of Lansing sound reproducers in a new folder which has just been released. Illustrated with some 40 photographs, drawings and charts, the folder includes data on wide-range speakers, low- and high-frequency drivers, dividing networks and various types of enclosures and horns. A featured listing is accorded the "Paragon," an integrated stereo reproducer which is the newest addition to the Lansing line. Be sure to specify Bulletin SC-504 when writing for your copy. **K-17**

• **Bell Sound Systems, Inc.,** 555 Marion Road, Columbus, Ohio, is now releasing a new 24-page booklet which is a handy reference guide, with photographs, of the complete line of Bell high-fidelity components. Detailed specifications provide a complete directory of the performance characteristics of all units shown. Two special sections of the handbook are devoted to questions and answers about high fidelity and stereo, to help readers plan their own installations. In requesting your free copy of this interesting booklet, be sure to specify Catalog 101. **K-18**

• **Centralab, A Division of Globe-Union, Inc.,** 900 E. Keefe Ave., Milwaukee 1, Wis., has just released a revised version of the Centralab booklet on the "Compentrol," a compensated volume control for high-fidelity music systems. Intended primarily as a replacement unit for ordinary volume controls on radio and TV receivers, phonographs, and the like, the Compentrol compensates for the Fletcher-Munson effect in human hearing. The 20-page booklet is profusely illustrated, and is available free of charge upon written request. **K-19**

• **Reeves Soundcraft Corporation,** 10 E. 52nd St., New York 22, N.Y., has just published a bulletin on "Magna-See," a new solution recently developed by the Reeves firm which makes visible the sound track recorded on magnetic tape. Magna-See Type SO (for sound recording) enables the recordist to make fast, simple and accurate equipment checks for head alignment, track uniformity, balance, and head wear. The bulletin describes, with illustrations, how the solution should be used. Requests for copies should specify Bulletin RS-57-10. **K-20**

HEARING

(*from page 36*)

broadcasting but it should be kept in mind when considering what improvements are possible in the quality of the reproduced sounds.

In conclusion then, it is seen that for an ideal system, one which is determined by the capabilities of hearing, the maximum and minimum intensity levels and frequencies will be determined by *Fig.* 3 and two or three channels should be used in the transmission. With such a system there will be no limitation upon the type of material used in the broadcast. For economic reasons we may back away from these ideal requirements. Although the best quality cannot be obtained with a frequency range lower than 14,000 to 15,000 cps, economic necessity may require a compromise to a somewhat lower frequency limit. The ideal volume range for producing a facsimile of such music is 65 decibels. How much this volume range can be reduced below this value without producing serious impairment has not been determined in a quantitative way. There is no doubt that considerable improvement in quality will also result by going to two or more channels instead of one, but whether such improvement is worth the additional cost must be decided for each kind of service in which the transmission system is used.

STEREO PLAYBACK

(*from page 27*)

problem exists the same head is used both for recording and playback. The writer rarely uses both sides of the tape for single track work because he likes to edit his tapes: consequenctly there is no cross-talk problem. Furthermore, the use of separate heads permits the tape to be monitored as it is being made, giving an audible indication of the quality of the recording.

Unfortunately the Viking deck does not have a second set of stereo heads for monitoring stereo recordings off the tape as they are being made. However, adaptor units are available with the necessary heads installed and these are designed for "outboard" mounting. Such an arrangement would be decidedly worthwhile and inclusion of such a device into the present system is contemplated.

This amplifier has been used to make duplicates of tapes recorded in the usual manner, both single track and stereo. Fortunately, the writer has been able to borrow a second deck for this purpose. One machine is used for playback, the other for recording. The output of the playback amplifiers are patched to the input of the recording amplifiers. Excellent results have been obtained. It has

been found that the tape hiss on a "first generation" duplicate is a little higher than that of the "master" but not seriously so. Also, there is the possibility that some differences of pitch will be evident to the trained ear. However, this is usually not serious enough to bother unless the tape machines differ markedly in speed or the listener is "cursed" with absolute pitch.

Sound-on-sound recording is also possible. The usual procedure for addition of material to material already recorded makes use of an extra playhead *in front of* the erase head. The original signals are mixed with the material to be added and the composite material is then recorded in the usual manner. With the Viking deck the procedure is somewhat different. The original material is recorded on the "wrong" side of the tape. (The tape must be new or erased completely beforehand!) It is then played back and mixed with the additional material: the composite material is then recorded on the regular side of the tape in the usual manner. This arrangement has the advantage that the original recording is not destroyed. With a little ingenuity the process can be repeated several times.

From time to time requests are received for single-track recordings of material originally recorded in stereo. Using a second tape deck the two signals are played back, mixed, and then recorded on a single track. Usually some trial and error is necessary before good balance is obtained but nothing is lost except time.

A more prosaic use for this amplifier might be mentioned. At one time or another most audio fans are called upon to set up sound reinforcing systems for special events. This recording amplifier can be used as the preamplifier and mixer for such a system. Simultaneous recording can be carried on as required. So far, there have been no requests for *stereo* sound reinforcement but it is obviously possible with this unit!

Conclusion

Development of the recording-playback amplifier required many weeks. Many circuit arrangements were tried out "on paper" and "in the flesh" before the final version was completed. Perhaps a few words of caution are in order. No one should attempt the construction of a unit of this kind unless he is thoroughly conversant with good audio techniques. Good wiring practice must be followed. Ground loops must be scrupulously avoided if hum is to be minimized. Some experimenting with chassis grounding points may be necessary for the lowest possible noise level. After construction is completed proper adjustment requires the intelligent use of a wide-range audio-frequency generator, oscilloscope, sensitive a.c. vacuum tube voltmeter, and various other instruments.

The system which has been described has been used for several months and has given excellent results once sufficient experience was gained for its proper operation. The writer happens to live in an area served by stereophonic broadcasts using AM and FM. Many of these programs have been recorded and within the limitations imposed by AM on one channel the results have been highly satisfactory. Live stereo recordings of chamber music and choral groups have been uniformly good once the problems of proper microphone placement were solved. Experience is the best guide here and no absolute rules can be given. Two identical cardioid microphones have given the best results in all cases.

Earlier reference was made to the "hole-in-the-middle" effect. This is hard to describe in words but a recent visitor put it this way: "It sounds as though you hear two point sources instead of one." Most available recorded stereo tapes avoid this effect provided that the two loudspeakers are placed flat against the wall away from the corners of the listening area. The writer prefers corner horns for their low-frequency efficiency but he often experiences the "hole-in-the-middle" effect when these horns are used

for stereo reproduction. It can be effectively eliminated by using a third, or middle, channel whose signal material is derived from both outside channels. This was the main reason for inclusion of the hybrid channel in the system described. It requires a third amplifier and speaker but the results are worth the price. It should be mentioned that the two outside channels are combined without the use of a resistance mixer. Electronic mixing is used to avoid cross-talk between channels. There is some unavoidable cross-talk between the two heads mounted in-line and there is no need to increase it.

The only valid objection to this system is its size and weight. It should be possible to reduce both by the use of transistors to replace some or all of the many tubes now employed. Work is now progressing along this line but that is another story.

PARTS LIST

Resistors

R_1, R_2, R_{32}, R_{34}, R_{36}, R_{91}	1 megohm, ½ watt
R_3, R_4	2200 ohms, ½ watt
R_5, R_6, R_{51}, R_{52}, R_{57}, R_{58}	2200 ohms, 1 watt
R_7, R_8, R_{15}, R_{16}, R_{95}, R_{96}	0.22 megohms, 1 watt
R_9, R_{10}	1,000 ohms, ½ watt
R_{11}, R_{12}	0.56 megohms, ½ watt
R_{13}, R_{14}, R_{21}, R_{22}, R_{25}, R_{26}, R_{71}, R_{72}, R_{111}	3300 ohms, 1 watt
R_{17}, R_{18}, R_{29}, R_{30}, R_{31}, R_{42}, R_{79}, R_{80}, R_{83}, R_{84}, R_{109}, R_{110}	47,000 ohms, 1 watt
R_{19}, R_{20}	0.1-megohm potentiometer, audio taper
R_{23}, R_{24}, R_{53}, R_{54}, R_{59}, R_{60}, R_{73}, R_{74}	0.1 megohms, 1 watt
R_{25}, R_{26}, R_{105}, R_{106}	0.62 megohms, ½ watt
R_{27}, R_{28}, R_{107}, R_{108}	1000 ohms, 1 watt
R_{31}, R_{32}, R_{85}, R_{86}	10,000 ohms, 1 watt
R_{37}, R_{38}, R_{63}, R_{64}	0.27 megohms, 1 watt
R_{39}, R_{40}	0.82 megohms, 1 watt
R_{43}, R_{44}, R_{47}, R_{48}	0.25 megohm potentiometer, audio taper
R_{45}, R_{46}, R_{49}, R_{50}, R_{55}, R_{56}	0.27 megohms, ½ watt
R_{61}, R_{62}	22,000 ohms, 1 watt
R_{65}, R_{66}	2 megohms, ½ watt
R_{67}, R_{68}, R_{69}, R_{70}, R_{97}, R_{98}, R_{97}, R_{98}	0.1 megohms, ½ watt
R_{75}, R_{76}, R_{77}, R_{78}	0.47 megohms, ½ watt
R_{81}, R_{82}, R_{115}	1800 ohms, 1 watt
R_{87}, R_{88}, R_{113}, R_{114}	0.22 megohms, ½ watt
R_{91}, R_{92}	4.7 megohms, ½ watt
R_{99}, R_{100}	50,000-ohm wire-wound potentiometer, linear taper
R_{101}, R_{102}	33,000 ohms, 1 watt
R_{103}, R_{104}	27,000 ohms, 1 watt
R_{112}	62,000 ohms, 1 watt
R_{116}	100 ohms, 1 watt
R_{117}	100-ohm wire-wound potentiometer, linear taper
R_{118}	10-ohm, 25-watt wire-wound, adjustable
R_{119}	1250 ohms, 20 watts

Capacitors

C_1, C_2, C_{19}, C_{20}	50-μf, 6-volt electrolytic
C_3, C_4	0.05-μf, 6-volt paper
C_5, C_6, C_9, C_{10}, C_{13}, C_{14}, C_{15}, C_{16}, C_{25}, C_{26}, C_{27}, C_{28}, C_{31}	

C_{32}, C_{37}, C_{38}, C_{41}, C_{42}, C_{51}	0.1-μf, 600 volts paper
C_1, C_8, C_{13}, C_{21}	40-μf, 450-volt electrolytic
C_{11}, C_{14}, C_{39}, C_{40}, C_{47}, C_{48}	50-μf, 25-volt electrolytic
C_{17}, C_{18}, C_{23}, C_{24}, C_{70}, C_{71}, C_{72}	20-μf, 450-volt electrolytic
C_{31}, C_{52}, C_{62}	8-μf, 450-volt electrolytic
C_{49}, C_{50}	25-μf, 25-volt electrolytic
C_{25}, C_{36}	100-μμf, mica
C_{43}, C_{12}	0.4-μf, 600-volt paper
C_{15}, C_{44}, C_{45}, C_{46}	0.05-μf, 600-volt paper
C_{19}, C_{20}	0.006-μf, mica
C_{53}, C_{54}, C_{66}, C_{67}	0.0005-μf, mica
C_{58}, C_{59}, C_{65}, C_{56}	0.01-μf, mica
C_{57}, C_{58}	6000-μμf, mica
C_{29}, C_{60}, C_{68}	0.25-μf, 600-volt paper
C_{61}	1000-μμf, mica
C_{69}, C_{69}	2400-μf, 20-volt electrolytic

Miscellaneous

D_1, D_2	diodes
F_1, F_2	2-ampere fuses
J_1, J_2, J_3, J_4, J_{15}, J_{16}	Closed-circuit jacks
J_5, J_6, J_7, J_8, J_9, J_{10}, J_{11}, J_{12}, J_{13}, J_{14}, J_{17}, J_{18}	Open-circuit jacks
L_1, L_2	4–30 mh adjustable coils
L_3, L_4	15-H., 65-ma chokes
S_1, S_2, S_6	DPST switches
S_3, S_4, S_5	SPST switches
SR	2-ampere selenium rectifier, full-wave bridge
T_1, T_2	Microphone-to-grid transformers
T_3	Bias oscillator coil (Viking D501 or (equivalent)
T_4, T_5	6.3-volt filament transformers
T_6	350-0-350 volts at 70 ma, 5 volts at 2 amps, 6.3 volts at 2 amps.
V_1, V_2	12AX7
V_3, V_4, V_7, V_8, V_{10}, V_{13}, V_{14}, V_{15}	12AU7
V_5, V_7	5879
V_{11}, V_{12}	6E5
V_{16}, V_{17}	VR150
V_{18}	5V4

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STEREO

(*from page 28*)

tem is a field type sound reproducing system in which two or more microphones, used to pick up the original sound, are each coupled to a corresponding number of independent transducing channels which in turn are each coupled to a corresponding number of loudspeakers arranged in substantial geometrical correspondence to that of the microphones, as in *Fig.* 4.

Description of Systems

Following the definitions[1] of monaural, binaural, monophonic, and stereophonic sound the next consideration will be a description of some of the characteristics of the four systems.

To achieve realism in a sound reproducing system, four fundamental conditions must be satisfied, as follows:

1. The frequency range must be such as to include without frequency discrimination all of the audible components of the various sounds to be reproduced.

2. The volume range must be such as to permit noiseless and distortionless reproduction of the entire range of intensity associated with the sounds.

3. The reverberation characteristics of the original sound should be approximated in the reproduced sound.

4. The spatial sound pattern of the original sound should be preserved in the reproduced sound.

A diagram of a monaural sound reproducing system is shown in *Fig.* 1. The most common example of a monaural sound reproducing system is the telephone in which there is, in general, a single source of sound, one microphone, a transducer, and one telephone receiver coupled to one ear of the listener. In most local applications, the carbon microphone is coupled directly to the telephone receiver. In long distance telephony vacuum tube and transistor amplifiers may be used between the microphone and loudspeaker. For other more limited applications, as for example, monitoring purposes, the transducer may be a radio transmitter and receiver, a television sound transmitter and receiver, a disc phonograph recorder and reproducer, a sound motion picture recorder and a reproducer and/or a magnetic tape recorder and reproducer. In some applications, there may be more than one sound source. One or more microphones may be used. In some applications two telephone receivers may be

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[1] The definitions of the terms monaural, binaural, monophonic, and stereophonic, agree substantially with those of modern dictionaries. In addition, the terms binaural and stereophonic as defined in this paper have been standardized. As a result, the incorrect usage of binaural to designate a stereophonic system is disappearing. Monaural is still incorrectly used to designate a single-channel field-type sound reproducing system. Monophonic is a relatively new term, which has been introduced to supply a void in terms to describe the four fundamental sound systems. Monophonic and stereophonic are harmonious and congruent terms which complement each other and have a common relationship in describing field-type sound systems. Monaural and binaural are also harmonious and congruent terms which complement each other and have a common relationship in describing closed-circuit sound systems.

used transmitting the same program to each of the ears of the listener. The monaural sound reproducing system is of the closed-circuit type in which the ear of the listener is transferred to a microphone location by means of the microphone, transducer, and telephone receiver combination. The acoustics of a single room are involved in the reproduction of the sound, namely, the studio in which the microphone is located. The monaural sound reproducing system may be constructed so as to satisfy conditions 1, 2, and 3 on realism of sound reproduction. It cannot, under any conditions, satisfy condition 4.

A diagram of a binaural sound reproducing system is shown in *Fig.* 2. There is no widespread use of the binaural sound reproducing system. The use is limited to specific applications. The binaural sound reproducing system consists of two separate channels. Each channel consists of a microphone, transducer, and telephone receiver. The microphones are mounted in a dummy simulating the human head in shape and dimensions and at the locations corresponding to the ears of the human head. The transducer may be an amplifier, a radio transmitter and receiver, a phonograph recorder and reproducer, a motion picture recorder and reproducer, or a magnetic tape recorder and reproducer. The binaural sound reproducing system is of the closed-circuit type. The listener is transferred to the location of the dummy by means of a two-channel sound reproducing system. The binaural sound reproducing system may be constructed so as to satisfy all four conditions on realism of sound reproduction.

A diagram of a monophonic sound reproducing system is shown in *Fig.* 3. It is the most widely employed of all sound reproducing systems. Examples are the disc phonograph, radio, sound motion picture, television, magnetic tape reproducer and sound systems. The monophonic sound reproducing system is of the field type, in which the sound is picked up by a microphone and reproduced by means of a loudspeaker into a field. The sound at the microphone is reproduced at the loudspeaker. The transducer may be an amplifier, radio transmitter and receiver, a phonograph recorder and reproducer, a sound motion picture recorder and reproducer, a television transmitter and receiver, a magnetic tape recorder and reproducer. The monophonic sound reproducer may be constructed to satisfy conditions 1, 2 and 3 on realism of sound reproduction. It cannot under any conditions satisfy condition 4.

A diagram of a stereophonic sound reproducing system is shown in *Fig.* 4. The stereophonic sound reproducing system is of the field type, in which the

sound is picked up by two or more microphones which are coupled to a corresponding number of independent transducing channels which in turn are coupled to corresponding number of loudspeakers arranged in substantial geometrical correspondence to that of the microphones. The transducer may be an amplifier, radio transmitter and receiver, a phonograph recorder and reproducer, a sound motion picture recorder and reproducer, a television transmitter and receiver, or a magnetic tape recorder and reproducer. Two channels are used in the disc phonograph and radio. Two and three channels are used in the magnetic tape reproducer. Two, three and more channels are used in motion picture reproducers. The stereophonic sound reproducer may be constructed to satisfy conditions 1, 2 and 3 on realism of sound reproduction. It can be constructed to provide auditory perspective of the reproduced sound and in this sense the stereophonic sound reproducer satisfies condition 4 on realism of sound reproduction. Stereophonic sound is being rapidly commercialized. The first wide scale use was in sound motion pictures. This was followed by the magnetic tape reproducer. The stereophonic disc phonograph is being commercialized this year. Experiments are now being conducted in the transmission and reproduction of stereophonic sound by means of a radio system. In one arrangement, the two channels are transmitted on two separate radio links, one by a frequency modulation system and the other by an amplitude modulation system. In another arrangement, the two channels are transmitted and reproduced by means of a multiplex frequency modulation system.

Summary

The four fundamental types of sound reproducing systems—namely, monaural, binaural, monophonic, and stereophonic—have been defined and described in this paper. The terms monaural and binaural are used to designate closed circuit sound reproducing systems. The terms monophonic and stereophonic are terms used to designate field-type sound reproducing systems. Monaural and binaural (or monophonic and stereophonic) are mutually harmonious and congruent terms which complement each other in describing closed-circuit type (or field type) sound reproducing systems. The definitions as presented in this paper agree substantially with modern dictionaries. The terms binaural and stereophonic have been standardized. In view of this and the logic presented in this paper it is only a question of time until all four terms, monaural, binaural, monophonic, and stereophonic are standardized. Æ

EDWARD TATNALL CANBY*

1. KEYBOARDS OF THE PAST

Cimarosa: Sonatas (complete). R. Veyron-Lacroix, harps.

Westminster XWN 18698

This once-famous Italian of the time of Mozart and Haydn is known ordinarily for his opera "Il Matrimonio segreto" (Secret Marriage)—and not very well known, at that; but even Mozart thought well of him. These short little one-movement sonatas for harpsichord (they could well have been piano works, but suit the harpsichord to perfection) were the product of an interlude in an otherwise busy career, thanks to the political upheavals of the French Revolution. They are nominally in the style of Scarlatti and may well remind listeners of the many Scarlatti harpsichord sonatas, but the date is considerably later and there are many traits of the Mozart-Haydn period to give these a new sort of harpsichord piquancy.

A valuable addition to the recorded repertory, as the old phrase goes, and a pleasing complement to better known harpsichord music. M. Veyron-Lacroix's somewhat wiry harpsichord is expressively played.

Dussek: Piano Sonatas Op. 61; Op. 45, #1; Op. 20, #2; Sonata for Piano Four Hands Op. 32. Heida Hermanns, Ruth Stoneridge, pfs.

Society for Forgotten Music SFM 1002

This "forgotten music" is another well worthwhile addition to available piano recording. Dussek was a Czech (Bohemia), somewhat younger than Mozart, who composed mightily at the end of the eighteenth century, at the turn towards Romanticism. His last sonata, Opus 61, of the time of early Beethoven, is claimed to be extraordinarily Romantic in cast and perhaps a forerunner of much to come. I found the others, in an earlier and more Mozart-like style, just as interesting. Altogether an important "second-line" composer, obviously an able and skillful writer. Pianists, as well as record listeners, will enjoy the good playing here. (The company is a division of Contemporary Records, Los Angeles.)

Haydn: Piano Sonatas #52, #34, #43. Nadia Reisenberg. (vol. 2).

Westminster XWN 18358

This music, except for the last big Sonata in E Flat, (#52), is actually of earlier date than the Cimarosa above—but it seems later. The music is clearly piano-style, the sonatas are multi-movement instead of the short one-movement type.

Haydn's piano sonatas have had a small and devoted following, mainly among amateur pianists who read endlessly and not very well through the numerous published volumes familiar to most pianists. They are quite unlike those of Mozart, these sonatas, both more advanced, more like Beethoven, yet in a way of an earlier time, Haydn being considerably older than Mozart. Nadia Reisenberg is a good pianist for them. She makes them sound as big as they actually are (most pianists make them tinkle like fragile miniatures), yet she does not romanticize them.

They aren't demonstrative, they are seldom showy; but after a few playings they are likely to stick in your memory. In true Haydn style, most of this music is far more profound than it outwardly seems; Haydn was a peculiarly reticent soul. In the big E Flat sonata especially (dating from after his last symphonies) there are extraordinary near-Romantic expressions, remarkable modulations, into strange keys, a really powerful expression, all in fairly gentle outward terms.

This is one of a continuing series. If you enjoy it, there'll be more coming.

Handel: Keyboard Music, Vols. I, II (Suites #3, #13, #11; Suites #14, #15, #8). Paul Wolfe, harpsichord.

Exp. Anonymes EA 0032, EA 0033

A million pianists have played various movements from these Handel suites as part of their beginning keyboard training; not one in a thousand of us ever hears the familiar little pieces in their original context and on the originally intended instrument! They are ever so clearly improved by the harpsichord playing.

Paul Wolfe is a gifted and fluent young performer, stable as a rock and accurate as to the implied rhythms and ornamentation that a harpsichordist must add to the literal written notes, imaginative in his registration for harpsichord tone color. Only a somewhat metronomic and too-mechanical tempo (as I hear it, anyhow) cuts down a bit on the expressiveness of these brilliant works.

The harpsichord is a large one with a gorgeously Handelian sound to it and the recording makes it seem even larger. Keep the volume down, as you listen, if you want a faithful harpsichord sound.

Couperin: Messe à L'Usage des Couvents. Titelouze: Four Versets on "Ave Maris Stella." André Marchal, organ at La Fleche, France.

Westminster XWN 18674

Ah—if only these older works had simple, easy titles, like "Dreaming of You" or "Ten for Two"! The long spiels in strange languages often are much harder to understand than the music itself.

This is a Mass, not a mess, to begin with. It's no mess at all, but a series of short organ pieces grouped around the five sections of the Catholic Mass and intended for use in convents and monasteries of the late Sixteen Hundreds in glorious France under the great Louis XIV. The composer was only 21, but already was a top figure in the King's music.

These little "couplets," sometimes eight or nine to a section, must have been played as brief interludes or "background music" to the actual Mass. They are as sweet and wholesome as a glass of light French wine, beautifully tinted in contrasting individual tone colors. The most interesting aspect of the music is that young Couperin actually specified the particular stops he intended, a rare thing in those days; thus, as played here on a splendid old French organ built fifty years before his time, the music is about as close to the actual sound of Couperin's day as we shall ever get in any artistic reconstruction. Lovely, especially the reedy trumpet stops and the Cromorne (Krumhorn), contrasted against the soft-toned Tierce.

Marchal is the great blind organist of France, recently heard in several organ records made at M.I.T. in Cambridge, Mass. A rather deliberate player who phrases his music carefully, he is an excellent player for this delicate music.

The Titelouze piece is an earlier work, variations built upon a Latin hymn. It takes up the last piece of Side 2—the rest is Couperin.

Le Roux: Pieces de Clavessin—1705. Albert Fuller, harpsichord. **Overtone 15**

—And here, from the same period as the Couperin, is a set of harpsichord suites in the elaborately ornamented French manner of Couperin's own keyboard music—a style that has come back into its own on the harpsichord, where on the piano it was virtually meaningless and quite unplayable. French music of the Louis XIV and Louis XV period is staging a monumental comeback these days, and a "new" composer of the period, name unknown, is no longer surprising.

Le Roux was an excellent musical workman in the brilliant circle of French music and art that existed then. Few of us could tell that these fluent works were by an "unknown" composer. The Suites, as was customary then, are loose collections of short pieces in a common key, each with a dance-form title or a fanciful name—one of these is called "The Piece without a Title."

You didn't have to play them all in the order given, then, and you don't need to now. An excellent record for sampling, an LP band or so at a time—or for nicely sophisticated background dinner music. (But don't tell the performer I said so.)

Buxtehude: Complete Organ Works, vol. 6: Toccata in D Mi., 2 Chorale Fantasias, 3 Chorale Variations. Alf Linder, organ at Skänninge, Sweden.

Westminster XWN 18689

This continues the intermittent Buxtehude organ series, on a fine old Swedish organ—the same on which the Westminster Bach series is issued, with Carl Weinrich.

Other reports may have been "glowing"—I'm not that enthusiastic, though Buxtehude, the jolly North German (Swedo-Danish) predecessor of Bach, is one of my own favorite organ composers. My slight reservations are on two counts; first, Alf Linder plays Buxtehude, it seem to me, with a slightly heavy hand (speaking figuratively) and less humor, in appropriate places, than he might. Rather serious-minded, though excellent as a player. Second, there is the "hi-fi" Westminster-style recording, which somehow disembodies the organ, bringing practically every pipe close to you (via multiple miking, as far as I know). It's no serious objection, but I still like a more dis-

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tant, perspective-giving pickup for this type of music.

Matter of taste, on both of these points, and you may find you feel quite otherwise.

Bach: Organ Works, vol. 4. (Fantasia in C, Fugue in C Mi., Prels and Fugues in F Mi., D Mi., G Mi., Trio in G.) Anton Heiller, organ. **Epic LC 3462**

The mere fact that in this recording the particular instrument being used is not specified is a clue to its nature, a sincere, dignified, somewhat noble and occasionally monotonous playing of much Bach in a style that is already rather old-fashioned, out of the time of Schweitzer. It will stress for most listeners the noble monumentality of Bach; those who are not well versed in Bach's music will find the sound and the playing unspectacular. Bach lovers will appreciate the good musicianship underlying this somewhat stolid Viennese approach.

Oddly, Heiller is a young organist, under forty. His playing is that of an older generation of Bach organists, far removed from the now popular "Baroque" or Classic approach.

2. CLASSICAL WINGDINGS

Copland: Billy the Kid (1938); Rodeo (1942). Morton Gould & His Orchestra. **RCA Victor LM 2195**

A good record, this one! Here are the two Copland ballets that first launched the vogue for Western material in ballet form—they've since been followed by innumerable examples in ballet, in films, musical comedies, TV shows. Just as it took a German, Handel, to show the British how to write British oratorio, so it took the boy from Brooklyn, no cowboy himself, to write the first effective Western music for our own ballet stage.

The thing about Copland is that his stuff is strictly high-level—yet it is strictly entertaining and strictly Western, without compromise. No highbrow effects here! There's a barroom piano with thumbtacks in its hammers to make it tinny enough, there's a low-down hoe-down and an old-style square dance—the titles of the parts run from Buckaroo Holiday to Corral Nocturne. But even so, the music is on a symphonic plane and up to anybody's standards for "classical." Copland showed how you could be classical and Western too and he's justly admired for it by all concerned. (Credit, too, goes to his dance colleagues, such as, here, Lincoln Kerstein, Agnes de Mille, Eugene Loring.)

It takes craftsmen like Aaron Copland to keep music alive and healthy—even if he isn't exactly a Mozart from New York. There are many such, and they are vital to musical development. I'm sure that in engineering and other sciences the same sort of men are equally admired—for the same superior skill, tenacity, imagination, inability to do a poor job no matter what. Copland is not the great American musical genius, but he is surely one of the best workers in American music ever to have put his services at our disposal. You can hear it, in his work, and you'll both respect and enjoy it.

Morton Gould was an excellent choice for these works—his playings are as fine as they come. His own orchestra is always crackerjack and though his own composing style is generally far from Copland's, he obviously appreciates the splendid new territories that were staked out in these ballets and his interpretation does them proud, with full understanding. You'll get the feeling he wished he'd written them himself.

The Moldau (The Moldau, Inv. to the Dance, Mephisto Waltz, Minuet of the Will o' the Wisps, Dance of the Symphs, Rakoczy March.) Philadelphia Orch., Ormandy. **Columbia ML 5261**

Columbia's durable and wide-selling list of old favorites by the Philadelphia is always hard to review—there really isn't much to say, though these records probably account for a good hunk of the total popular classics market sales.

They just go on and on, they get better and better technically, and Ormandy proves always to be a superb conductor of war horses, who somehow makes them sound on records as though they hadn't been played for several months. Fresh, musical, well-tailored, expertly toned, the stiff doesn't sound a bit hackneyed. Don't know how they do it.

Tchaikowsky: Piano Concerto #1. Van Cliburn; Anon. orch., Kondrashin. **RCA Victor LM 2252**

Biggest surprise of the year—at least to me: this turns out to be a really very nice recorded performance of the familiar Concerto, with much unexpected warmth and sincerity, a "new approach" feeling, that comes both from the earnest young pianist and the unaccustomed leadership of the visiting Russian conductor. The sound is good, too, though RCA really had to rush this through to capitalize on the great to-do over "Van," before it should show signs of deflation. Heartily recommended, anonymous orch. or no.

Levant's Favorites. Oscar Levant, piano. **Columbia CL 1134**

Oscar Levant is making a species of comeback, I gather. I didn't know he had gone away—guess I didn't notice. Anyhow, he's the same old Oscar here, the bad, naughty, brilliant boy of the old "Information Please" (before the billion-dollar TV quizzes), the witty, erratic pianist who always did and still does seem to play like an extremely gifted amateur.

Oscar goes in for Spanish and French—Ritual Fire Dance, Malaguena, Claire de Lune, Le Cathédrale Engloutie, the Albeniz Tango, and even an odd little intrusion by the modern Poulenc, very nice. The playing is not polished, not really professional, full of blurs and unevenness; but it would be silly to deny that it has the old flashy Levant persuasiveness. You'll enjoy it.

Granados: Goyescas; El Pelele. Eduardo del Puyeo, piano. **RCA Victor LC 3444**

Here's some really professional Spanish piano playing, a whole suite of Granados pieces, which will hit the ear more or less as familiar stuff I think, plus one extra number that goes into the same general category. All based on sketches by the Spanish artist, Goya. Fine playing, I'd say.

Tchaikowsky: Swan Lake (excerpts). Royal Opera House Orch., Covent Garden, Morel. **RCA Victor LM 2227**

Ah! Scrumptuous. A fine, smoothly articulated and very much alive playing of the familiar (mostly) Tchaikowsky ballet music, with a minimum of that soggy, repetitive feeling that sometimes emerges from this sort of music when it is heard minus its visible dance. This goes right along, the verve making up for the missing, unseen stage.

Moussorgsky-Ravel: Pictures at an Exhibition. Chicago Symphony, Reiner **RCA Victor LM 2201**

Oof, what a high-powered "Pictures" we have here! Disciplined, taut, admirably played, steely-true to Ravel's orchestration, but for my ears it is all cold chrome and lacks the sombre magnificence (to use the best cliché I can pull out) of the original Moussorgsky music. A lot of people will like it better this way, maybe.

Schumann: Piano Concerto in A Minor. Chopin: Piano Concerto #2. Maria Tipo; Bamberg Symphony and Pro Musica Orch., Perlea. **Vox PL 10.320**

Two solid warhorses in a Vox bid for competitive buying, but the competition is only half there. Maria Tipo continues to be a big lady artist, an impulsive, commanding young pianist, who does a rousing job with almost any concerto she picks, though her style may be a bit on the rough-and-ready side. But the two orchestras here, playing as though one (I couldn't tell them nor their recorded sound apart) seem to have been earnestly incompetent on these two occasions. Mine is not to reason why; I can only state that the orchestral backing is notably underpowered, through it tries hard. Nice piano sound, nice orchestra too—as far as it goes.

3. EUROPE IN THE OLD DAYS

Haydn: Oboe Concerto in C.
Dvorak: Serenade in D Minor, Op. 44. Members the Hallé Orchestra, Barbirolli. Evelyn Rothwell, oboe. **Mercury MG 50041**

Haydn was both a prolific and, eventually, a very famous composer within his lifetime. So was almost everybody else prolific in those days—especially when it came to writing music that could pay well if palmed off under Haydn's name. There is plenty of pseudo-Haydn, and a lot of it sounds very much like the real thing. Is this Oboe Concerto of that sort? There seems to be a question.

As to little old me, I somehow doubt if it is by the old man himself, even in his earlier period, around 1760, thirty years before the well known symphonies. Only the last movement has a Haydnish ring to it, and the whole piece is not only of a more elaborate outward style than most of Haydn—full of typical "busy" playing of the sort that he did not so extensively indulge in—but the tunes and harmonies are relatively lax, quite good humoredly lacking in any forceful shape or color. A nice piece and a good one, but not good enough for old man Haydn, I say. The oboe playing by Mrs. Barbirolli—Evelyn Rothwell professionally—is superb. She's a whiz. Husband John does a somewhat over-tensioned orchestral part, more vigorous than the music itself.

The lovely Dvorak Serenade, for winds with a few lower strings added, is given a luminous but strangely cool performance here. That's one way to do it, but I've heard this same music played with much more intensity and a powerfully romantic mood—and I liked it. Still, this is surely a legitimately musical approach, and Mercury's one-mike sound makes the whole thing glitter and glow. A beautiful mike pickup.

(The Oboe Concerto sound is excellent, too, with an unusually natural and musical balance between the oboe and the orchestra.)

Vivaldi: Concerto in G Mi. for Flute, Oboe and Bassoon (without orchestra). Haydn: Wind Divertimento in B Flat. Mozart: Wind Cassation in E Flat. Paris Wind Ensemble. **Epic LC 3461**

Boy oh boy! France is famous for virtuoso wind playing and that's what we have here, with a vengeance. The players toss the three works off (with that peculiarly nasal, brilliant French wind tone quality) like so many technical exercises—and that, I suspect, is what they amount to in this company. The whole thing reminds me of an engineering conference—only these men talk musical shop. To them, it would seem, Mozart and Haydn, Vivaldi as well, were so many wind technicians.

Two items of special interest, even so, are the Haydn, with the "Saint Anthony" theme used by Brahms in his ultra-familiar Variations on a Theme by Haydn—this tune, note for note—and, secondly, the interesting little Vivaldi Concerto for three wind instruments all by themselves; they somehow manage quite easily to give the impression of solos and "orchestra," in concerto grosso fashion. Ingenious. (This is already its second appearance on records.)

Geminiani: Concerti Grossi, Op. 7. I Musici. **Epic LC 3467**

Complementing its earlier Mozart anniversary series (his 200th birthday, 1956), Epic—Philips of Holland, to be precise—is running a new one with a fancy Latin name, Monumenta Italicae Musicae, Monuments of Italian Music, under the direction of a gent with an Italian-Dutch name, Vittorio Negri-Bryks. The recordings by the famous I Musici (the Musicians) in this series seem to me to be superior to those done earlier for Angel, and the difference is probably in the more knowledgeable historical direction, by the above-mentioned *Negri-Bryks*.

Geminiani was one of the famous roving Italians who brought the Italian musical influence in the eighteenth century to many

other countries; he spent much time in England and died, of all places, in Dublin. His sweet music is very much of the progressive school of Bach's day, that, already, in Italian terms, was leading onwards to the grace and elegance of Mozart.

The wretched notes on this album cover don't tell us about the interesting musical sleight of hand in several of these concerti; one of them is written in "three different styles"—French, English and Italian (countries where Signor Geminiani had made music himself), another is "the art of the fugue in four real parts"—this in a day when the fugue was blending handily into a symphonic orchestral style—and still another is written in multiple voice-lines, 5, 6, 7, and 8 parts, a genial tour de force. You won't have to fathom all of this to enjoy the fluent writing, the rather feminine grace, of the Geminiani music.

Johann Stamitz: Orch. Trio Op. 1, #2; Oboe Concerto in C; Clarinet Concerto in B Flat; Sinfonia à 8 in D. Soloists, Munchener, Kammerorchester, Gorvin.
Archive (Decca) ARC 3092

The generally superb Archive series from Deutche Grammophon in Germany is far too extensive for the space we can occasionally give to it; I must fall back on occasional samplings, to indicate the sort of things it covers.

For all those who have had a brief session in music history and can remember mention of "The Mannheim School" of pre-Mozart composers—for anybody who is curious as to how Mozart got to be Mozart in style—this pleasant record is a revealing one. There were two younger Stamitzes from Mannheim, sons of this one, who lived on after Mozart. But they weren't the real innovators. The father, Johann, died in 1757—when Mozart was one year old. It's the more remarkable, then, that in this, his music, so much that is basic to the 'Mozart" sort of expression is already well worked out. Stamitz died before he was forty, but he turned out vast amounts of music—74 short symphonies, for instance, in the days when the symphony was just taking form as a worthwhile device on its own.

The Oboe Concerto is a somewhat earlier work, continuing interestingly the older plan of the *continuo* accompaniment, harpsichord harmonies to support the music. (Haydn used the same in his first couple of dozen symphonies.) The Clarinet Concerto, later, was one of the very first big pieces for that instrument, long before Mozart's Clarinet Concerto, which set the instrument up in higher musical society for good.

Monteverdi—Selected Works. (Originally recorded in 1937). Nadia Boulanger, vocal and instr. ensemble **Angel COLH 20**

This is a reissue (Great Recordings of the Century Series) of one of the very first of the "old music" revivals, a 78 album that had an immense effect on a whole generation of enthusiasts. I still remember its impact, back in the slim pre-war days when unusual old music on records was practically unavailable.

The performance is, perhaps, more French than Italian and somewhat out of date as of present standards, using a piano (played by the great teacher herself, Boulanger) instead of a harpsichord, but it was, and is, a powerful set of performances, its authority still enough to make any ear listen closely to the strange, wild music, voices and instruments combined, of the great Monteverdi, a basic musical pioneer and a genius to boot.

Lassus: Missa VIII toni; 8 Latin Motets. (a) Aachener Domsingknaben, (b) Aachener Domchor, Rehmann.
Archive (Decca) ARC 3077

Here's one more Archive disc that has intrigued my ear. Lassus, one of the very biggest and most universal composers of the late Sixteenth century, is better known by choral singers than by most record listeners, since his greatest output was in choral music, paralleling that of Palestrina but of a much more varied scope, composed in four or five different languages, in every current style of the Europe of the day.

This disc is, as far as I am concerned, a one-sider, and worth the cost for that. Oddly, there are two choirs here, the Children's Choir (Aachen Cathedral Singing Boys) and the grown-up choir of the cathedral; of the two, the youthful group is by far the best—it sings rings around the old folks! Its Lassus Mass (Missa) is superbly alive and beautifully recorded; you don't need to worry about the Latin nor the fancy title—just listen straight through and you'll know what Lassus had to say.

The short Motets sung by the older choir are beautiful enough but the performance is less interesting, and it is not as easy to acclimate the ear to each of these more concentrated pieces in turn, one after the other, as it is to sense the cumulative power of the longer Mass in its five great sections.

Blanchard: Te Deum (1745). Soloists, Chorus of Radiodiffusion-Télévision Francaise, Lean-Marie Leclair Instr. Ensemble, Frémaux **Westminster XWN 18692**

Here's another in the French-produced revivals of older French music, recorded by Westminster's Erato affiliate. Blanchard was one of a later period of brilliance at the French court, in the days of Louis XV—the times of Bach and Handel in other lands.

The Te Deum is a big piece, as usual only recently dug up out of the library. For ears accustomed to Bach and Handel it will have a curious flavor, sometimes sounding Handelian or like Bach (it is closest to his Magnificat), more often full of the more leisurely, low-pressure gracefulness of French musical art. There are periodic choruses here, alternating with groups of solo pieces or duets—two tenors, two sopranos, a contralto and a baritone—with obbligato instrumental solos to go with them. In the big, impressive numbers a trumpet part adds pomp and circumstance, most decoratively.

It's not a profound piece, this, nor was it so intended (it was a victory celebration for the winning of a battle by Louis XV) but it is largely pleasurable and only occasionally a bit routine, in a showy way.

4. BIG VOICES

Mark Reizen sings Highlights from "Boris Godunov (Mussorgsky); "Aleko" (Rachmaninoff). With other soloists, chorus, orchestra the Bolshoi Theatre, Bebolsin, Golovanov. **Monitor MC 2016**

Chaliapin sings "Boris Godounov," other Russian Operatic Arias. (Recorded 1925–31). **Angel COLH 100**

In spite of the mixed-up titles and assorted spellings on these two discs, the main theme is clear enough—a brand-new Russian basso and the great all-time master, Chaliapin, sing from Moussorgsky's (our spelling) great opera—plus tidbits of this and that to fill up the extra space.

The comparison is most interesting. Anyone who has followed recorded music these last thirty years will have heard the ultra-famous Chaliapin recordings of "Boris"—with the well-remembered groans, grunts, rending sighs, ghastly death-agonies, as the Tzar Boris expires in stark musical form. The present-day basso, Mark Reisen, sings some of the same passages. What a difference! In Chaliapin's days—which extend back into Moussorgsky's own time—the role of Boris was sung with extraordinary freedom to act and emote, in the flamboyant style of the day. Never will you have heard such death-rattles as are Chaliapin's! The famous interpretation seems to us—if we haven't heard it before—exaggerated in the manner of many an old movie; for Chaliapin was the John Barrymore of Russian opera. But this was the performance that shook a generation of music-lovers and operagoers and it remains a tremendous force in music, if now stylistically outdated.

Mark Reisen is the modern interpreter of the same music and so are his vocal cohorts, whose names are too long to spell out here. They preserve much of the stark, sombre tradition of great Moussorgsky performance but, in the modern manner, they do far more on-pitch singing, put on fewer and less exaggerated histrionics. Times have changed.

The Monitor disc is a good one, the presentation as fine as any that now is available in terms of present-day singing. Don't make the mistake of thinking it is an "either-or" proposition, as between the immortal Chaliapin and the present Bolshoi Theatre artists. Far from it. Tradition must move and grow to stay alive; it is not possible to sing as did Chaliapin, these days—though to hear him "in person" will always be a rare experience, via these beautifully restored recordings.

Russian Art Songs (Balakirev, Borodin, Moussorgsky, Cui, Rimsky-Korsakoff, Rachmaninoff, Tchaikowsky, Gretchaninoff). Maxim Karolik, tenor, various pianists. **Unicorn UNS 2 (3)**

A monumental recording project energetically carried out, this three-disc album covers a fine collection of Russian songs of the last century, sung with great drama in the original Russian. An interesting and extensive booklet, with all of the texts in English, makes following the sense of this music unusually easy. That highly-colored, "speaking" quality of excitement in Russian song, so easily lost in translation, is brought out magnificently by Maxim Karolik, who explains in his preface that the singing-artist—as distinct from the mere singer—must have as his motto, "Listen to what I am *saying* with my voice." It is that speech, even in a strange language, that carries us through this album with growing interest as the many songs follow one another.

It is, therefore, merely incidental to the main impact of the singing that Mr. Karolik's musical ear turns out to be somewhat less than accurate, and easily thrown off by unexpected twists of Russian Romantic harmony! At times, voice and piano simply part company, until the new harmonic path is found by the wandering vocal instrument.

Yet I am here to say that, in a case like this, good drama and a high sense of diction can make up for a bad ear. I enjoyed Mr. Karolik and I found a new respect for his numerous composers' unusually powerful songs—which is surely what Unicorn had in mind when the album was made.

Robert Pettitt is the excellent pianist in most of the works, but two others spell him for a song or two, here and there.

Nicolai Gedda—Mozart Arias. Paris Conservatory Orch., Cluytens. **Angel 35510**

Well, Nicolai Gedda is supposed to shed the resplendent lustre that comes with a contract at the Met (1957–58) and he has been one of the last season's highlight voices. But here, on my first hearing of his voice, he turns out to be a shallow and colorless Mozart singer. His best, I guess, is "Dalla sua pace" from "Don Giovanni" of Mozart, where he suits the smug virtuousness of the somewhat mealy-mouthed Don Ottavio—Mozart's foil for lusty Don Giovanni himself.

In short, just another fine tenor, complete with golden tone, beefy physical proportions, yet lacking in any sort of communicative musical intelligence, at least in this music. And his father was a Don Cossack, too!

Mahler: Songs of a Wayfarer.
Brahms: Seven Songs, Op. 32. Dietrich Fischer-Dieskau; Philharmonia, Furtwangler; Hertha Klust, pf. **Angel 35222**

Mahler: Lieder eines Fahrenden Gesellen (Songs of a Wayfarer); Kindertotenlieder (Songs on the Death of Children). Kirsten Flagstad; Vienna Philharmonic, Boult. **London 5330**

Here are two impressive vocal records, overlapping in the songs-with-orchestra by Mahler—the most personal, the most poetic Romantic composer after Schubert.

Fischer-Dieskau is the finest German baritone of the younger generation and the reason why is easy to hear—a fine voice, plus a tremendous musical intelligence and an emotional power that hits to the very depths of these songs. (Like German songs with piano, the Mahler works can be sung by various types of voice, male or female.)

Generally, it is harder for us to get the sense of this sort of music via a male voice

(*Continued on page 77*)

ABOUT MUSIC

Noises Are Expensive

HAROLD LAWRENCE*

THE STAGEHANDS have already set up the players' seats and stands, and the recording crew is now busy laying out cables and hanging microphones. Thirty minutes or so before the start of the session, the musicians begin arriving; violinists can be heard limbering up their fingers with snatches of the Mendelssohn and Tchaikovsky concertos, the harpist goes through the elaborate process of tuning her instrument, and the first desk men who have solos are practicing for their big moments. Finally, the personnel manager herds the orchestra on stage, the conductor strides out on to the podium, greets his players, and the session is about to begin. If all goes well, no extra-musical sounds will crop up to affect the proceedings seriously. Unfortunately, sonic gremlins have a way of intruding on recording sessions, despite all advance precautions.

By way of illustrating the kinds of unwanted sounds that harass recording companies, the preceding mythical session will be sprinkled liberally with the more common varieties of noisemakers.

Humidity and temperature are known to affect the acoustics of a hall in terms of brightness and resonance. These factors can be responsible indirectly for less subtle aural results. The time of the present session is nine a.m. It is a chilly March day. Because the stage lights were switched on only moments before the recording was to begin, the first 25 minutes were marred by cracking filaments. Outside the hall, the weather has taken a turn for the worse. Dark clouds are forming overhead, and the wind and the rain quickly follow. Inside the hall, the sensitive microphones pick up the gusts and raindrops in *pianissimo* sections of the music.

The storm now subsides and the men in the control booth breathe easier. Suddenly the microphones begin transmitting a series of low-frequency sounds which are obviously not called for in the orchestral score. A rapid investigation reveals that the conductor, carried away by the rhythmic excitement of the work, is vigorously stamping out the beat with his right foot. Informed of his misbehavior, he decides to get off his feet entirely so as not to risk a repetition of the noise. A new number is slated and the session moves along. Minutes later, during a vitally important and tricky bridge-pasage leading to a new section of the work, odd squeaks begin to emerge from the playback speakers. It appears that the stool on which the conductor is now seated is a rickety antique fit for the woodpile.

"Take Five"

Furious at being interrupted so many times, and annoyed with himself for having been the cause of the last two incidents, the maestro asks for and gets a break, in order to regain his composure.

During intermission, the stagehands remove the stool and place a carpet on the podium. Alone in the artist's room, the conductor paces the floor.

The clanging of a bell indicates that it is time to get back to work. The personnel manager claps his hands, gets everyone on stage. Up on to his sound-treated podium steps the conductor who lifts his baton, and waits for all rustles, squiggles and conversation to stop. But he does not give the down-beat—an airplane motor has just broken the silence of the hall. As it dies away, the stick goes up again, to be interrupted this time by a call from the control booth. The drone of the engines has been replaced by a mysterious hum, and could the maestro "bear with us while we try to locate it?" The stage manager, accompanied by the recording crew, rush out. The source of the trouble is the blower system, which had not been turned off after the intermission.

The now restless conductor faces his players, grits his teeth, and at last succeeds in giving an unbroken down-beat. But now the sound of distant chimes is heard in the hall. Since the work being recorded is not *Night on Bald Mountain, Dream of a Witches' Sabbath* (from Berlioz' "Symphonie Fantastique"), or *Danse Macabre,* and since the percussionist isn't touching the chimes, obviously these bells are intruders. They belong to the Town Hall's clock tower, and are ringing the hour.

Among the extra-musical sounds produced by musical instruments, the fixing and removal of mutes is a familiar one. No one notices them during a concert performance, but it is a different matter in a recording session, especially when the music is quiet. In the present mythical session, the affected section was played twice; the first time *with* mutes, going on beyond the point at which mutes were to have been removed; and the second time *without* mutes, proceeding without interruption. In this way, the noise of mutes could be thoroughly eliminated in editing the tape.

Although barriers were posted outside the hall to divert traffic, one annoyed driver who had taken the wrong turn and found himself confronted with a closed-off street, did what so many motorists do when faced with delays: he sounded his horn. This was of course picked up in the hall, as were the shouts of children being let out of school down the block.

Before the session was over, a door or two had slammed shut somewhere up in the balcony, a vacuum cleaner whined in the corridors, several members of the orchestra sneezed or coughed, and the conductor forgot himself and hummed, grunted, and sang as he worked.

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

Why Bother?

The difficulties encountered in this imaginary recording session would have long ago exhausted the patience of even the mildest-mannered of conductors. That all of these mishaps could occur within one session is highly improbable. Yet, taken individually, none of them is a rare phenomenon when recordings are made in a concert hall, theatre, church, or town hall. Why then, you might ask, are recordings made in these places when there are insulated recording studios available?

First, the studio has yet to be built that can rival the acoustics of Chicago's Orchestra Hall, London's Kingsway Hall, Amsterdam's Concertgebouw, or Vienna's Musikverein. Second, an orchestra is generally more at ease in the familiar surroundings of its own home, and for other than purely sentimental reasons. Tonal production is intimately related to acoustics. In a 'dry' hall, musicians play louder and more forcefully in order to overcome the sonic limitations; in a more resonant room, dynamics are enhanced, and they can play truly soft passages without the danger of slipping into inaudibility. Acoustics play a basic role in shaping an orchestra's personality. Therefore in order to preserve this personality, many record companies prefer to visit the orchestra in its own home, rather than take it to a studio. As for these extra-musical sounds, what's a little noise to a 'big sound'? Æ

COMING HI-FI SHOWS

According to our latest information, the following is a list of the high fidelity shows presently scheduled for the next few months:

Sept. 5–7—Albany, N. Y.; De Witt Clinton Hotel. (*Rigo*)
Sept. 19–21—Chicago, Ill.; Palmer House Hotel. (*International Sight & Sound Exposition*)
Sept. 19–21—Syracuse, N. Y.; Onandaga Hotel. (*Rigo*)
Sept. 26–28—Rochester, N. Y.; Sheraton Hotel. (*Rigo*)
Sept. 30–Oct. 4—New York; Trade Show Bldg. (*IHFM*)
Oct. 10–12—Philadelphia, Pa.; Benjamin Franklin Hotel. (*IHFM*)
Oct. 10–12—Cincinnati, Ohio; Sheraton-Gibson. (*Rigo*)
Oct. 17–19—Boston, Mass.; Hotel Touraine. (*Independent*)
Oct. 17–19—Detroit, Mich.; Statler Hotel. (*Rigo*)
Oct. 17–19—St. Louis, Mo.; Ambassador Kingsway Hotel. (*St. Louis Electronics Club*)
Oct. 24–26—Milwaukee, Wis.; Wisconsin Hotel. (*IHFM*)
Oct. 24–26—Kansas City, Mo.; Bellerive Hotel. (*High Fidelity Music Guild of Greater Kansas City*)
Oct. 29–Nov. 1—Montreal, Canada; Windsor Hotel. (*Dominion High Fidelity Association*)
Oct. 31–Nov. 2—Indianapolis, Ind.; Hotel Antlers. (*Electronic Show Corp. of Indiana*)
Nov. 7–9—Omaha Neb.; Paxton. (*Rigo*)
Feb. 16–23—Los Angeles, Cal.; Biltmore Hotel. (*IHFM*)

CHARLES A. ROBERTSON*

STEREOPHONIC

Erich Kunz: German University Songs, Vol. 2 **Vanguard VSD2009**

Jimmy Rushing: If This Ain't The Blues **Vanguard VSD2008**

One of the advantages enjoyed by an independent record firm is mobility and the ability to change direction at the first shift of the wind. These two stereo items not only mark the entry of another label into a fast growing field, but also are representative of the mastering practices of two major companies. Acting on its prerogative as a free agent, Vanguard allotted a portion of its initial stereo disc release to the custom departments of both Columbia and RCA Victor.

The German University Songs, handled by Columbia, are ideal for the new medium in its present stage of development. The settings are varied and impose no overmodulated passages on the grooves. The suave baritone voice of Erich Kunz is balanced by a male chorus which spreads to the two loudspeakers when not supporting the soloist. As conducted by Anton Paulik, the Orchestra of the Vienna State Opera remains mostly in the background. When a harp is brought to the fore, it seems centered between the sound sources, effectively tying them together.

The fraternal harmonies of the songs are quick to create an illusion of the high hills divided by the Rhine, rather than the concert hall. Their outer limits evade spatial limitations, and the voices dissolve pleasantly in the distance. Much of the stereo interest stems from the different ways in which the forces involved are employed by the arrangements. As each variation opens new possibilities, the attention of the listener is consistently engrossed.

The bullnecked blues shouting of Jimmy Rushing is more firmly embraced by the phrases of eight stellar instrumentalists in the stereo version mastered by RCA Victor. The virtues of the session were detailed in these pages when it first appeared on LP, and it is packed with the vigorous jazz interplay that has proved so adaptable to stereo. The electronic organ which competes with Rushing can be balanced to suit your taste, and the guitar of Roy Gaines serves to hold the rhythm section together.

If the German Songs seem more successful, they also presented fewer problems. Both discs have adequate volume level and distortion is kept within bounds. They reached the stores about a week before the first Victor releases and preceded the initial Columbia offering by a longer interval, illustrating another aspect of the independent's capacity to move fast.

According to Vanguard engineer John Beaumont, who was engaged in its recorded tape program from its inception, the company is keeping alert to all developments in stereo. Like every other label in the industry, it is still feeling its way in the stereo disc field. One of the pioneers of stereo tape, it has built a substantial catalogue. For the past several years, all sessions in its studios in this country were recorded in stereo. It will use the experience gained in the process to seek out and employ the best techniques for transfering them to discs.

Dick Marx: Marx Makes Broadway **Omega Disk OSL2**

Somewhat of a fixture in the recorded tape industry, Omega is adding a catalogue of stereo discs to its line. Of the first four items received, the jazz treatment of Broadway show tunes by Dick Marx is most successful. The young Chicago pianist, in one of his rare journeys away from his native city, joins a group of Los Angeles musicians in ten hits of such caliber as Leonard Bernstein's *Cool, Just In Time*, and *Too Close for Comfort*. His flexible piano work is nicely balanced by the flute of Buddy Collette. Red Mitchell alternates with Carson Smith on bass, and Howard Roberts and Irving Ashby share featured roles on guitar. The quartet is in the lyric modern vein, and the swift interplay becomes especially rewarding through stereo.

Paul Tanner, a former trombonist with Glenn Miller, plays an electro-theremin on "Music For Heavenly Bodies," (OSL4). Developed to his specifications, it boasts a measured frequency range from zero to better than 20,000 cps, and its sounds are pure sine waves without any harmonics. Unlike a theremin operated by hand motions, it works on a slide and is more accurately controlled. Andre Montero's Orchestra backs the eerie melodies in astronomic mood settings by Warren Baxter.

Another mood item is Lloyd Mumm's Orchestra on "Champagne Music for Dancing," (OSL1). Heinz Sandauer conducts the Omega Orchestra on Leith Stevens' dynamic score for the movie "Destination Moon," (OSL3).

The Stereo Disc **Capitol SWAL9032**
Capitol Stereo Demonstration Record

With the entry of Capitol into the arena late in August, all of the majors and a goodly number of independent companies are represented on stereo discs in some form or other. To introduce its new product and disseminate advance information on its quality, the label has prepared two demonstration records, both narrated by Art Gilmore. One lists to sell at the usual price of an LP, and the second is not for sale, being allotted to distributors and dealers to promote the merits of the firm's line of packaged stereo equipment.

Their combined total is an impressive array of excerpts, with only one duplication—the mighty impact of a train at an unidentified railroad crossing. Several artists and groups appear on both, the honors going to the thrice heard Concert Arts Orchestra, under Felix Slatkin, playing Britten's *Young Person's Guide to the Orchestra*. In the part devoted to the percussion section, stereo separation works its wonders and, for once the tympani fail to overpower the strings.

This interlude is assigned to the paying customers who, on the whole, receive the best value. Fewer hard-sell tactics are employed in announcing the examples chosen to acquaint them with the new system of home entertainment. The sound effects are there to dramatize the event, but they are not lacking in interest. The Manhattan subway train is easily identified as belonging to the IND, rather than either of the alternate lines. A slumbering Diesel engine is roused into action and moves ponderously out of the yards. A New York ferry boat smacks comfortably into its dock. There is a sequence in a bowling alley and one of children returning from school. Only the crowds in Times Square celebrating New Year's Eve seem a little artificial. They hardly ever come that boisterous anymore. A track for balancing speakers uses the sound of castanets.

The musical samplings cover the entire range of the catalogue and aim at "creating an even, natural display of sound all across the 'stage' in front of the listener." This seems to be a characteristic of the items recorded at Capitol Tower. Not only is there no drop-off of sound in the middle, but there is no excessive amount of presence centered between the two speakers, as is found in some three-channel efforts. It is a quality especially evident in numbers by the Roger Wagner Chorale and Fred Waring. The highs are clean and clear, even to the hiss of air so essential to Ernst Toch's *Symphony No. 3*. Nat Cole, Stan Kenton, and Jackie Davis all appear, in addition to Carmen Dragon conducting the Hollywood Bowl Orchestra.

The side given over to music runs roughly twenty-two minutes, a goodly length for a stereo demonstration disc. The sound is excellent and cannot be distinguished from that on the promotional sides. As a briefer program is desirable and the wider cut will permit the harsher handling anticipated, these are shorter by half. Classical bits fill one side and the reverse is devoted to Les Brown, Harry James, Les Baxter, Billy May, and others on the Capitol roster. Never have the big bands seemed more live.

When compared to the London demonstration disc or those mastered with a Fairchild cutter, our two main reference points at the moment, the reaction is wholly favorable. There is a little less gain, but almost no technical deficiencies distract from the music and distortion is at a minimum. If you attend a High Fidelity Show this fall, you will hear just how far the stereo disc has advanced in less than a year.

MONOPHONIC

The Music Of New Orleans, Vol. 2 **Folkways FA2462**

The subject of the second volume in a series devoted to the traditional sounds of New Orleans is the Eureka Brass Band, the largest of the marching bands left in the city and the one closest to the legendary paraders of the past. Organized about 1920, it *outlived many* of the older bands and survived the depression to enjoy its best years after 1936. Its jauntier tunes are part of the standard dixieland repertoire and have achieved wide circulation, but the actual units are more amply covered in print than by recordings. These are somewhat of a rarity, and the Eureka participated seven years ago in the only previous one not made by a group hastily organized for recording purposes. Because the setting was then an open courtyard, the sound is diffuse and little of the impact of the band is felt. Such is not the case in the present venture, recorded in a meeting hall on Dryades Street, last March, shortly after Mardi Gras Day and the Zulu Parade. When the band begins to roll with resounding bass drum and sousaphone on *Just A Little While To Stay Here*, the wonder is that the equipment stayed in the room.

Samuel B. Charters briefly outlines the history of the brass bands in his notes, touching on the changes in instrumentation which brought into the Eureka the saxophones of Manuel Paul and Ruben Roddy, a veteran of Walter Page's Blue Devils, in place of baritone horn and clarinet. The trombone team of Albert Warner and Sonny Henry, who at 72 is the oldest member, overflows with good spirits on the ragtime piece *Trombonium*, and fluently supports the trumpet of leader Percy Humphrey on *Lord, Lord, Lord*. One of the players is always carrying the melody as the band improvises on *Maryland*, and a less ably recorded rehearsal of *Panama*. A quieter moment comes with the funeral dirge *Eternity*, an intense and difficult lament in four strains, and its eloquent trumpet solo by Willie Pa-

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jeaud. The Ampex 600 and Electro-Voice 655 microphone, as well as technical assistance, were supplied by Dr. Edmund Souchon, and the recording belongs in every jazz or folk collection.

The Ward Singers: Meeting Tonight
Savoy MG14015

There is a lesson for all aspiring jazz and folk singers in the gospel songs of The Ward Singers, the most outstanding of several such worthy groups based in New Jersey. A pure passion animates their every phrase, in contrast to the blatant emotion of rock and roll or the devitalized sentiment of much pop singing. One side reconstructs a tent-covered revival service, with the group singing *Testing Tonight On The Old Camp Ground* to introduce featured soloists on *The Lord's Prayer, Swing Low, Sweet Chariot*, and a wordless lament by Gertrude Ward on *Amazing Grace*. A recital of spirituals, in forceful arrangements which place them in the private preserve of leader and pianist Clara Ward, fills the reverse side and includes *A Step To Make, I'll Be There*, and *Blessed Are They*. Robert Banks is organist, and drummer Buddy Mack Jones matches the varied and moving rhythm patterns of the group. None of its heady excitement is lost in the recording.

Al Hirt: Swingin' Dixie
Audio Fidelity AFLP1877

Based at Dan Levy's Pier 600 on Bourbon Street, the Al Hirt band also wakes the Delta with a morning radio show. It presents a unique amalgamation of swing and dixieland, operating much as might, in a playful moment, one of the smaller forces that Harry James or Lionel Hampton drew from the Benny Goodman organization in the late '30s. The leader's trumpet is fiery and brilliant, roistering along the path of the powerhouse stars of the swing area. To showcase it and the work of other soloists, the band prefers fast tempos and loosely-woven dixieland ensembles to repeated riff patterns. It strives for excitement and attains it through swift changes of mood, the sudden climax and a charging rhythm section.

Three members were formerly led by George Girard, the New Orleans trumpeter who died last year of cancer. They are Bob Havens, a trombonist in the Brunies' tradition even to maneuvering the slide with his foot, bassist Bob Coquille and drummer Paul Edwards. Once clarinetist with The Dukes of Dixieland, Hal Cooper is back in his native city and with pianist Ronnie Dupont completes the lineup. Hirt contrasts skyrocketing solos on *And the Angels Sing* or *Big Butter and Egg Man* against a quieter *New Orleans* or *Mississippi Mud*. A younger edition of Wingy Mannone and Louis Prima, he has their zest and capacity to drive a band. Edwards sets a rapid pace on *Caravan*, and Cooper sparkles on *Hindustan*. And the band has worked on *The Saints* long enough to add several new choruses. Made on location at the club, the recording dispenses with audience noises and applause in favor of good sound. Stereo versions on tape and discs are forthcoming.

Dukes Of Dixieland: Circus Time
Audio Fidelity AFLP1863

Having exhausted a large amount of the standard dixieland fare on their six previous albums, The Dukes of Dixieland are up early to meet the circus train and expand their repertoire by catching the glamor of the big show. There are *Billboard March* and *Washington Post* to get the parade underway. *Entry Of The Gladiators* puts the three rings in motion, and there is a lofty *Flying Trapeze*. The extravagant attractions of the sideshows are relayed on *Ta-Ra-Ra-Boom-De-Ay, A Vision of Salome*, and *In A Persian Market*.

Some of the introductory passages find the three Assuntos far removed from their usual style, but before they are finished even the Lone Ranger's theme is brought around to a dashing two-beat on *Swinging William*. And clarinetist Jack Maheu's solo on *Over the Waves* is steeped in New Orleans tradition. Barney Mallon, a new addition on tuba, reaches down to the lower depths in awesome low-frequency meanderings on *Asleep in the Deep*. He switches to bass to take the *Merry Widow* on a tour of the midway. In their use of sound to evoke a carnival spirit, The Dukes are unmatched on records and on this trip they are bigger and better than ever.

Bobby Henderson: Call House Blues
Vanguard VRS9017

Having recalled the era of Harlem stride pianists on his previous effort, Bobby Henderson pays a visit to a still earlier period in this leisurely documentation of the honky-tonk sounds that filled the gap between ragtime and the matured styles of Fats Waller and James P. Johnson. It is joyous party piano, drawing strength from countless regional artists and pointing the way to later developments. It survives, with any authenticity, only in the memories of some of the older musicians, a few piano rolls and still fewer records. Where else is it possible to hear *Alexander's Ragtime Band* played in march tempo, as it was treated in 1911? Henderson's placement of accents and use of dynamics transforms it in a performance which could be studied with profit by all jazz aspirants, not just pianists. His style may seem remote, but his methods will never be outdated.

For Henderson gets under the surface of a tune and takes his audience with him on *Diga-Diga-Doo, Land of Jazz*, and *A Good Man Is Hard to Find*. He always uses two full hands, guiding them with audible humming, and builds a smoldering blues atmosphere on his title piece. There is a diversionary *Missouri Waltz*, matched by the tinkly rhythms of *Three O'Clock in the Morning*. The piano has the stringy treble tones of an old upright and a resonant bass, all superbly conveyed in the recording.

Jimmy Witherspoon: Goin' to Kansas City Blues
Victor LPM1639

Jay McShann, the Kansas City pianist and leader, gave Jimmy Witherspoon his start as a blues singer in 1944, and this reunion engages them on a group of songs associated with the city and its jazz greats. There are more than five minutes of Joe Turner's *Piney Brown Blues*, a recollection of Pha Terrel on *Until the Real Thing Comes Along*, a trip to Mary Lou Williams' *Froggy Bottom*, and three Witherspoon originals. The blues shouter is in fine form and the arrangements by Budd Johnson are loose and swinging. Assembled by McShann for the session, only part of the band has the direct Kansas City antecedents of bassist Gene Ramey, but all are close to the blues, notably trombonist J. C. Higginbotham and guitarist Kenny Burrell. McShann's appearance on an LP is long overdue, and the recording is free of the echoed concessions to the rock-and-roll fraternity which marred Witherspoon's last effort.

Modern Jazz Concert
Columbia WL127

Commissioned by Brandeis University and performed at its 1957 Festival of Arts, the six works on this record are remarkable in the variety of their conception. By the broadest of generalizations, they might be called a marriage of jazz and other musical forms, but it is simpler and more exact to regard them as extensions of ideas with jazz origins. In addition to fostering the project from its inception and conducting the orchestra, Gunther Schuller brings the subject into focus in his composition *Transformation*, and the liner notes. Much of his reasoning will become academic to those who heed his dictum that the works "will take participation on the part of the listener, repeated hearings, and an open mind!"

They are far removed from earlier symphonic jazz, ranging from the fundamentals preached by Charlie Mingus in his *Revelations* to the blocks of sound molded by Milton Babbitt in his *All Set*. They seem most compelling according to the amount of space allotted for improvisation by Bill Evans, Art Farmer, Jimmy Knepper, Fred Zimmerman, and James Buffington, indicating that Schuller might have expanded his remark about the commercial "level that suppresses creative imagination by the stereotyped mass-appeal patterns" to include a larger area than jazz or popular music. George Russell conducts his *All About Rosie*. Harold Shapero's *On Green Mountain* bears the subtitle "Chaccone after Monteverdi," and Jimmy Giuffre is represented by *Suspensions*.

Charlie Byrd: Blues For Night People
Savoy MG12116

The place of the unamplified Spanish guitar becomes more secure in jazz with this recital by the talented Charlie Byrd, a former student of Andres Segovia and leader of a jazz trio in Washington, D. C. Filling one side is the title piece, an inclusion examination of blues moods in three sections, at times reminiscent of the solos of Teddy Bunn. His classical training and concert experience never impede his flow of ideas, but are used unobtrusively to shape and extend them into a composition of sustained interest. The blues vein is continued on an old favorite, once recorded by Jimmy Noone under the title *Blues My Naughty Sweetie Gives To Me*, as the regular bassist in his trio, Keeter Betts, moves from a supporting role for melodic choruses. Gus Johnson drums discreetly to recall his former post in the Basie band on *Jive At Five*. With two newcomers like Bill Harris and Charlie Byrd to state its case, the unamplified guitar looks to a splendid future.

Mose Allison: Young Man Mose
Prestige 7137

After introducing his delightful southern sketches on his first two albums, Mose Allison treats a sheaf of standard tunes in the same individual style. The resulting mixture of old and new is refreshing in its element of surprise and the recasting of familiar themes. His single-line piano statements bear a close resemblance to his laconic, unstrained vocals on *Don't Get Around Much Anymore*, *I Hadn't Anyone Till You*, and *Let Me Hold Your Hand*. His lone composition is for muted trumpet, played against a background of Addison Farmer's bass and the drums of Nick Stabulas. Its title, *Stroll*, is indicative of its carefree nature. Fed by his memories of country blues singers and the ragtime playing of his father, Allison's roots give him an advantage over most young modernists, though some may boast more technical proficiency. Like Thelonious Monk, he always has something to say and the means to say it, making him the most distinctive new pianist to emerge since Horace Silver.

Cliff Jordan: Cliff Craft **Blue Note 1582**

In its gift of saxophonists to jazz, Chicago's DuSable High may soon acquire the fame Austin High School boasted in another day. Among Cliff Jordan's classmates were Johnny Griffin, John Gilmore, and John Jenkins, all visitors to Manhattan recording studios. The young tenorman mines a rich blues strata here, urged on by pianist Sonny Clark. His three originals are formed with strong, flowing lines and contain reflective muted passages by trumpeter Art Farmer. They exercise their ingenuity on Parker's *Confirmation*, and a faster paced *Anthropology*. Jordan, with Clarke and bassist George Tucker, makes a beautiful solo vehicle of *Sophisticated Lady*, impinging on her more earthy qualities. Louis Hayes is on drums.

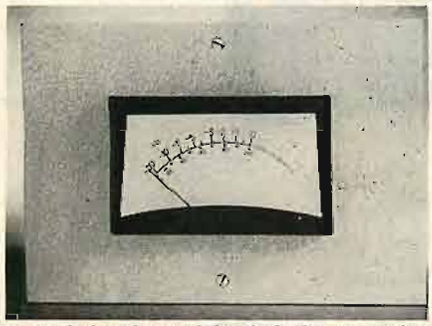
Hal McKusick: Triple Exposure
Prestige 7135

Because of his concentration on the alto saxophone in recent years, the playing of Hal McKusick seemed fairly static in its references to Lee Konitz and Charlie Parker. Nothing he does here on the instrument moves him from a category somewhere between the two, but he essays his first recorded solo on tenor, choosing a warm sound suited to the Basie-styled *Something New*, and features his clarinet on three numbers, as he did when with Terry Gibbs seven years ago. Two of them are his own compositions, a blues and the vernal *A Touch of Spring*, and provide a creative base for his pleasant, melodic solos. They open a folk vein that he should explore further, as his ideas become more individual and his tone is liquid and full. After a period spent in France working as an arranger, trombonist Billy Byers marks his return with an exultant war whoop on *The Settler and The Indians*. Unison chording by pianist Eddie Costa paces the rhythm section of bassist Paul Chambers and drummer Charlie Persip.

(*Continued on page 75*)

NEW PRODUCTS

• **VU Meter.** Although they meet American Standard C16.5-1954, the new Model 561 VU meter recently introduced by Assembly Products, Inc., Chesterland, Ohio, occupies 15 per cent less panel space than comparable units. Construction is such that only the indicating area is exposed, the remaining portion of the



meter being located behind the mounting panel. For easier reading without strain, the scale of meter is tilted upward to reduce glare. The meter may be illuminated from behind the panel through a strip of translucent plastic across the top of the scale section. In accordance with the Standard, the meter has a response time for a step change of 0.3 second ±10 per cent. Overshoot is 1.0 to 1.5 per cent. **K-1**

• **Transistor Tester.** A general purpose transistor tester for laboratory, field, and industrial application, the Sonex Model TT-205 measures small signal beta, collector leakage current, and collector resistance on all NPN, PNP, surface barrier, grown or diffused junction transistors.

Eleven operating points are provided with one convenient selector switch. The tester is self-calibrating and the transistor under test is operated in a temperature-stabilized circuit insuring that each unit is tested under identical biasing conditions. The tester employs three transistors and is powered by one battery with very low current drain. Sonex, Inc., 73 S. State Road, Upper Darby, Pa. **K-2**

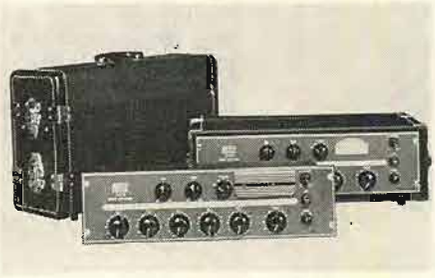
• **Garden Speaker.** Designed to blend naturally into outdoor settings, the "Audiolier" is made of molded fiber glass, weather-proofed, and is garden green in

color. It is easily connected as an extension to indoor hi-fi or intercom systems. The speaker unit is a 6-in. extended range model baffled to afford 360-degree listening. Frequency range of the entire assembly is 100 to 12,000 cps. Power rating is six watts. The Audiolier is available in stake-type or base-equipped models. Manufactured by Shalda Manufacturing Company, Inc., 156 W. Providencia Ave., Burbank, Calif. **K-3**

• **Oscillator-Voltmeter.** Constructed to fit a standard 19-in. rack and using only 7 inches of panel space, the Waveforms Type 1501 oscillator-voltmeter combination is a complete miniaturized audio test system. The oscillator section covers a range of 18 cps to 1.1 mc and delivers 10 volts open circuit. Distortion is under 0.2 per cent. The voltmeter operates over the same frequency range with an accuracy

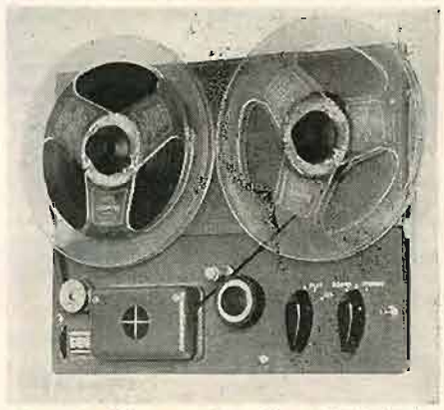
of ±3.0 per cent. Twelve overlapping ranges read from 1.0 mv to 300 volts full scale. Input impedance is 10 megohms. Waveforms, Inc., 331 Sixth Ave., New York 14, N. Y. **K-4**

• **Altec Lansing Mixer Amplifier.** Exceptionally flexible for use as a remote broadcast mixer, in public address systems, or for recording, the new Altec Model 1567A has four low-level and one high-level inputs, each with individual volume controls, a master gain control, separate bass and treble controls, and an illumination



control. A VU range switch is provided for use with a VU meter which may be easily installed without soldering. Inputs, normally high-impedance, may be converted to low impedance by installation of the 4722 plug-in transformer. Illustrated as it appears both in and out of an accessory portable carrying case, the amplifier may be rack-mounted when desired, occupying three units (5¼ in. high). Total weight, including all accessories, is 22 lbs. For portable use an adapter provides XL connectors for inputs and binding posts for outputs. Complete technical information will be supplied by Altec Lansing Corporation, 1515 S. Manchester Ave., Anaheim, Calif. **K-5**

• **Starlight Two-Speed Stereo Tape Deck.** A new tape-transport mechanism featuring a hysteresis-synchronous motor, stereo record/playback heads and professional-type construction throughout has recently been introduced by Metzner Engineering Corporation, 1041 N. Sycamore Ave., Hollywood 28, Calif. Designated the Starlight 120, the new deck is designed for professional use and home hi-fi systems. Operating speeds are 7½ and 3¾ ips. Complete shielding of the stacked stereo heads provides a signal-to-noise ratio of 60 db and response flat within ±1.0 from 40 to 10,000 cps or ±2.0 db from 30 to 15,000 cps when amplifiers employing NARTB equalization are used. Wow and flutter are less than 0.18 per cent rms at 7½ ips; under 0.27 per cent rms at 3¾ ips. Other features include slot loading, flywheel capstan drive, switch contacts on record-playback control for operation of external equipment, universal compatibility with avail-

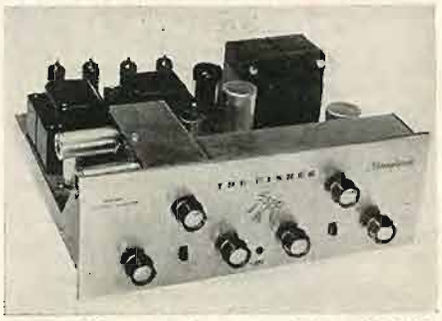


able amplifiers, and a three-digit index counter. Additional information and specifications may be had by writing to the address given. **K-6**

• **G-E FM-AM** Tuner. Scheduled for availability in September, the new General Electric FM-AM Tuner will feature high sensitivity, precision tuning, and an unusually low hum and noise level. It will also be equipped with an FM multiplex jack for reception of multiplexed broadcasts with addition of a special adapter. Sensitivity of the unit will be 5.0 microvolts for 30 db quieting on FM, and 200

microvolts/meter for a 20-db signal-to-noise ratio on AM. A built-in dual-purpose tuning meter will allow precise visual FM center tuning and maximum-signal AM tuning. The FM frequency response falls within plus or minus 2.0 db of the FCC standard de-emphasis curve. AM frequency response is down 25 db at 10 kc for interference suppression. The tuner will be announced as the Model FA-11. The control panel features a textured escutcheon with extra-size knobs, a station logging scale, and easily-read white edge-lighted dial numerals. Further information is available from: General Eletcric Company, Specialty Electronic Components Department, West Genesee St., Auburn, N. Y. **K-7**

• **Fisher 40-Watt Stereo Amplifier.** Designed for use in both stereo and monophonic installations, the new Model X-101 Stereophonic Master Audio Control/Duplex Amplifier combines a two-channel



preamplifier-equalizer, complete audio controls, and a two-channel power amplifier

STEREO RECORDS

Organ Symphony (Saint-Saens) XWN 18722
The Armenian Mass XWN 18726
The Divine Liturgy of Saint John Chrysostom XWN 18727
Hebrew and Yiddish Songs XWN 18728
Cantorial Gems XWN 18729
Gayne Ballet Suite, Night on Bald Mountain, Polovitsian Dances, Flight Of The Bumble Bee XWN 18731
Air (Bach), Perchance to Dream, Largo, Solvejg's Song, Ase's Death, Morning, The Swan, Hymn to The Sun, Waltz of the Flowers XWN 18735
In Waltz Tempo, Waltz of the Flowers, Valse, Rosenkavalier Waltzes, Waltz, Mephisto Waltz, Waltz in A Major XWN 18736
Peter and The Wolf, Carnival of the Animals, The Young Person's Guide to The Orchestra XWN 18737
Sonatas #8 in C Minor, #14 in C Sharp Minor, #23 in F Minor (Beethoven) XWN 18740
Sonatas #21 in C Major, #32 in C Minor (Beethoven) XWN 18741
Le Marteu Sans Maitre, Oiseaux Exotiques XWN 18746
The Vienna Academy Chorus on Tour WP 6088
Gospel Singing in Washington Temple WP 6089
Hebrew Melodies in Popular Dance Time WP 6091

PHASING

(*from page 38*)

and forth rapidly as you walk, the system is out of phase.

Rumble Improvement

Considerable improvement in quality of monophonic record reproduction can be noted by connecting a pickup as in *Fig.* 1. We have played many lateral records through a system connected for stereo, and if the two speakers are different there is some illusion of separation. With the coils paralleled, however, there is much less rumble noted in the starting and run-out grooves, and any vertical motion of the stylus due to the pinch effect is entirely cancelled out. We would recommend that the "hot" leads be shorted together for monophonic use, either by some switch at the amplifier, or by a separate switch at the turntable. For instance, the filter resistor on a Miracord can be shorted out with a wire jumper which will permit the filter switch to be used as a mono-stereo switch. We have done this to serve as a stopgap until we get around to designing a new preamp especially for stereo. In the meantime, we are enjoying excellent reproduction on both types of records.

There is still much to learn in the making and playing of stereo records, but we still remember that the LP—now so uniformly excellent—was not always as good as it is now. *Æ*

AUDIO ETC

(from page 12)

mercial four-track tapes, the "slave units" that record quarter-inch tapes from half-inch masters, will of course operate within professional tolerances and should cause no trouble, at least in public—but what of home equipment?

My only question, at this point, is in respect to low-priced home equipment that may be put out by various other companies who merely take over the basic Ampex-RCA specifications, with few strings attached. As in every expanding area of production, there may well be various shades of shoddy, quick-profit designing in low-cost magazine tape equipment. Here, it seems to me, is a fine area for trouble with the tricky matter of mechanical tape alignment. What's more, many an honest and sincere design attempt may turn out to be bug-ridden, in spite of best efforts. Building to a price often involves miscalculations of this very sort. It seems to me likely that in the first rush of tape magazine equipment we'll run into some trouble here. A slightly wobbly tape drive (it wouldn't have to wobble very far)—and there'd be a resulting irregular cross-talk as the four tracks strayed off the straight and narrow path.

The straight-line tape drive problem, after all, isn't completely settled in conventional tape drive, even for two tracks or for a single track.

But, to turn about again, the fact is that it is already practical to make a drive system accurate enough to prevent "wandering" and four-track cross-talk, yet inexpensive enough for introduction into home equipment. Experience and mass production, as always, will do plenty to improve the situation later on.

I see no reason, then, why we should run into any major or inherently permanent cross-talk on this second score, due to mechanical drive trouble—though I strongly suspect that there *will* be some transitory trouble here and there in the early months. There is, as Ampex observes, even less chance of trouble via signal interaction between closely spaced heads. No chance, I'd say, except through grossly poor design.

Well . . . we'll soon know, in practical terms. Sometime between now and next spring, perhaps.

2. PHASED-OUT

As I started to observe above, we are now entering the birth-pang phase of practical stereo disc—that is, those of us who are already dabbling, wading, or plunging into the new medium to see what's there. Most people haven't got around to worrying about it yet. It takes a year or so and millions in persuasive advertising to "orientate" the general mass public towards something new that costs money, like disc stereo.

Thus, as you read this, there will be a handful of hardy consumers who actually own the new "hi-fi" home-type stereo disc equipment and records to match. There'll be more people who have bought into component hi-fi stereo, adding sections, duplicating existing channels, buying double preamps and the like. Oddly, since component stereo disc got an early start, there will be more component systems around, for a while, than ready-made disc stereo hi-fi.

And oddly, too, I suspect that the people who buy the complete and ready-made stereo phonographs this autumn will generally have an easier time, get better stereo satisfaction (and better musical pleasure) than those who elect to plunge into parts. That may sound traitorous, coming from me, but there's sound reasoning behind it. The ready-made systems may boast such hi-fi virtues as pairs of 3-watt amplifiers ("6-watt peak") and 3-inch "woofer" speakers. Yet the plain fact is that each of these handy home systems has been designed as a working unit and may be depended upon to work, at least for a while, without technical complications. The pick-ups match the amplifiers' needs, the speakers do likewise, the system is integrated, phased, de-hummed, as far as is commercially possible.

The big headache in stereo component equipment right now is, shall I say, the extensive unintentional mismatching between various excellent components—excellent in themselves but not yet standardized to the point where there is real, honest, true interchangeability. It's an old, old problem; we went through all this years ago with the standard monophonic, one-channel hi-fi. There, it is now solved, remarkably well, after these many years of adjustment and consolidation. Components do hook up easily, rightly, effectively, with remarkably little disagreement between them.

The trouble is that, superficially speaking, stereo components are merely an extension of standard component equipment and so, on the surface, can be too easily thought of as "the same." Alas, the differences, in practical stereo, are appallingly great. Great, worse luck, in that they are mostly small, but irritatingly important. All sorts of minor problems erupt—seemingly minor. A little bit of a mismatch here, another there; things that ought to be identical turn out not to be—speakers, amplifier characteristics, equalization; output is a little lower somewhere than it might be ideally, required gain higher than it really ought to be by a bit, impedances not quite rightly matched . . . all sorts of minor misfits.

Stereo in plain fact has brought tremendous behind-the-scenes engineering problems, such as few outsiders are likely to realize. The results show up in these seemingly minor divergencies, compromises, changes, the not-quite-matched characteristics, just a little different from things in the past, which actually are the final almost-heartbreaking result of engineering sweat over months and months of problem-solving.

When it comes to hooking up stereo components, then, you will be running into a nest of Nagging Incidentals, minor stumbling blocks of incompatibility or confusion that can turn a hi-fi holiday into a cumulatively bewildering set of frustrations.

Until we—i.e. the hi-fi manufacturing industry—can phase ourselves out of this stage, an inevitable and quite understandable one, you'll find that home stereo component listening isn't going to be all fun. If you don't care a fig for phasing and if constant 60-cps hum-music pleases your ear, then you'll have no trouble. But frankly, my disc stereo listening hasn't yet been happy, though my predictions for the future remain rosy—I like stereo.

The two biggest sets of bewilderments and confusions for me, so far, have involved those ancient and familiar problems, hum and phasing, both of which are a good

deal more than doubled in seriousness in the stereo components for disc. Transitory problems, of course. No excuse for either one of them. Day after tomorrow, all will be well. But not right now.

Situation Fluid

I've been working already for some time (as all this may suggest) with three or four specific makes of stereo cartridge, with any number of stereo discs—official and for sale, instead of the endless test discs we've been playing with in past months—and I've on hand a reputable, modestly priced stereo dual amplifier. (I chose the modest price range deliberately since I felt that stereo problems, if and when, would tend to concentrate in that area and engineering ingenuity in solving them within the cost budget would be at its most intense.)

But in all honesty, I am not yet ready to report on these products by name, model by model. Black print is much too final, too positive, to be realistic at this point. Things are too fluid—not the products but the situation. Stereo is not yet solidified, in the area of evaluation. Evaluation means judging a product in the light of its relations to other products, and to a hypothetical norm of "good" performance that comes from long experience and constant acquaintance. We can do that sort of judging with almost any kind of monophonic equipment for the home. There, critical standards (production standards as well) are fairly clear, accepted, understood.

Even (I would like quickly to point out) stereo tape is now in the settled, judgeable, to-be-counted-on-for-performance category. This is amazing, after so short a time. It crept up on me. But, paradoxically, I have suddenly realized that stereo tape (non-magazine, 7½ ips) *has* settled down—at least for me. Surely for many others, too. I know what it can do, is supposed to do, I can judge it and judge its associated equipment without heart-rending uncertainty. Best of all, I can listen to stereo tape for its end-product, music, without undue technological or mechanical interference, I can enjoy it for what it was always intended to be, at leisure and in relaxation.

Not so with stereo disc—yet. There are flashes of sheer joy to be had from it (otherwise I would long since have given up in disgust!) and much satisfying, pleasing listening. But in between there is H. to pay. Granted, a lot of it is my fault, at least on the surface. I'm just dumb; I don't get things right, I get tangled up in confusions. I spent a good half hour, one recent hectic stereo day, trying to figure out what strange stereo technique the Vanguard Recording Society had used to produce one of its new Beethoven symphonies on stereo disc. Believe me, I was so addled at that point that I didn't even notice I was playing the non-stereo version of the record. The album covers are almost identical; I had both versions on hand.

My fault for being a dope—but that sort of thing wouldn't happen if I hadn't gone through fifty-nine other confusions and indecisions that same day. Beethoven tends to get thoroughly lost in the shuffle, for the time being. Maybe the performance is good—or bad—but what worries me most is whether the cellos should be on the right side or the left, whether I'm hearing music from the middle, whether—above all—the sound is in phase, or out of phase. Also, whether I'll ever be able to get rid of the constant, nagging hum problems that have risen out of the particular combination of circumstances I have at hand. Rather typical circumstances, I fear.

Phasing

Two things are dreadful about phasing. One, it is so very hard to determine consistently, so ephemeral, in the midst of constantly changing musical sound—and yet it is so very important. You can't tell the difference when you want to; yet if you are wrong, you'll have hours of ill-defined discomfort and falseness of effect in your stereo listening, until you fix it.

Secondly, wrong phasing is so very simple and yet so devilishly hard to locate—it can happen in so many places, both legitimately and not-so-legitimately. There are dozens and dozens of possibilities, even such unthinkable (but likely) matters as reversed phasing in a master recording tape, or in the recording amplifiers, or in any one of the many tape-playing steps *before* there is a thought of a disc master; or in the disc cutter itself.

Or in various types of supposedly simon-pure commercially-released home stereo equipment. Witness my fine RCA Victor Stereotape player, described here a year or so ago, which arrived from the factory with its speakers out of phase. (Or was it somewhere else, inside?)

The worst—the very worst—thing about phasing in stereo is that it depends 99 percent on the ear. Very seldom can you check it via a strictly electrical or mechanical test, minus listening. An out-of-phase sound is just the sort of audible subtlety that is most easily ignored by 99 percent of the technicians who deal with stereo equipment. They can't hear the difference, can't take the time, or haven't the curiosity, to study it and learn what the difference is; and therefore they simply do not take phasing seriously. Hence—phasing trouble, here, there and everywhere.

They should take it seriously, those who have any hand in the matter. It makes all the difference. The difference, that is, between satisfactory stereo listening and false. It is the sort of difference that a rank outsider, a musical amateur, will disconcertingly spot for you on the instant, where a hardened critic like myself may have been overlooking it for days.

I had this happen to me on three occasions last summer. Two of the people had never heard of stereo—but they were right. The third was editor of one of our co-publications in hi-fi and he thereby earned his medal as a good Hi-Fi Ear, as far as I was concerned. (These people spotted the out-of-phase RCA Victor machine, each in his or her own terms. The amateurs described the out-of-phase effect itself, accurately, though not knowing what it was. The editor just said "it's out of phase."

It's subtle but devastating, this phasing. You can't hear it at all when you're tired or out of sorts or discouraged or confused, or fed up with the kids or acid indigestion or traffic jams. Your mental ear just shuts up and doesn't hear—or everything seems out of phase, right or wrong. The best hours for phase testing are between 8 and 11 in the morning. You are fresh in mind and body, your ears still have that sound of bacon frying in them, the daily routine is not yet wearing you down. Later on—you can't be sure. Sometimes you can tell, sometimes you can't. What seemed right at 11 a.m. is horribly wrong at 3 p.m. You are uncertain. And yet the phasing *must* be right, you *must* fit it. Or you'll go crazy trying to figure out why your stereo sounds wrong, wrong, wrong. Yep, it's really a problem.

And the goad that sticks into your back is that you have always that 50 per cent chance of being right, willy-nilly. Is it right because it *is* right—throughout your stereo system? Or because the sum-total of eight or nine phasing mistakes happens to come out correctly phased? Not a pleasing thought, and you can't ignore it as academic; chances are that when you switch to some other medium, some other record, some other cartridge, you'll be in the phasing soup for fair.

It's here that I'm presently going nuts. I want to be right ALL the time, and not by any fifty-fifty accident. The way things are shaping up now, I'd say I'm right maybe 52 per cent, allowing a whopping two per cent for deliberate, calculated, checked correctness. The rest is happenstance. Each time I think I've got phasing licked, a new contradiction pops up and I start all over again.

The most exasperating part of the whole problem is the way it keeps popping out improbable contradictions at you, springing unforeseen traps, confusions, redundancies, until you don't know whether you're coming or going. Maybe I should say, whether you're in phase or out. (Am *I* out of phase, or is IT?)

For instance, here's one of my unresolved little phasing mysteries, as of this moment. I found out that a certain highly reputable magnetic stereo cartridge was in phase for stereo sound, dual-track, but that when I switched to one track alone (in both speakers) the sound was out of phase. Same with my radio input or any standard mono cartridge—when they were in phase, from the two speakers, the stereo cartridge's stereo sound was out. I have a phase switch in my speaker line, of course, to check AB on these matters. (So should you.)

No doubt about it—I've checked this again and again. To shift from playing stereo to playing the radio through both speakers (or to a standard monophonic cartridge) I have to change the speaker phasing. Why? I really don't know. I'm no chess player nor a mathematical game fan. Maybe you are—in which case, you can try it out for yourself, on your own equipment. I'll bet you I'm right.

(*See page 38 for some possible explanation.* ED.)

A simple reversal of phase can happen in so many, many places! I had already checked two pairs of speakers. One pair (still nameless, for this month) was definitely opposite. The other pair were identical. Or maybe the first pair was identical and the second pair opposite—for my equipment? It's all relative. Anyhow, indubitably the two pairs were *different*. One I hooked up with the connections the same on both units, the other with the connections opposite. . . . Then there's the amplifier—or amplifiers. Two circuits, switched together in all sorts of combinations. How do I know what goes on inside that mass of interconnected complexity? Output transformers? They could be oppositely phased—why not. Or could they?

And, of course, there are my own home connections. Yep, it turned out that my two stereo arms were hooked up with the channels reversed. What came out "right-speaker" on one arm was "left-speaker" on the other, until we corrected this. But phasing?

We've gone over every foot of yards of hookup wires, we've color-coded connections, tested circuits electrically, and I'm sure—I *think*—that what goes in one way comes out the same way. But there's always a tiny, gnawing doubt in my mind . . . one slip, one connection overlooked, and the whole system is 180 deg. out.

I don't know the answers to most of these nagging doubts on phasing, at this stage. I haven't had the patience to try *all* my equipment, systematically, and keep log books on what happens. I haven't tried, for instance, to find out whether a ceramic stereo pickup also produces the curious phase-reversal noted above with the two

magnetics. I haven't tried my *two* ceramics, to see whether they act alike. Dollars to doughnuts they won't, and the fault might be mine, in the connecting, or the maker's, in the making.

I just don't have enough ear left.

Correction: I had just barely enough ear left to listen monophonically, in a simple, happy state of bliss minus any phasing complications at all, to the vast number of non-stereo discs you'll find reviewed in this month's Record Revue. So far, I haven't listened to disc stereo; I've listened mainly to phasing. And I'm tired of it, I can tell you. Also to hum.

3. Ho-Hum.

I will effuse briefly on hum; it is a subject that oughtn't to be mentioned in polite hi-fi circles. It is my most cordial hate, above all other sounds.

Stereo hum is just around the corner in a great deal of present component concatenations. At the present moment, I hear hum on *all* stereo disc reproduction, with all my cartridges (in different ways, degrees) and in all possible set-ups, using the presently un-named stereo amplifier. Some aspects of my hum are still inexplicable to me—various mysterious ground-loops and the like that defy detection. Other hum situations I have cleared up in part, reduced the hum to a satisfying degree, without quite eliminating it.

But what gets me down is that with any one of a half dozen fine monophonic magnetic cartridges I can play ordinary records with *no hum at all*, on the very same amplifier. That galls me. I like stereo, but I like standard sound better—if it has no hum. I'm still tearing my hair. I still have hum and I cannot take the blame for all of it.

Plural Trouble

Since this month's writing is deliberately in general terms, I'll mention no cartridges nor other equipment. But the combined source of my hum is not hard to apportion out. The trouble is never serious in any one place or component. It is the combination of minor ills that makes the major one, the sum total of hums.

1. Stereo magnetics, so far, are often very low-level as compared to well known high-quality standard magnetics, monophonic.

2. Some that produce a healthy output do it via transformers—and thereby risk jumping from the frying pan to the fire. Transformers love to pick up hum, especially two of them.

3. Some ceramic stereo cartridges, with high-level non-preamplified output, nevertheless produce (a) relatively low level for this stage, requiring plenty of work on the amplifier's part—hence more amplifier hum; and (b) the ceramics now available tend to rate a very high impedance input, which makes for more and easier hum pickup.

Thus for a variety of reasons, my first batch of stereo cartridges all involve an objectionable hum level, as compared to monophonic standard cartridge equivalents.

4. Stereo discs tend to be cut lower in level than standard discs—considerably lower in many cases. Hence—more gain needed in the systems and more hum produced in the final sound, from wherever it may come. Bad!

5. Admittedly a somewhat special set-up, my pickup connections allow for switching from standard to stereo operation, using either type of cartridge. In the same manner, with standard equipment and standard records I experienced no hum trouble—but along comes stereo and I find *myself* involved in a lot of private hum, induced along the way in my own hookup. The switch has had to be heavily shielded, the "shielded" leads I have twisted into odd positions to keep them as far as possible from contamination, and so on. My biggest unsolved problem, with the transformer-coupled stereo cartridge, is an unexplained ground loop (?) that acts this way: When only one channel is connected —either one—there is only negligible hum. But when the second channel is hooked up—either one—there is loud hum *and* a a very unpleasant pickup of motor noise from the turntable. So, at the moment, I'm "testing" that particular stereo cartridge on one channel only.

* * *

If I seem to grouse, and if my problems seem particularly fuzzy and ill-assorted, I bring them upon this generalized way simply because, the world being imperfect, I suspect that many a home buyer of very high quality stereo disc equipment is going to run into the same tangled confusions as to phasing and, very likely, as to hum, and I further suspect, people being what they are, that many a hi-fi dealer and, perhaps, even many a professional engineer, is going to find himself disagreeably ensnared too in a few of these minor but irritating plural-problems.

As I've often said, if every audio problem had *one* inescapable, exclusive, single cause, if every single fault could be cured with a single solution—then hi-fi life would be a dream come true. Also the rest of life. But as things usually are, trouble is virtually always plural trouble, a combination of factors, a plurality of causes. And most of us, being typical, find that to pinpoint plural trouble is the nastiest small job in the world.

It never was more typically nasty than in stereo hum and stereo phasing. Pluraled plural.

(P.S. I trust that by next month I'll be back in my usual optimistic frame of mind, with most of my plural problems reduced to singular. In any case, I'll be more specific then as to equipment and, in the Record Revue, as to records.)

I'll throw out one specific product, for your inspection, in case you have hum troubles and haven't run into it. It's sticky aluminum tape in rolls and it makes a marvellous shielding material to cover those inaccessible unshielded sections of hi-impedance lead, out of pickups into preamps, that add to the total hum in critical situations.

My own hi-impedance hookup, as mentioned above, had an unshielded switch (stereo-monophonic) in the pickup line, plus several sections of unshielded connection. The hum pickup was inaudible in all applications other than stereo disc—but when I threw in my stereo cartridges, something had to be done.

There are probably many brands; the stuff I got, via my engineer assistant, is called Pressure Sensitive Electronic Adhesive Aluminum, put out by Modern Adhesives and Electronics (what a sticky corporate name!) of Garden City, N.Y. Came in a 900 foot roll, three-eighths in width, .0008 gauge and sort of crimped. As far as I can tell, you can make contact through the adhesive backing but to be sure you can always crimp over a bit of the edge on each layer. It greatly reduced the hum pickup at and around my hi-impedance toggle switch, and took only a few moments to apply. Look out for accidental shorts with the signal "hot" lead, though.

3. MAGNETIC CARTRIDGES

It's getting so that I can't find anything to say at all about the best of the newer

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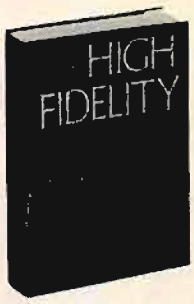


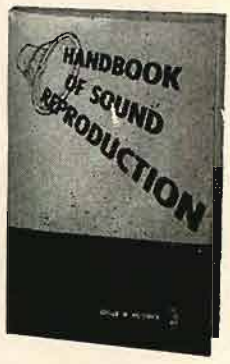
NEW!

No. 119

HIGH FIDELITY AND THE MUSIC LOVER

by Edward Tatnall Canby

An up-to-the-minute guide that shows you how to get the best out of your hi-fi records and tape recorder. Mr. Canby discusses in detail the speaker, the amplifier, the radio tuner, the record player and the tape recorder. He shows you how to save time and money, and get the hi-fi equipment that suits your particular needs. Illustrated with line drawings. $4.95



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HANDBOOK OF SOUND REPRODUCTION

by Edgar M. Villchur

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o. 120

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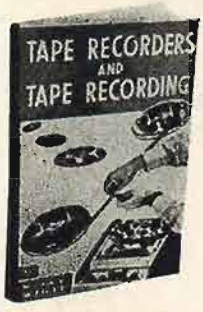

No. 112

TAPE RECORDERS AND TAPE RECORDING

by Harold D. Weiler

A complete book on home recording by the author *of High Fidelity Simplified.* Easy to read and learn the techniques required for professional results with home recorders. Covers room acoustics, microphone techniques, sound effects, editing and splicing, etc. Invaluable to recording enthusiasts.

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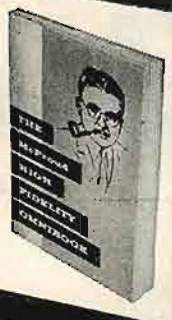
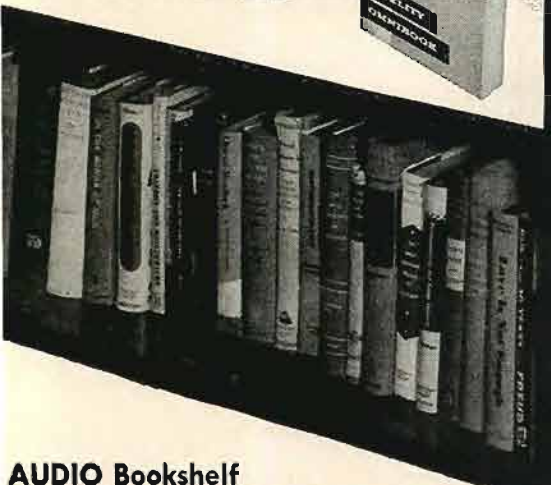
No. 115

McPROUD HIGH FIDELITY OMNIBOOK

Prepared and edited by C. G. McProud, publisher of Audio and noted authority and pioneer in the field of high fidelity. Contains a wealth of ideas, how to's, what to's and when to's, written so plainly that *both* engineer and layman can appreciate its valuable context. Covers planning, problems with decoration, cabinets and building hi-fi furniture. A perfect guide. *$2.50 Postpaid.*





No. 114

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THE NEW HIGH FIDELITY HANDBOOK

by Irving Greene and James R. Radcliffe

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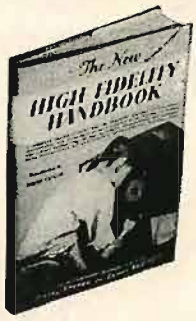

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magnetic cartridges; they all sound alike, and they should, considering the extremely low distortion factors present. Normally, I don't go around AB-ing cartridges one after the other. I prefer to put them to work on music, over a good span of time. This tells me more of what I need to know than any AB test.

Shure and Norelco

Two new units that recently reached me are in this category and use the same basic principle, a novel one, the moving magnet. Which of them came first I do not know; one, Norelco, comes from Philips in Holland, the other, Shure Dynetic, comes from the U.S., and both produce top-quality sound from a removable stylus that is also a magnet, oddly magnetized in a sidewise manner so that one side of the pencil-like shaft is North, the other South.

Whether the moving-magnet magnetic is now the ultimate ultra I don't know. It certainly works beautifully and sounds the same. Output in both of these cartridges is enough to avoid any thought of a transformer. The compliance in the Norelco is somewhat higher than in the Shure—but this all-purpose model of the Shure Dynetic is made somewhat more ruggedly than the original studio Dynetic (the one on its own spear-shaped arm), for use in changers and in standard arms to choice, and thus it has a slightly heavier, slightly less compliant stylus assembly. Even so, it is plenty compliant enough to give ultra-smooth response on the loudest recorded passages. Both cartridges will zoom easily over stereo vertical bumps. Both are well worth investigating if you want the latest in top quality sound in a separate cartridge, to fit in any good arm.

I must say in all honesty, now that I have my cartridges rigged up for frequent and quick interchangeability, that most of the time I can't possibly tell these superduper newer units apart. Is it the Fairchild 225, the ESL (the older model, with transformer—still a terrific cartridge), the Norelco, the Shure-by-itself, or the Shure-built-into-its-own-arm? or the Grado?

What I hear, as you can guess, is music. Unless something about the cartridge's performance distracts me, I tend to forget it, in favor of the music itself, or the sound itself, whatever it may be.

I find it very difficult to concentrate on the performance of an extremely fine cartridge—and this is precisely as it should be. If it shows no unpleasant peaks, tracks nicely and cleanly in the loud parts, gives enough wallop, if the stylus stays clear of the side-guards or pole pieces (one of my GE 78 styli keeps buzzing against the pole-piece on one side—stylus is bent a bit), if dust refrains from collecting and jamming the point en route (which happens plenty often with some cartridges)—then I just listen. That's what a cartridge is for.

It's only afterwards—after many playings—that I suddenly wake up one day and say, hey, that cartridge is *good*. Cumulative high performance. It's likely to be that way with these moving-magnet jobs, the Norelco and the Shure Professional (the separate cartridge). At this early point they're both too good to tell apart, my style. Give 'em time.

Grado

I've had a Grado cartridge in use, too, for a longer time, and am pleased with it, decidedly. It's made like a watch, by watchmakers, etcetc. but what really sells it to me is simply the fact that it works, sounds extremely good, is rugged so far, in spite of a seemingly risky suspension of the stylus, out in front of the cartridge. I was sure it would break or get caught in something, but it hasn't yet, after many months of solid use as my main radio broadcast pickup. I've really banged it around, too, under duress.

The compliance on the Grado is fantastic, and the play of the projecting stylus "bar", both vertically and horizontally, has to be felt to be believed. It is of the type that sticks far forward at a diagonal and in this respect is extremely useful for all who need to pinpoint record groove positions by eye, as in radio stations and in all situations where records are played by hand, by the LP band. This is a blessing to me.

So far—there are no quirks and tricks along with this extreme compliance. The stylus is still centered; it doesn't stick over to one side of its long almost-free movement, it doesn't hit anything and buzz, as many styli do on provocation. It doesn't distort when you weight it downhill sidewise, as is so easy to do with a slightly off-level playing surface. It doesn't make funny noises on extremes of vertical warping (the compliance allows it to track warped records unusually easily). Altogether a reliable and top-sounding unit, so far, with no reservations that I can think of. More can't be said; if you want engineering details go check the specs yourself.

Volpar

Finally, still another cartridge that is unusual, though a bit on the delicate side for a rough user like me. The Volpar, made in Florida, is a unique cartridge-and-arm combo, a long, thin aluminum tube supported on a simple and ingenious nylon bearing, the end of the tube flared out to house the tiny magnetic cartridge, all of a piece. No springs—the tube is counterweighted and point pressure is adjustable by a simple screw-on weighted tube at the rear, slightly larger in size than the arm-proper. Balsa wood and such aside, this is about the lightest arm I've seen. You pick it up and put it down yourself, without handles, pushbuttons, or fingerlifts. Economical and ultra-simple.

I can't tell you at this point what construction the cartridge uses, but in working with it for my weekly broadcast (temporarily in place of the Grado) I found quickly that it is sensitive to sidewise pull and, oddly, to sudden pressure from above, as in dropping it or accidentally pushing it down with a finger. Side-pull makes it distort; the stylus is centered in a very narrow space—but stays centered very nicely when you aren't mauling it. (To maul, in this case, means barely to touch the feather-weight arm.)

The effect of dropping this cartridge, or pushing down gently on it, is strange—a kind of amplitude flutter. It sounds like a vibrato, but obviously can't be frequency-modulated. The pulsing, only for an instant, sounds like the quick flutter when a tape recorder starts up. It must, however, be an oscillation that affects the output level, not the frequency, and has to do, I'd guess, with the (vertical) stylus suspension. Unimportant, but I've never heard this particular effect before. Interesting.

The Volpar was sent me for trial some time ago, and I suspect that it was a hand-made prototype. It just looks that way. If the pickup has got into production, it should be of considerable interest to a lot of readers. It comes, if I remember rightly, from Panama City, Fla. Don't have the address with me at the moment. I haven't bothered to say that the sound of this unit appears to be excellent. Negatively speaking, I haven't noticed anything wrong with it. Good sign, especially with all of the above competition. (P.S. I've found the address—it is 4404 W. 22nd Panama City, Fla.) Æ

CONTROL UNIT

(*from page 21*)

sively. A great improvement in reliability was realized by a 50 per cent saving in parts when compared to the control unit formerly used.

PARTS LIST

(All resistors ½ watt 5%, unless otherwise indicated)

C_1, C_2	20-20/450, electrolytic
C_3	.01 μf, mica
C_4	.0025 μf, mica
C_5, C_8	100 μf, 6v., electrolytic
C_6	0.5 μf, 600 v., paper
C_7	0.2 μf, 600 v., paper
C_9	600 μμf, mica
C_{11}, C_{19}	.05 μf, 600 v., paper
C_{12}, C_{20}	4 μf, 250 v., electrolytic
C_{13}	.006 μf, mica
C_{15}, C_{16}	50 μμf, mica
C_{17}, C_{18}	.01 μf, 600 v., mica (Sangamo type H)
F_1	Fuse extractor post (Littelfuse 324003)
F	⅜ amp. fuse (Littelfuse 3AG)
J_1, J_2, J_3	Amphenol 80-PC2F connector
J_4, J_5	Amphenol 80-P-MC2M connector
J_6	Phone jack (Mallory SC-1A)
PL_1	Pilot light socket (Dialco 95408)
R_1, R_2	4700 ohms, 2-watt, 10%
R_3	12,000 ohms, 2-watt, 10%
R_4	0.27 meghoms
R_5	30,000 ohms
R_6	2 megohms, 10%
R_7	1000 ohms, 10%
R_8	0.1 megohms, 10%
R_9	0.39 megohms, 10%
R_{10}	0.24 megohms
R_{11}	0.36 megohms
R_{12}	0.15 megohms
R_{13}	1200 ohms, 10%
R_{14}	47,000 ohms, 10%
R_{15}	75,000 ohms
R_{16}	24,000 ohms
R_{17}, R_{27}	0.51 meghoms
R_{19}	0.56 meghoms
R_{20}	0.16 megohms
R_{21}, R_{22}	9100 ohms
R_{23}	600 ohms (use two 300-ohm resistors in parallel)
R_{24}, R_{25}	12,000 ohms
R_{26}	5100 ohms
R_{28}, R_{38}	1.0 megohm, 10%
R_{29}, R_{39}	47,000 ohms, 1-watt, 10%
R_{30}, R_{32}	820 ohms, 10%
R_{31}, R_{36}	62,000 ohms
R_{33}, R_{34}	0.39 megohms
R_{37}	0.5 megohm potentiometer
S_1	2-gang, 2-pole rotary switch (Centralab PA-2005)
S_2	1-gang, 2-pole rotary switch (see text)
SH_1	UTC transformer shield, A-33
T_1	Power transformer: 500 v. CT at 20 ma; 6.3 v. at 2 a. (Triad R-3A)
T_2	Input transformer—Chicago WF-28
V_1, V_2	EF86 tubes
V_3	12AU7A or ECC82 tube
V_4	6X4 tube

Miscellaneous

3	Vector Socket turret 8-N-9T
1	Vector turret 8-12
6	Vector socket saddle nuts 4-40U
6	Vector socket screws, S4
1	DPDT toggle switch
1	NE-51 neon bulb
1	7-pin miniature socket
3	noval tube shields, 1⅛ in.
1	miniature tube shield, 2¼ in.
1	chassis, steel, 5 × 13½ × 2½ in.
1	bottom plate, steel, 5 × 13½ in.

Æ

Industry Notes...

H. H. Scott, Inc., Maynard, Mass., recently received two awards for company advertising from the National Federation of Advertising Agencies. One was for the best consumer advertising in 1957, while the other was for the best single ad of the year. Presentation of the awards was made to Hermon Hosmer Scott, company president, and Marvin Grossman, advertising manager, by Harold S. Goodstein, vice-president of **Arnold & Co.**, Scott advertising agency. Participating in the competition were more than 200 agencies.

Sidney Frey, president, has announced plans for **Audio Fidelity, Inc.**, to enter the classical record field. Present thinking calls for the release of monophonic and stereophonic record albums, as well as tapes, ranging from light classical to very serious works. Emanuel Vardi, well-known violinist and conductor, has been appointed to head up the Audio Fidelity classical Artists and Repertoire department.

Altec Lansing Corporation is the latest of the major component manufacturers to enter the field of packaged high fidelity. Within the near future the firm will introduce two hi-fi consoles in furniture styled by **Glenn of California.** Both models incorporate a Garrard record changer, with all other components, including an FM-AM tuner, manufactured by Altec Lansing. Although distribution has been established in the New York area, Altec is currently searching for sales representation in other parts of the country, according to H. S. Morris, Altec product sales manager.

Nationwide sales and marketing of **Madison Fielding** high-fidelity components are now being handled by **Brand Products, Inc.**, national sales organization, according to joint announcement by the two companies. Participating in the statement were Leonard Feldman, president, and Ben Braun, marketing director for Madison Fielding, and Mort Wimpie, president of Brand Products, Inc. All advertising and sales promotion, as well as the actual mechanics of selling Madison Fielding equipment, will be handled through the Brand Products office at 11 Lorimer St., Brooklyn, N.Y.

Daystrom Incorporated, of which **Heath Company** is a subsidiary, recently announced the formation of **Daystrom Limited of England,** a division of **Daystrom International.** The new British facility will manufacture a complete line of Heathkits in a new 10,000-sq.-ft. building in the general vicinity of London. The American Heathkit line will be adapted to British requirements, and all of the parts will be manufactured in the United Kingdom. The new British company is expected ultimately to service not only the United Kingdom, but all of the world's sterling areas, according to W. H. Westphal, general manager of Daystrom International. Daystrom-Limited do-it-yourself Heathkits are expected to find rapid acceptance by British industry and consumers alike since there will be no dollar purchases involved, Mr. Westphal said. Managing director of the new Daystrom operation will be A. E. B. Perrigo, formerly with the British firm of Parkinson and Cowan Instruments.

Industry People...

Edwin Cornfield, executive secretary of the Institute of High Fidelity Manufacturers, resigned effective August 1. He has joined British Industries Corporation in an executive sales capacity. His position with the Institute has been assumed by **Abraham Schwartzman,** according to **Joseph Benjamin,** Institute president. Mr. Schwartzman has been in the magazine publishing business as editor and publisher for 30 years, most recently as publisher-editor of the "Brooklyn Queens Standard."

Thomas J. Nicholson, high-fidelity sales manager for the General Electric Company for the past eight years, has joined Ampex Audio, Inc., as western zone manager. . . . **Robert G. Bach** has announced his resignation as sales and advertising manager of Fairchild Recording Equipment Corporation in order to devote his efforts to promotion of Fairchild high-fidelity components in the New York area as an independent sales representative. Bach Sales Company will headquarter at 26 Mahan Road, Old Bethpage, N.Y.

Sound Talk

by John K. Hilliard
Director of Advanced Engineering

WHAT SPEAKERS FOR STEREO?

Sound engineers agree that the finest stereo reproduction can be achieved only by two identical speaker systems of exceptional quality. Short of this ideal, however, the premise is muddled by an ever-increasing number of unfounded claims... most of them based on sales philosophy rather than scientific fact.

Actually, the proper selection of stereo speakers is quite clear. Due to certain psycho-acoustic effects, one exceptional speaker system and one of moderate abilities will provide better stereo than matched speakers of intermediate quality. This is only true, however, if the lesser speaker meets certain requisites.

The two speakers must be similar in frequency response and character. In the high end of the spectrum they must have the same limits. At the low end, they must be similar down to 100 cycles. Below that point, the performance of the lesser speaker is relatively unimportant.

If the lesser speaker goes down to only 300 cycles or has major irregularities in its response, a phenomenon called the "orchestral shift" will occur. This shift results from the fact that the sound from any given instrument is reproduced from both speaker systems. The comparative loudness determines the auditory location. If an instrument is "placed" in the lesser speaker and then plays into a frequency range where that speaker is inefficient, it will then be louder in the better system and will appear to shift to that better system.

Speakers that are inefficient below the 300 cycle point will not provide true stereo. This is obvious because the 300 cycle point is above middle C on the piano, 70 cycles above the primary pitch of the female voice and nearly 200 cycles above primary male pitch. For full stereo it is therefore imperative that the lesser speaker efficiently reach at least 100 cycles.

All ALTEC speaker systems are similar in their exceptional smoothness of frequency response, have a high frequency limit of 22,000 cycles, and are efficient below 100 cycles in the lower range. This regularity in response, range, efficiency and quality is the reason why ALTEC speaker systems are noticeably superior for stereo reproduction.

For further information concerning the best elements for stereo, write **ALTEC LANSING CORPORATION**, Dept. 9A-B, 1515 S. Manchester Ave., Anaheim, Calif., 161 Sixth Ave., New York 13, N. Y. 12-25

CIRCLE 88A

ADVERTISING INDEX

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Your RCA Field Representative has complete information. Call him today. For Technical data, write RCA Commercial Engineering, Sec. I-91-DE, Harrison, N. J.

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3-way speaker system costing between $300 and $325 such as the E-V Manuscle II (Net $303) or the E-V Aristocrat III (Net $312)

4-way 15-inch speaker system costing between $325 and $375 such as the E-V Carlton IV (Net $359)

4-way corner 12-inch speaker system costing between $325 and $375 such as the E-V Centurion IVE (Net $365)

3-way 15-inch speaker system costing between $375 and $400 such as the new E-V Regency III (Net $393)

4-way corner 15-inch speaker system costing between $400 and $480 such as the E-V Cardinal IV (Net $425)

4-way corner 15-inch speaker system costing between $480 and $600 such as the E-V Georgian 600 (Net $490)

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CARLTON IV

Deluxe version of the Duchess IVE in smart, handsome low-boy design; harmonizes gracefully with many modern furnishing modes. A complete Phase-Loaded System, affording unusual bass response with smooth, resonance-free characteristics. Includes deluxe 15-inch indirect bass driver 4-way components.

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CENTURION IVE

New complete 4-way system incorporating all design features of the magnificent E-V Georgian, but on a smaller scale. Uses Klipsch "K" folded horn with E-V deluxe 12-inch indirect-radiator speaker system, [12WK LF driver, MT-30 coaxial mid-bass and treble assembly, T35 VHF driver and X336 crossover]. Response from 30 cps to beyond audibility.

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Add-on the E-V
REGENCY III

The versatile Regency III deluxe separate 3-way system allows operation in the corner for full bass efficiency or along the wall for convenience. Powerful 15-inch bass driver crosses over at 800 cycles per second to diffraction-type treble and very high frequency components to give maximum dispersion and full stereo effect.

Net $393

Add-on the E-V
CARDINAL IV

Authentic E-V Klipsch "K" horn noted for deep fundamental bass range; complemented by diffraction principle in coaxial mid-bass and treble driver assembly. Very high frequencies insure realism over broadest living room areas.

Net $425

Add-on the E-V
GEORGIAN 600

Utilizes same horn construction and driver complement of Cardinal IV enclosed by beautiful contemporary housing functionally styled by Robert W. Fuldner.

Net $490

Add-on the incomparable
PATRICIAN

World's largest, most deluxe loudspeaker system for those discriminating listeners who demand ultimate tonal perfection. The epitome of style combined with peak performance for the ultimate illusion of reality. Available as the Patrician IV in traditional styling.

Net $970

Patrician 600 in Fuldner-designed contemporary housing.

Net $819

Special models available to custom-finish specifications . . . at higher price.

or alternate step two

ADD-ON E-V STEREON III

The all-new Electro-Voice speaker system that solves your space problem—saves you money. Where space doesn't permit you to add a second full-range speaker, a Stereon is the answer. It's compact, because the Stereon reproduces only those frequencies NEEDED for stereo (bass below 300 cps does not contribute to the stereo effect . . . so bass from both is handled by your PRESENT full-range speaker through the accessory XX3 Stereon Control Filter).

Stereons have the finest E-V mid-bass, treble and high frequency components. (Frequency response: 300 to 19,000 cps).

STEREON III for high efficiency systems . . . . . **Net $129.50**

XX3 STEREON CONTROL . . . . . **Net $30.00**

NOTE: All E-V Systems also available in limed oak or walnut finishes.

Systems shown are but a few of the multitude of E-V combinations found in every price class. Ask your dealer or write Electro-Voice for information on the industry's most complete line of high fidelity speakers and enclosures.

Electro-Voice

ELECTRO-VOICE, INC., BUCHANAN, MICHIGAN