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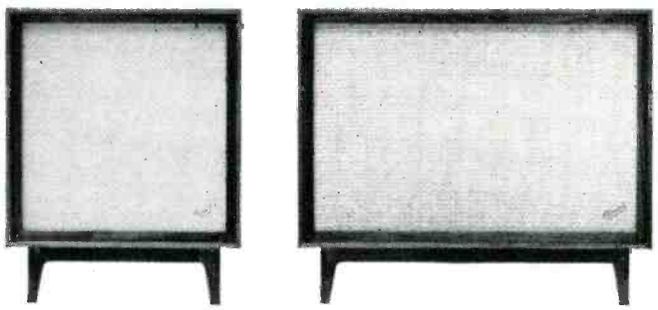

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★ You may accept or reject the regular Classical Selection, take any of the other records offered, or take NO record in any particular month

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Terre Haute, Indiana

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CIRCLE 5 NUMBERS BELOW:

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12. Schweitzer Plays Bach, Vol. 1
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15. Mendelssohn: Midsummer Night's Dream; Schubert: "Unfinished" Symphony
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17. Vivaldi and Bach: Violin Concertos
18. Haydn: "Surprise", "Drum-Roll" Sym.
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HARMAN-KARDON MAKES STEREO SENSIBLE

Harman-Kardon stereo instruments are the most flexible on the market today. Intelligent design assures ease of operation. The new Duet stereo tuner and Trio stereo amplifier — make stereo attractive, effective, inexpensive — and sensible.

THE TRIO, Model A-224, Stereo Amplifier – actually embodies *three* excellent instruments in one handsome, compact unit. The Trio is: A complete stereo preamplifier with two separate 12 watt power amplifiers (24 watt peaks each.) A complete 24 watt monaural amplifier (48 watt peak.) A 24 watt monaural amplifier with complete stereo preamplifier arranged to convert an existing monaural amplifier to stereo. Outstanding features include: Separate ganged treble and bass controls, balance control, mode switch, speaker selector switch for local and remote speaker systems, contour control, tape output for recording application and rumble filter.

THE TRIO, Model A-224 $99.95
the Cage (AC-24) optional 7.00

THE DUET, Model T-224, Stereo Tuner: Monaural! Binaural! Whatever the application, this new tuner is designed to give maximum performance. A superb monaural tuner—the T-224 incorporates separate AM and FM channels for receiving stereo broadcasts through this *one* unit. Rear jack makes it adaptable for multiplex reception.
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THE DUET, Model T-224
$114.95
Prices slightly higher on the West Coast.

For additional information on Harman-Kardon stereo and monaural units, simply send a postcard with the word stereo on it to Harman-Kardon, Dept. AC-10, Westbury, N. Y.

harman kardon

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THE MAGAZINE FOF THE HI-FI HOBBYIST

OCTOBER 1958

Volume 3 *Number 10*

THIS MONTH'S COVER: This isn't really true, since this month's cover actually is next month's cover, but what with vacations, high humidity and the inevitable lure of Berkshire lakes, cover production became secondary to almost everything. C'est la vie, you know. It's a speaker box, in case you wondered. Cover by Phil Geraci.

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The Grounded Ear

What's new in sound reproduction?

by Joseph Marshall

Enter: the Blend Control

So far, the circuitry of stereo control units and adapters has been fairly conventional. But as I write this, the Dynakit Stereo Adapter Kit is being shipped to dealers throughout the country, and it contains a distinct novelty — a blend control.

The blend control is extremely simple; the whole idea is diagrammed in Fig. 1. But it provides a versatility in use which is surprising and, so far as I can verify, brand new in the stereo field.

It will be noted that the blender is simply a pot of 1.2 megs (the value is not critical, so long as it is high) connected across the two inputs of a stereo system. When the knob is at the extreme left, the total resistance is across the two inputs, and they are effectively isolated from each other. On the other hand, when the knob is at the extreme right, the pot is shorted out, and the two inputs are fed together into both outputs. The two 10-K resistors provide the slight isolation needed to

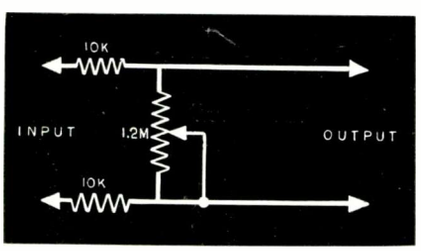

Fig. 1. Dyna's stereo blend control.

avoid disturbing the inputs. Obviously, in intermediate positions of the knob, the two inputs are combined in varying degree and fed in common to both outputs.

Clearly, when the maximum resistance is in the circuit, and the two channels have maximum isolation, we would enjoy complete stereo reproduction with a stereo source. On the other hand, with the pot completely shorted out, we would have completely monophonic reproduction with spaced speakers, or, by turning off one of the output channels, with a single speaker. The two extremes, therefore, provide the equivalent of a stereo-monophonic switch — but with some significant differences. With some switched arrangements, in the monophonic position one or the other but not both inputs are fed into both outputs. Here, however, both inputs are blended to any degree and fed to both outputs. This is almost necessary if, for some reason (and there are some good ones) it is desirable to play stereo discs or tapes monophonically, because neither channel alone carries all the information needed. Further, when playing monophonic discs with a stereo cartridge, both inputs should be paralleled to eliminate vertical response.

Suppose also that monophonic tapes or discs are fed into only one of the input channels. The blend control will route the signal through one channel of a stereo system or both channels, and provide a means of dividing the signal in various proportions between the two channels for monophonic reproduction with either a single speaker or with spaced speakers.

Even more interesting, however, is the application in stereo reproduction. We have mentioned that, with the total resistance in, we obtain the normal type of stereo reproduction. When we decrease the resistance we begin to cross-feed a portion of each channel. And while the dominant output of each channel is its own proper portion of the stereo source, both speakers radiate a common component in addition. Now, this is the easiest way to fill in the hole in the middle which is occasionally noticed with stereo. And it is precisely what is being done in the recording process by most manufacturers of both stereo tapes and discs today. In the recording process though, the blending can be arranged only arbitrarily.

The blend control makes it possible for the user to fill in the hole to whatever extent the individual recording, or the individual setup, or the individual taste dictates. It is particularly useful, for example, when the two speakers are too far apart for some recordings, or when they have dissimilar radiation characteristics.

The blend control, therefore, makes a stereophonic system completely compatible for both monophonic and stereo inputs, and offers every possible variety of reproduction from single-speaker, single-channel monophonic to isolated two-channel stereo. At the same time it provides a means of adjusting the stereo effect to conditions of the environment, equipment, or taste.

I had the opportunity while in Philadelphia to see and hear a prototype in operation. It strikes me as a significant contribution to better stereo.

The Dynakit Adapter also has a reversing switch, a normal type of balance control, ganged volume controls, and a switch to monitor either stereo or monophonic tape while recording. It is designed to work with two Dynakit preamps but will also work with any preamp that has a tape monitor switch; other preamps could be modified without too much trouble.

120 Watts with 0.1% IM

I also saw at the Dynaco lab something I must admit I never really expected to see — an amplifier that delivers 120 w with less than 0.1% IM distortion. Actually, both of the distortion meters used for these measurements had residual readings on the order of .075%, and the amplifier, although it had a low noise level, undoubtedly produced some noise. The 0.1% reading included both the above components. Consequently, the actual IM distortion was very probably less than .05%.

The harmonic distortion was also well below 0.1% (including noise) from 60 to 10,000 cps, and the 20-cps distortion was under 1% at 120 w. The amplifier delivered 100 w at 20,000 cps with less than 2%. Distortion was unreadable below about 60 w. What's more, the amplifier can be built for less than one dollar a watt, and there is no reason to suppose that these results could

Continued on page 44

book reviews

by RICHARD D. KELLER

DC Circuit Analysis

Ed. by Alexander Schure; pub. by John F. Fider Publisher, Inc., New York; 70 pages; $1.35, paper-bound.

This latest booklet in Rider's Electronics Technology Series provides the fundamental concepts of direct-current analysis including treatment of electric current, charge, resistance and conductance, Ohm's Law, wire gages, power and power dissipation, Kirchoff's Laws, superposition, and Thevinin's theorem. Mathematical treatment has been kept simple, yet thoroughly adequate, and step-by-step diagrams provide clear-cut concepts of the methodology involved in problem solutions. It is an excellent addition to the series.

Electronic Designers' Handbook

Robert W. Landee, Donovan C. Davis, and Albert P. Albrecht; pub. by McGraw-Hill Book Co., Inc., New York; 850 pages; $16.50.

This engineering handbook is lucid, up-to-date, and thorough in its coverage of vacuum-tube applications, transmission lines, and antennas, but is quite sketchy on transistors. Generally self-explanatory, it contains many practical design examples, and will be found useful as a text.

Much is included in the way of new design data and design techniques on such topics as statistical and probability theory; graphical methods on inverse Laplace Transforms; design data for the optimum number of RC and LC ladder types of filter sections; extensive coverage and analysis of both voltage and power-amplifier fundamentals, graphical presentation of the amplitude and phase characteristics of RC parallel-T and RC bridged-T circuits and for constant-k and m-derived filter sections having dissipation; feedback theory fundamentals, and the principle methods of stability analysis and network analysis; and much more (23 big sections altogther) covering the over-all electronics field. The new graphical material is particularly noteworthy. In short, this appears to be a good handbook for the advanced engineer or student.

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high quality

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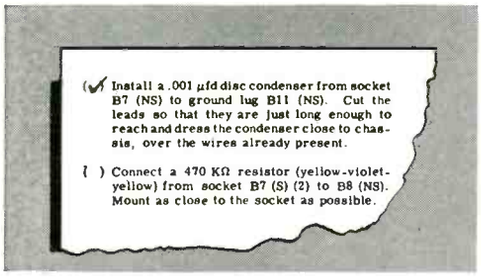
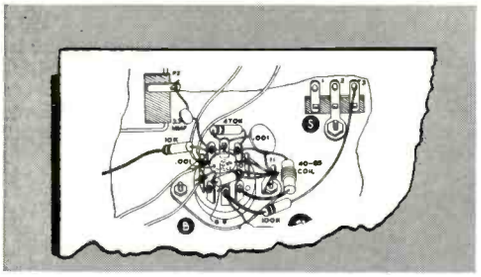
Look . . . how simply you can assemble your very own high fidelity system! Fun-filled hours of shared pleasure, and an everlasting sense of personal accomplishment are just a few of the rewards. Heathkits cost you only HALF as much as ordinary equipment and the quality is unexcelled. Let us show you how easy it really is! . . .

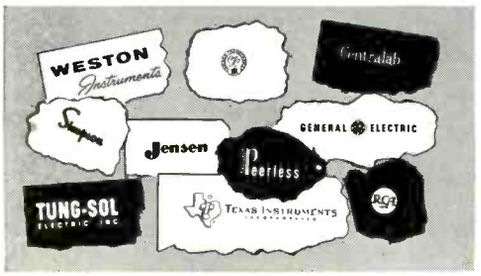


Step-by-Step Assembly Instructions . . .
Read the step . . . perform the operation . . . and check it off—it's just that simple! These plainly-worded, easy-to-follow steps cover every assembly operation.



Easy-to-follow Pictorial Diagrams . . .
Detailed pictorial diagrams in your Heathkit construction manual show where each and every wire and part is to be placed.

Learn-by-doing Experience For All Ages . . .
Kit construction is not only fun—but it is educational too! You learn about radio, electronic parts and circuits as you build your own equipment.



Top Quality Name-Brand Components Used in All Kits . . .
Electronic components used in Heathkits come from well-known manufacturers with established reputations. Your assurance of long life and trouble-free service.

HEATHKIT

bookshelf 12-watt amplifier kit

MODEL EA-2

NEW **$28.95**

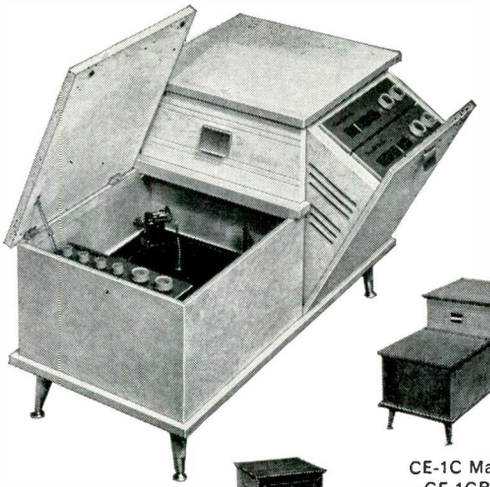
There are many reasons why this attractive amplifier is a tremendous dollar value. You get many extras not expected at this price level. Rich, full range, high fidelity sound reproduction with low distortion and noise . . . plus "modern" styling, making it suitable for use in the open, on a bookcase, or end table. Look at the features offered by the model EA-2: full range frequency response (20—20,000 CPS ± 1 db) with less than 1% distortion over this range at full 12 watt output—its own built-in preamplifier with provision for three separate inputs, mag phono, crystal phono, and tuner—RIAA equalization—separate bass and treble tone controls—special hum control—and it's easy-to-build. Complete instructions and pictorial diagrams show where every part goes. Cabinet shell has smooth leather texture in black with inlaid gold design. Front panel features brushed gold trim and buff knobs with gold inserts. For a real sound thrill the EA-2 will more than meet your expectations. Shpg. Wt. 15 lbs.

TIME PAYMENTS AVAILABLE ON ALL HEATHKITS WRITE FOR FULL DETAILS

HEATHKIT

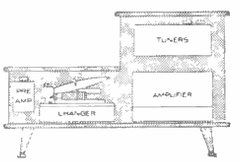
chairside enclosure kit

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.



CE-1C Mahogany
CE-1CB Birch

CONTEMPORARY



CE-1T Mahogany

TRADITIONAL

Be sure to specify model you prefer

$43.95 each

HEATHKIT

high fidelity FM tuner kit

For noise and static free sound reception, this FM tuner is your least expensive source of high fidelity material. Efficient circuit design features stablized oscillator circuit to eliminate drift after warm-up and broadband IF circuits assure full fidelity with high sensitivity. All tunable components are prealigned so it is ready for operation as soon as construction is completed. The edge-illuminated slide rule dial is clearly numbered for easy tuning. Covers complete FM band from 88 to 108 mc. Shpg. Wt. 8 lbs.

MODEL FM-3A $26.95 (with cabinet)

HEATHKIT

broadband AM tuner kit

This tuner differs from an ordinary AM radio in that it has been designed especially for high fidelity. A special detector is incorporated and the IF circuits are "broadbanded" for low signal distortion. Sensitivity and selectivity are excellent and quiet performance is assured by a high signal-to-noise ratio. All tunable components are prealigned before shipment. Incorporates automatic volume control, two outputs, and two antenna inputs. An edge-lighted glass slide rule dial allows easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 9 lbs.

MODEL BC-1A $26.95 (with cabinet)

HEATHKIT

master control preamplifier kit

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

MODEL WA-P2 $19.75 (with cabinet)

pioneer in "do-it-yourself" electronics

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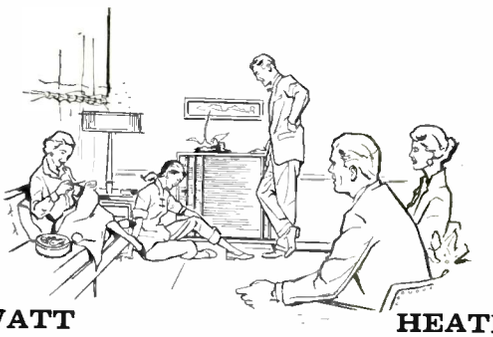
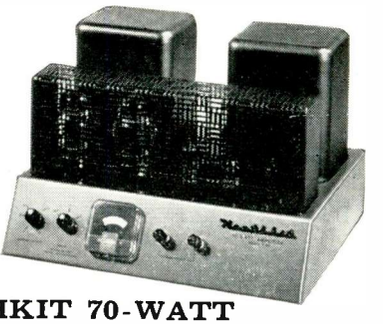




HEATHKIT 25-WATT **HEATHKIT 70-WATT**

MODEL W-5M
$59.75

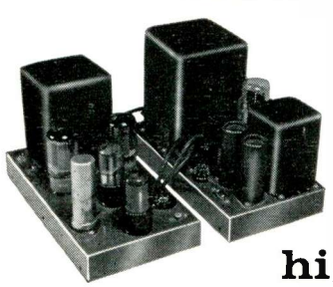
high fidelity amplifier kits

MODEL W-6M
$109.95

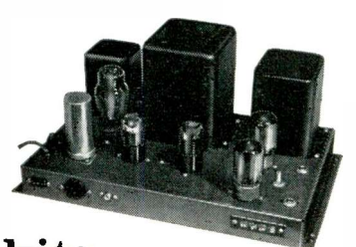
To provide you with an amplifier of top-flight performance, yet at the lowest possible cost, Heath has combined the latest design techniques with the highest quality materials to bring you the W-5M. As a critical listener you will thrill to the near-distortionless reproduction from one of the most outstanding 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

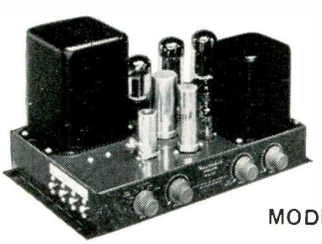


HEATHKIT

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

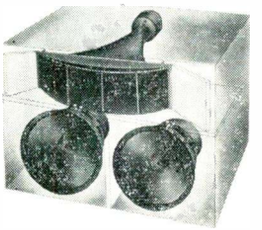
MODEL XO-1 **$18.95**

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

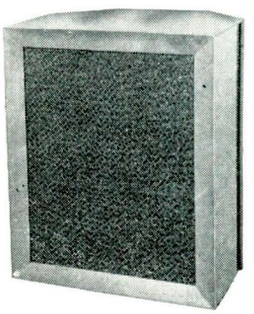


Wrap yourself in a blanket of high fidelity music in its true form. Thrill to sparkling treble tones, rich, resonant bass chords or the spine-tingling clash of percussion instruments in this masterpiece of sound reproduction. In the creation of the Legato no stone has been left unturned to bring you 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.

Free Catalog!

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!

HEATH COMPANY · BENTON HARBOR 18, MICHIGAN

a subsidiary of Daystrom, Inc.

pioneer in "do-it-yourself" electronics

☐ Please send the Free HEATHKIT catalog.

☐ Enclosed is 25c for the New HI-FI book.

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ALSO SEND THE FOLLOWING KITS:

QUANTITY	ITEM	MODEL NO.	PRICE

Enclosed find $..... Please enclose postage for parcel post—express orders are shipped delivery charges collect. All prices F.O.B. Benton Harbor, Mich. NOTE: Prices subject to change without notice.

An important announcement for everyone considering a small-space wide-range speaker system . . . monaural or stereo

ACTUAL TESTS PROVE *University* RRL*

ULTRA LINEAR RESPONSE SYSTEMS

SUPERIOR

Compared with competitive widely publicized high compliance small-space systems

AT $40 to $85 SAVING

RRL systems use a specially designed acoustic coupler to load the new University high compliance woofer, enabling it to radiate tremendous bass energy with only small cone excursions. This achieves greater linearity and virtually eliminates distortion. Tweeter response, carefully matched to the woofer's acoustic output, is smooth and flat to beyond 20,000 cps. Result: better bass, cleaner treble, smoother response than any competitive small-space, high compliance units based on totally sealed enclosures using "air spring" capacitance loading.

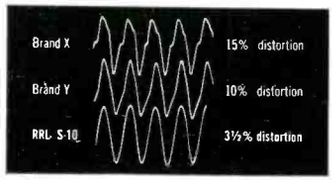
*RRL — *Radiation Resistance Loading*

PROOF OF SUPERIORITY

. . . as demonstrated by actual comparative measurements* of University Model S-10 RRL ultra linear response system . . . and widely publicized competitive brands X and Y, under identical conditions.

75% LESS BASS DISTORTION

Distortion measured at 30 cycles with equal sound output for all systems.



The highly efficient S-10 requires only ¼ of the cone excursion of Brands X and Y to produce the same sound output. Result: greater inherent linearity and 75% less distortion.

Brands X and Y reach overload conditions 4 times sooner (6 db) than the S-10. Bass distortion at higher sound levels is therefore considerably greater with X and Y than with the S-10.

WIDER FREQUENCY RESPONSE

Brand X .....7 db down at 15,000 cps
Brand Y .....2 db down at 15,000 cps
RRL S-10 .....flat to beyond 20,000 cps

Measured average acoustic energy, 7000-20,000 cps, for equal power inputs, demonstrates that Model S-10 performs . . .

5 db better than Brand X
2 db better than Brand Y

Ultra linear response systems are not handicapped by the treble deficiencies common to competitive systems. With clean program material, the remarkably flat response and exceptionally true reproduction of upper harmonics by the S-10 result in amazingly realistic reproduction without "harshness." A Program Distortion Filter is provided which can be switched into the circuit to correct for inferior radio programs, worn records, tapes, etc.

LOWER POWER REQUIREMENTS

Measured average of acoustic energy in 30-100 cps range, demonstrated that Model S-10 performed . . .

4 db better than Brand X
2 db better than Brand Y

This test shows that the S-10 is, in effect, 100% more sensitive. (The ultra linear response systems will fill any average room with sound above normal listening level, using any high quality low power high fidelity amplifier.)

NO "DAMPING FACTOR" PROBLEMS

Model S-10 RRL will work at maximum effectiveness with *any* modern (low internal impedance) high fidelity amplifier. No damping factor adjustment at all is needed, whereas both Brands X and Y require optimum settings. If an amplifier does not have this control the performances of Brands X and Y may be adversely affected.

*** HOW TESTS WERE CONDUCTED**

Frequency response was obtained in an anechoic chamber, using a calibrated Western Electric 640AA Microphone and RA-1095 Amplifier, a General Radio Model 1304B Beat Frequency Oscillator and a Sound Apparatus Model FRA Graphic Recorder.

Distortion was measured with a Hewlett-Packard Model 330B Distortion Analyzer. The speakers were driven from a Hewlett-Packard Model 200AB Audio Oscillator, feeding a McIntosh 50-watt Power Amplifier.

ALL THIS...AND MAJOR COST SAVINGS TOO!

You don't pay a premium for RRL's improved quality and performance. University's superior design and manufacturing know-how has resulted in substantial cost savings to the consumer. Compare for yourself!

Brand X ..... over $180
Brand Y ..... over $220
RRL Model S-10 ..... $139

GREATER SAVINGS WITH STEREO!

These RRL systems incorporate an exclusive University woofer feature . . . a *dual voice coil* . . . that receives the fully separated bass energy from both stereo channels and provides authentic full bass response without need for expensive or complicated networks, *or* an additional woofer and woofer enclosure. Thus you can have a complete stereo speaker system consisting of one RRL S-10 and a matching stereo adapter (speaker system with bass response attenuated below the 150 to 200 cycle range) for approximately the same cost as a single monaural Brand X and *less* than a single monaural Brand Y.

ALREADY THE ACCEPTED LEADER

At WFUV-FM, pioneering stereo in New York City via FM-Multiplex, RRL systems have been selected for studio monitoring and public demonstrations. Fred Waring chose RRL systems for his latest nationwide high fidelity concert tour. "Research House, 1958" of Beverly Hills, California, awarded its Seal of Research Approval to the RRL systems for their beautiful design as well as quality performance. The undeniable superiority of the RRL ultra linear response speaker systems has been recognized by all authorities who *know* music and whose work *demands* the finest in speaker systems.

Hear these magnificent speaker systems at your dealer . . . soon!

LISTEN *University sounds better*

UNIVERSITY LOUDSPEAKERS, INC., 80 SO. KENSICO AVE., WHITE PLAINS, N. Y.

Electronic Firsts

by MONROE UPTON — Author of "Electronics for Everyone"

DR. LEE DE FOREST applied for a patent on his grid Audion, today's *triode*, in January of 1907. The little Audion was the culmination of a long search for a better detector of radio's dot-and-dash signals. He was seeking a detector that would not only rectify the received signal but amplify it to some extent as well. That he had succeeded was obvious from the reports of its first users, U.S. Navy operators, whose headphones delighted them with louder signals than they had ever heard before. The Audion was sealed in a small wooden box with a filament rheostat. Finding that twisting the rheostat knob increased signal strength, the operators overdid it and burned out the filaments, whereupon the supply clerk ruled, "No more Audions."

Although De Forest claimed "amplification at all frequencies" in his patent application, he didn't get around to developing a separate amplifier until 1912, and then it was for long-distance telephone circuits. He tells in his autobiography how the idea of an Audion telephone repeater (amplifier) first came to him (*Father of Radio*, Wilcox and Follett Co., Chicago, 1950).

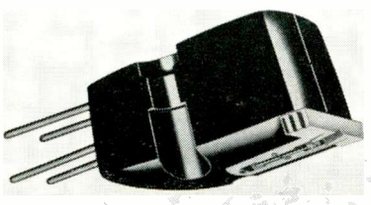
"That spring (1907) I was visited by a magician, Carl Anderson by name, who was interested in staging a little mind-reading act wherein he could, while passing among the audience and asking questions or receiving answers, transmit what was said *sotto voce* by means of a small microphone concealed in his clothing, with wires extending down his trouser legs to spikes in the soles of his shoes. Beneath the aisle carpet were to be laid two sets of copper strips, the ends of which would be connected through a battery to a headphone concealed under the hair of his assistant, a lady standing or seated upon the stage. All his attempts to accomplish this so far had been futile, due to the extremely weak signals received.

"I reasoned then that since the Audion was a very sensitive wireless telegraph detector, it might also be adapted to serve as a wire-telephone amplifier, or repeater. I made some experiments at that time along these lines, and the results, although not very satisfactory to Professor Anderson, convinced me that the little Audion was actually a telephone repeater as well as a detector."

Audionews

STEREO FLUXVALVE

Pickering and Company has announced that its Fluxvalve cartridge is now available in a stereo version, the *Model 371D Stanton*. It contains two magnetic systems with a magnetic discriminator which is said to attenuate interchannel interference by more than 20 db. Frequency response is reported to be flat within 2 db from 10 to 30,000 cps for

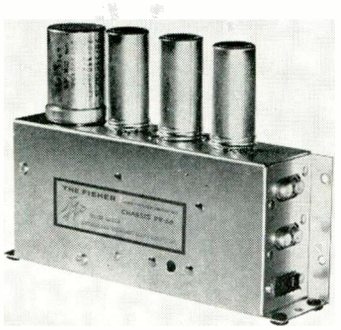


Pickering 371D stereo cartridge.

both stereo and monophonic use. Four-pin signal-cable connection provides flexibility of application. The replaceable T-Guard stylus assembly contains all of the moving parts of the system. The 371D is supplied with a 0.7-mil diamond and sells for $29.85.

FISHER STEREO PREAMP

Completely self-powered and self-contained on one chassis, Fisher Radio's *PR-66* stereophonic preamplifier and equalizer is both small in size and low in price: 8 by 1⅞ by 5½ in., and



PR-66 stereo preamplifier.

$29.95, respectively. The unit was designed for remote operation and has no controls. Necessary preamplification for low-level stereophonic cartridges and equalization for stereo records are provided. With a simple modification, the PR-66 may be used as a preamplifier-equalizer for direct connection from stereo tape-playback heads, or as a two-channel preamp for two microphones. Monophonically, it serves as a two-channel preamplifier for two low-level monophonic phono cartridges, tape-playback head, or microphone. Two inputs and two outputs for connection to an audio control and an AC hum-balance potentiometer are also provided.

PACO EQUIPMENT

The PACO Electronics Company has announced that the PACO line of test-equipment kits will now be available optionally and at extra cost in prewired, tested, and calibrated form.

STEREO ARM AND CARTRIDGE

H. H. Scott and the London Recording Laboratories have combined forces to develop a new magnetic stereophonic pickup arm and cartridge designated the *Mark I* and being marketed by H. H. Scott, Inc. Manufacturer's specifications include: compliance — 3.5×10^{-6} cm/-dyne; frequency response — 20 to 18,000

Stereo arm and cartridge.

cps, ±2 db; shielded construction for minimum hum; impedance — 4,000 ohms per channel at 400 cps; crosstalk — better than —20 db. Price is $89.95 including arm rest, connecting cables, mounting hardware, and templates.

HEATHKIT AMPLIFIER

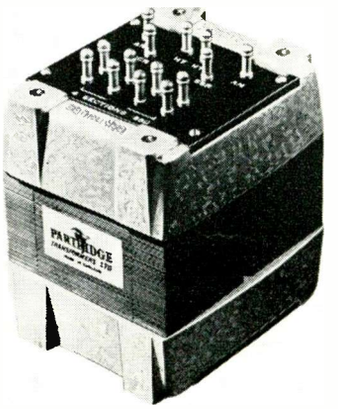
The circuit of the Heath *EA-2* 12-watt bookshelf amplifier kit uses miniature tubes including EL84 output tubes in a push-pull tapped-screen output circuit. A built-in preamp provides inputs for mag phono, crystal phono, and tuner; the mag-phono input features RIAA equalization. There are separate BASS

Heath 12-watt control amplifier.

and TREBLE controls and a back-panel HUM BALANCE control. A frequency response of ±1 db from 20 to 20,000 cps, harmonic distortion of less than 1%, and IM of less than 1.5% at 12 w output are claimed. The amplifier has a black and gold vinyl-clad steel cover which is resistant to scuffing, wear, abrasion, and chemicals; it measures 12½ by 8 3/16 by 4⅜ in., and sells for $27.95.

PARTRIDGE TRANSFORMERS

A four-page booklet describing the Partridge *P-5000 Series* of high-fidelity output transformers is available through



Partridge output transformer.

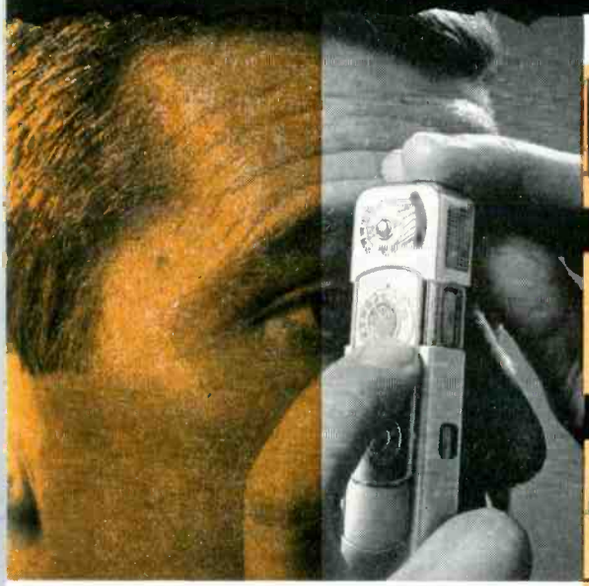
Swedgal Electronics, the U.S. distributor for Partridge products. Besides technical information, an interchangeability guide is included.

FOUR-TRACK STEREO PLAYBACK

Ampex Audio has announced availability of the *Universal A 900 Series* tape recorder and reproducer. The unit will record and playback monophonically, and will play two- and four-track stereo tapes. Two speeds of operation (3¾ and 7½) are provided. Ampex claims an unusually high standard of reproduction at the lower speed. A conversion is available to owners of "A" Series recorders so that they may use their present machines for playing the four-track tapes.

For more information about any of the products mentioned in Audionews, we suggest that you make use of the Product Information Cards bound in at the back of the magazine. Simply fill out the card, giving the name of the product in which you're interested, the manufacturer's name, and the page reference. Be sure to put down your name and address too. Send the cards to us and we'll send them along to the manufacturers. Make use of this special service; save postage and the trouble of making individual inquiries to a number of different addresses.

step UP your speaker system with ELECTRO-VOICE BUILDING-BLOCK KITS



first, choose an acoustically-perfect Electro-Voice factory-assembled enclosure or a do-it-yourself enclosure kit

E-V Coronet net $75.50

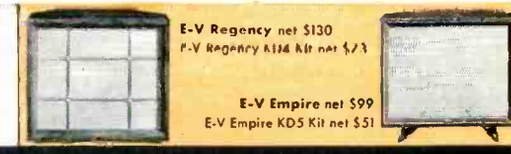
E-V Baronet net $45

E-V Baronet KD7 Kit net $26

E-V Aristocrat net $72

E-V Aristocrat KD6 Kit net $39

or its along-the-wall counterpart the new **E-V Marquis** net $63



E-V Regency net $130

E-V Regency KD4 Kit net $73

E-V Empire net $99

E-V Empire KD5 Kit net $51

second, choose an Electro-Voice full-range coaxial two-way speaker

SP8B net $29.50

SP12B net $35

SP12 net $66

SP15B net $43

SP15 net $89

STEP ONE add-on an Electro-Voice high-frequency Building-Block Kit for a separate two-way system

BB1 BUILDING-BLOCK KIT includes T35B Super-Sonax VHF Driver, X36 Crossover, AT37 Level Control, Wiring Harness. net $37

BB2 BUILDING BLOCK KIT includes T35 Super-Sonax VHF Driver, X36 Crossover, AT37 Level Control, Wiring Harness. net $50

BB1 BUILDING-BLOCK KIT net $37

BB2 BUILDING-BLOCK KIT net $50

or start with an Electro-Voice integrated three-way speaker (equivalent to coaxial plus high-frequency driver)

12TRXB net $66

12TRX net $125

15TRXB net $79

15TRX net $149

STEP TWO add-on an Electro-Voice mid-range Building-Block Kit for a separate three-way system, the ultimate in high fidelity reproduction

STEREO'S STANDARD

BB3 BUILDING-BLOCK KIT includes T10A Driver, RHD Horn, X825 Crossover, AT37 Level Control, Wiring Harness. . . . . net $86

BB4 BUILDING-BLOCK KIT includes T25A Driver, RHD Horn, X8 Crossover, AT37 Level Control, Wiring Harness. . . . net $114

BB3 BUILDING-BLOCK KIT includes T10A Driver, RHD Horn, X825 Crossover, AT37 Level Control, Wiring Harness. . . . net $86

BB4 BUILDING-BLOCK KIT includes T25A Driver, RHD Horn, X8 Crossover, AT37 Level Control, Wiring Harness. . . . net $114

Picture your speaker system with E-V Building-Block Kits.* You can start with a single, full-range Electro-Voice Loudspeaker and expand it step-by-step to a multi-way system as your budget permits.

Electro-Voice enclosures are ready for future addition of high-frequency and mid-range speakers. Your E-V enclosure can never be obsolete because there's *always* room to expand your system.

*E-V Building-Block Kits may also be used with some non-E-V quality systems. Ask your high fidelity specialist or write Electro-Voice for details.

Two ways to a Separate Three-Way System

1. Start with an Electro-Voice full-range coaxial speaker. Then, when your budget permits, add-on the correct E-V high-frequency Building-Block Kit to give you a *separate* two-way system; later add-on the E-V mid-range Building Block Kit for a superlative *separate* three-way system.

2. Or, begin your system with an E-V integrated 3-way speaker; merely add-on the E-V mid-range Building-Block Kit to achieve a *separate* three-way system.

Of course, you can purchase a *complete* three-way system composed of low-frequency driver, high-frequency driver BB Kit, and mid-range driver BB Kit.

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FOREMOST IN ELECTRO-ACOUSTICS—Microphones, Phono-Cartridges, High Fidelity Loudspeakers and Enclosures, Public Address Speakers, Marine Instruments, EVI Professional Electronic Instruments and Military Material.
ELECTRO-VOICE, INC., Buchanan, Michigan

Electro-Voice has the industry's most complete and versatile line of speakers, enclosures, and kits.
Ask your high fidelity dealer or write E-V for complete information on how to step-up your system.

Gentlemen:

I would like to take some exception to certain comments and assumptions made in Joel Ehrlich's comprehensive "Stereo-Cartridge Roundup" in the August issue.

It seems that the old question of record changers versus turntables is being thrashed around without too much regard to the facts involved. While it is certainly true that vertical rumble must now be taken into greater consideration, this consideration becomes applicable for *all* record-playing equipment whether it be record changers *or* turntables. There are just as many turntables that must be improved for stereo as record changers.

After these improvements are made, there is no valid reason why any of the cartridges shown in Mr. Ehrlich's article

could not be used in record changers with complete satisfaction and in accordance with the manufacturer's specifications. To take one example, the very fine ESL cartridge is shown as not recommended for changers. After reading the article, I requested Mr. John McConnell, vice president of ESL, and Mr. Herb Horowitz, chief engineer of ESL, to take one of our Collaro stereo changers and let us know exactly what specifications were not being met as far as the correct operation of their cartridge was concerned. They checked the changer with their Gyro-Jewel stereo cartridge for rumble, signal-to-noise, arm tracking, and tripping. All requirements were met well within ESL's specifications.

To sum up, we feel that the arbitrary

Continued on page 44

EDITORIAL

Hi-Fi at Brussels--Audio Shows--An Anniversary

ONE complaint voiced quite often about the American exhibition at the Brussels World Fair concerns the shoddy treatment given high-fidelity equipment. There is quite a lot of space devoted to ready-to-hear "hi fi's," but the few genuine high-quality components have been incorporated into such exhibits as the fashion ramp, the modern kitchen, and so on.

Readers of this magazine, in particular, will be glad to know that something has been done about it. A group of dedicated hi-fiers persuaded the State Department to let it use the 1,100-seat theatre, attached to the American Pavilion, for demonstrations of component high fidelity. Involved in this project were both amateur and professional enthusiasts: Donald B. Davis, whose primary affiliation has been with the Christian Science Church, and his wife, Carolyn P. Davis; George Petry, Jr.; and William H. Bell, proprietor of The Music Box in Wellesley, Massachusetts. They secured the co-operation also of several component manufacturers and of Sabena Airlines, which scheduled a special DC-7 flight to cart approximately a ton of equipment to Brussels for them.

The equipment was chosen, they emphasize, to be *representative* of the best American hi-fi components. It consisted of Ampex tape machines, Fairchild turntables, arms, and cartridges, Klipsch speaker systems and special microphones, Marantz amplifiers and preamp-control units, and H. H. Scott tuners. Irish raw tape, and Mercury recorded tapes and records, were used. With this impressive complement they could have live recording and playback demonstrations, and play both monophonic and stereo discs and recorded tapes. As this was written they were hoping to arrange stereo broadcasts with some European stations.

They were promised the American Theatre for a week beginning August 26, with an extension if attendance at the exhibit was satisfactory. When we last spoke to Messrs. Davis and Bell they were confident that interest would be sufficient to warrant an extension. So are we. There are tentative plans for the Institute of High Fidelity Manufacturers to sponsor an exhibit of this equipment at the New York High Fidelity Music Show, September 30 through October 4 at the New York Trade Show Building, provided it is successful in Brussels.

It should be mentioned that no one is actually sponsoring this group in its sojourn in Brussels. The members are going it on their own simply because they believe our high-fidelity industry should be more adequately represented to the world than it has been at the American exhibition. They deserve our support and heartfelt thanks, and our best wishes for an SRO success.

SPEAKING of audio shows, there have been some changes since the list was published in our August issue. *New dates and/or places* are in effect for the following shows:

St. Louis, Missouri, October 17-19, Ambassador Kingsway Hotel.

Indianapolis, Indiana, October 31-November 2, Hotel Antlers.

Minneapolis, Minnesota, January 16-18, Leamington Hotel.

The following shows should be *added* to the list:

Kansas City, Missouri, October 24-26, Bellerive Hotel.

Columbus, Ohio, October 31-November 2, Neil House.

Cleveland, Ohio, November 14-16, Hotel Carter.

WITH this issue AUDIOCRAFT will have reached the end of its third year of publication. We don't intend to blow any bugles on this occasion. Instead, we'll let the editorial progress we've made since the first issue speak for itself, and simply point out that several of our innovations have been given that most sincere form of flattery: superficial imitation in other magazines. We hope that before long we'll be able to make AUDIOCRAFT *bigger* (that depends on advertising), and certainly we will continue our efforts to make it even better. To the latter end we have several possibilities under consideration; the only thing we can say right now is that you'll hear about them soon. And finally, we'd like to give thanks and proper credit to those who have really shaped the magazine as it is now: you, the readers.

—R.A.

How compatible are

Part II: Wear on stereo cartridges and discs

WHEN LP's were first introduced, questions were asked immediately about the life expectancy of the new records, the life expectancy of the microgroove stylus, and how to improve both. Now the same questions are being asked about stereo records and pickups. This article was undertaken to find the answer on a practical level.

Before going into detail, however, I would like to point out that there are currently some experiments being conducted to find better materials for records. One of these materials, interestingly enough, is less expensive than vinyl; it is harder than vinyl, tougher than a plate of steel of equal thickness, and has a smoother and better-lubricated surface than any record material thus far used. In fact, it "rings" in a manner similar to fine steel when dropped on end. But this is still experimental and, if it should be used in this industry, it will not be for the next four or five years. It is simply something to look forward to.

When I first started to prepare this article and the one which preceded it, I asked a good many people what their experience had been with stereo records. I was surprised to hear a number of complaints that cartridges gouged the record grooves. Some attributed this to the stereo records; most, however, blamed the cartridges. I had several cartridges on hand, and none had ever shown such an unfortunate tendency. One popular magnetic stereo cartridge was cited often for this offense, and it happened to be of a make I liked particularly well. To make sure I had not gotten a good one inadvertently, I tried five others; four were perfect, but one gouged records. As a record was played, the grooves were seen to be grey behind the stylus — clearly, badly damaged.

I now had six of these cartridges, only one of which was bad. Why was it bad? What caused the damage? I examined the cartridge carefully and found that the cantilever (the metal strut upon which the stylus is mounted, sometimes called the shank) was not aligned properly. In other words, the cantilever was twisted, causing the stylus to bear against one wall of the record groove. But this should cause only severe distortion, not groove damage. Upon further examination the cantilever was seen also to have a back angle, which would tend to make the stylus dig into the vinyl groove wall.

Obviously, if the stylus had been in this condition at the factory, it never would have passed final inspection. It must have been damaged in shipment. Now, was this a trouble that would occur only in this cartridge? I examined my other cartridges and found nothing wrong with any of them. But I had found nothing wrong with my first sample of this one either. A call to Capitol Records (which had been cooperating with me in the preparation of these articles) informed me that the same difficulty had been found with a widely used piezoelectric stereo cartridge — the same cartridge that one cutter manufacturer uses in development work because of its high quality!

I checked my sample of this cartridge again, and it was perfectly all right. Then I bought eight more; of these, three were defective, causing the same type of record damage as the defective magnetic. A few days later a friend brought me a different type of cartridge with the same kind of defect, and then I received a cartridge of still another type in similar condition. Undoubtedly, this could happen to any cartridge. The questions remaining were how could it be spotted, how could it be cured, and how could it be prevented?

Stereo cartridges are somewhat more fragile than their conventional monophonic counterparts. The stylus has to drive two channels, and, in the attempt to keep moving mass comparable to that in a monophonic unit, much of the metal on the cantilever has been removed. In part, this is the reason the trouble occurs so easily. However, exercising a good deal of care and caution, I found the stylus shank could be bent into proper shape in all cases. Except for the Sonotone, on all the cartridges I tested the styli should be vertical when properly positioned. On the Sonotone it should have a small back angle; this is illustrated in the installation sheet. The cartridges I tested were the Shure Professional Stereo Dynetic, Audiogersh Stereotwin, ESL Gyro Jewel, Pickering Stanton 45/45 Stereo Fluxvalve, Sonotone 8T, Electro-Voice 21-D, and Ronette Binofluid. Again, on all these cartridges except the Sonotone 8T, the stylus should be perpendicular to the record from all angles.

Now let's turn to the question of wear on stereo records incidental to normal

Exhaustive life tests on stereo discs and cartridges have unearthed revealing guides to longer wear which every record listener should read.

STEREO DISCS ?

by JOEL EHRLICH

use. That is, of course, one of the main subjects of this series of tests.

Using cartridge manufacturer's recommended stylus force, I found that most stereo records had a useful life, in a package "hi fi," of well over 250 plays. Since all these packages incorporated changers, I thought that this figure could be improved on. But before looking into that, I ran a series of tests using record changers (the same types as were in the packages, as well as others) and, to my surprise, found that 50 plays were gained before the noise became severe. The only difference was that the changers were mounted outside the cabinets. The decreased record life was attributed to feedback from the speaker to the changer, causing stylus motion with relation to the disc, and resultant extra wear.

With the same changers and cartridges, records of the same type had a useful life of some 150 plays on a component amplifier-speaker system. Evidently the better high-frequency response of the component system and the lower distortion of the reproduction decrease listeners' ability to tolerate record wear. These figures were improved only slightly when the tests were repeated with turntables and high-quality tone arms. Similarly, there was little difference in results between cartridges — including the crystal and ceramic types. Incidently, there were no "typical" differences observed in sound quality between the magnetic and crystal/ceramic types.

In an effort to determine whether or not record life could be extended even more (it should be noted that 150 plays is a pretty good record life in anyone's book), I decided to check the various record-cleaning devices and preparations on the market. Best results were obtained with radioactive materials. One way of utilizing this technique is to build a radioactive foil into the body of the cartridge. This requires that the stylus be brushed clean after each playing. Note that I said *brushed* clean after each play, not *rubbed* clean — these are delicate stylus assemblies.

The dust gathers around the stylus tip in a ball. A very dirty record will have enough dust on it to cause the stylus to lift from the surface of the record before the end of the disc. Nuclear Products Company markets the Static-Master Positioner and Ionizing Unit which accomplishes essentially the same thing as the foil on the cartridge: it holds a foil strip over the disc while it plays. This system has two disadvantages: the stylus should be brushed after each play, and it cannot be used on a record changer. Nuclear Products also has a Static-Master Brush which is used prior to playing the record. It works well, and the stylus need not be cleaned after each play.

Mercury Scientific Products has the Dis-Charger, a foil in a plastic casing which clips to the cartridge shell. This works with record changers but, again, the stylus should be cleaned after each record.

With the radioactive disc cleaning method, however, the average life of stereo records was *doubled*! An unprotected disc lasted up to 150 plays before the surface noise became objectionable; with radioactive cleaning, it lasted 300 or more plays.

Some chemical destaticizing solutions (not all) left a residue in the groove which was later picked up by the stylus. This created distortion and groove hopping. In addition, there was no noticeable surface-life improvement. While these chemicals reduced the static charge and the gooey residue held the dust, later helping the stylus to pick it up, the grinding action of the pastelike, dust-filled ball on the stylus seemed to negate the benefits of static elemination and dust pickup. The soaplike washing processes were more beneficial but not too convenient. Incidentally, washing the records with hand or bath soap was quite effective in removing finger marks, spills, and chemical residue from the chemical methods of cleaning. But it had no antistatic effect.

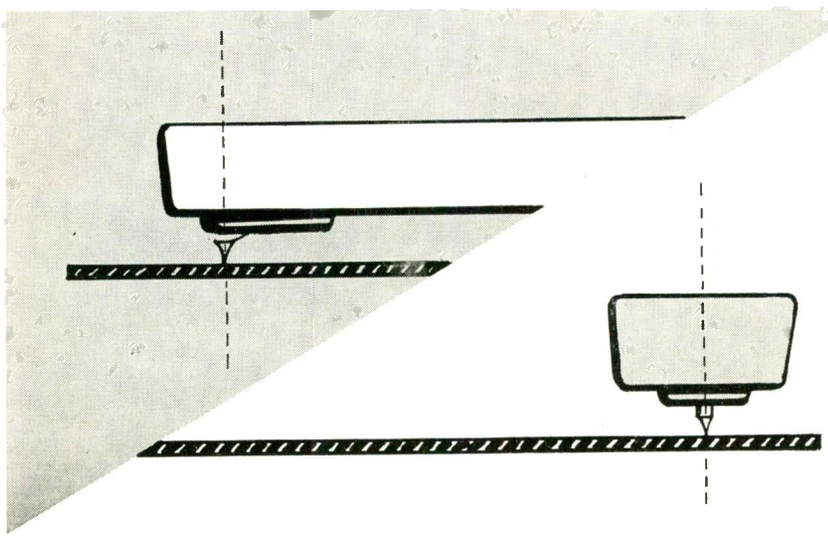
The ESL Dust-Bug was quite effective also. It leaves very little residue to be picked up by the stylus. Cleaning the stylus after each play with a stiff brush keeps it clean. The bristles of the Dust-Bug lead brush are quite effective in removing dust particles in the groove, and they are trapped by the plush pad.

I found that stylus force was a bit more critical with the stereo cartridges. Stylus forces greater than necessary cause some added vertical distortion as well as reduced disc life. Too little force causes stylus chatter in the groove, groove skipping, and increased sensitivity to turntable vibrations. In addition, distortion is higher than it is with proper stylus force. Moral: get a stylus-force gauge and use it regularly.

Stylus-wear characteristics are slightly different on stereo discs, since the stylus

Continued on page 40

Most stereo-cartridge styli should be vertical to record surface, viewed any way.



BATTLES IN PRINT about amplifier power requirements may be amusing, but they have left a good many people confused. There are so many factors that enter into an answer for any specific case that generalizations are not only foolish but misleading (see "Editorial," Nov. 1957 issue, p. 15); the only thing that can be said safely is that there are as many applications for super-quality amplifiers of moderate maximum power as for high-power units of equivalent quality, and perhaps more. Since the former are less expensive to build, why not use one if it is adequate for your needs?

The amplifier described in this article is virtually distortionless up to 10 watts output. It has excellent transient response and stability, wide frequency range, and a simple circuit. Total cost for parts is less than $45. This sum buys you performance differing from that of the best amplifiers you can buy only in the matter of maximum power limits.

The Circuit

A 12AX7 triode section is used as the input voltage amplifier, direct-coupled to the second triode section in a split-load phase inverter. The advantages of direct-coupling to the phase inverter (elimination of one low-frequency rolloff network, and consequent simplification of feedback problems) are very well known, and need not be enlarged on here.

The phase inverter drives a pair of EL84 output tubes directly; connected as pentodes, the EL84's have very good linearity and high enough power sensitivity to make additional drive amplification unnecessary. A Dynaco

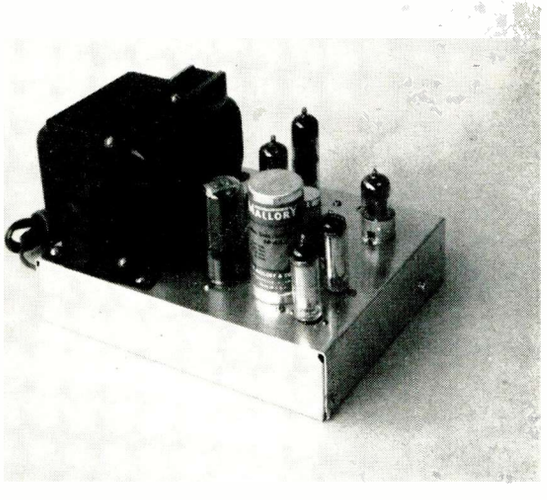


Fig. 1. The 10-watt super-fi amplifier is built on a 7 by 9 by 2-inch chassis base. Both transformers are at far end.

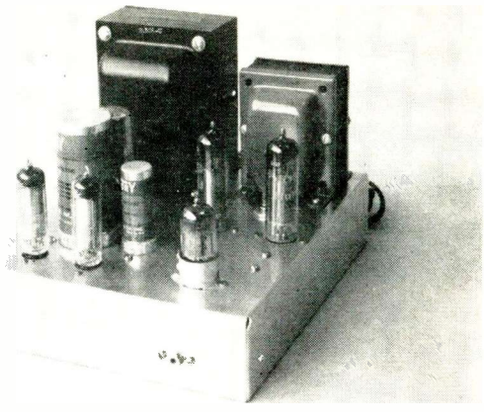


Fig. 2. Power supply components as viewed here are on the left side. The voltage-regulator tubes are closest to front.

A-410 output transformer is used. Others that would be suitable (with, possibly, a different value of feedback capacitor) include the Acrosound TO-310, the Partridge P-5202, the Peerless S-510-F, and the UTC LS-54. DC balance for the output stage is adjustable by means of a 50-ohm potentiometer in the cathode circuit. Cathode bias — simplest, most reliable, and perfectly satisfactory in this instance — is employed, with bypass capacitors.

A most unusual feature of this amplifier is the superb high-voltage regulation, obtained by using two OA2 regulator tubes in series across the output of the power supply. This provides a regulated 150 v for the plate of the input amplifier stage, and a constant 300 v for the output-stage screen circuit. The amplifier's stability is improved considerably by the voltage regulation, and so is its linearity at power-output levels near maximum. The 5Y3GT rectifier works comfortably under its maximum rating in this amplifier; the power transformer, rated at 150 ma, is called on to supply only a little over 90 ma. There is plenty of reserve to furnish power to a preamplifier, if the builder wants to add an output power receptacle.

Construction Notes

Wiring of the amplifier is not critical. The following suggestions, however, may be of benefit.

Use of a bus bar, grounded only at the input jack, is recommended although not essential. To prepare the bus, straighten an 18-inch piece of No. 12 bare copper wire and tin it. One end of a 9-inch piece should be soldered to a lug slipped under one of the input-jack mounting screws. It should be bent to pass over the center of the 12AX7 and the EL84 socket nearest the center of the chassis. The other end should be soldered to the speaker-terminal-board lug in line with the EL84 (the ground

If you're 'going stereo' and need a topnotch second amplifier, or if your demand is simply for high quality at low power, you'll be interested in building

A Super-Fi

lug). It should be spaced about ½ in. above the tube pins. A support for the center of the bus is made by soldering a 1-inch piece in the center terminal of each EL84 socket, after bending the top ½ in. of each at right angles to provide a place for a soldered connection. The remaining 7 in. of bus wire is soldered to the first bus midway between the 12AX7 and first EL84, and passes over and is soldered to the center terminal support of the other EL84 socket.

The unused leads from the output transformer are placed out of the way, after the bare ends are clipped off. Tape should cover the ends of the leads, to prevent a possible short, or they may be soldered to unused terminal tie points.

There is no hum-balancing potentiometer for the filament voltage, so wiring of the heaters should be done carefully. Twist the leads tightly together, and keep them close to the chassis and away from the tube grid pins.

The four-section electrolytic capacitor should be mounted on an insulating wafer and the can grounded to the bus bar.

The 2,500-ohm, 4-watt resistor is a current-limiting resistor for the voltage-regulator tubes. It's value was calculated for a 117-volt AC line voltage; if the voltage available is much lower than 117, it may be necessary to reduce the resistor value in order to keep the regulator tubes burning a pleasant purple. The reverse is true if the input voltage is much higher than 117. A milliameter connected between pin 2 of the 5Y3 and the end of the resistor (disconnected of course, from pin 2) should read between 25 and 32 ma when the resistance value is correct.

A 500-K audio-taper potentiometer may be used if an input level control is desired. It should be installed where the input jack is now positioned, and the jack moved about 1½ in. toward the center of the chassis.

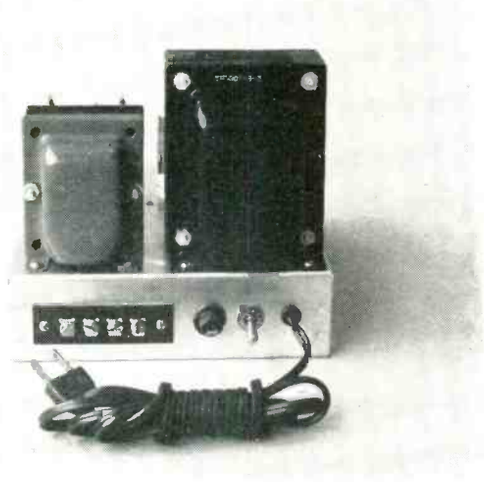


Fig. 3. Rear view, showing layout of the output terminals, fuse, switch, and line cord. Compare with pictorial, p. 23.

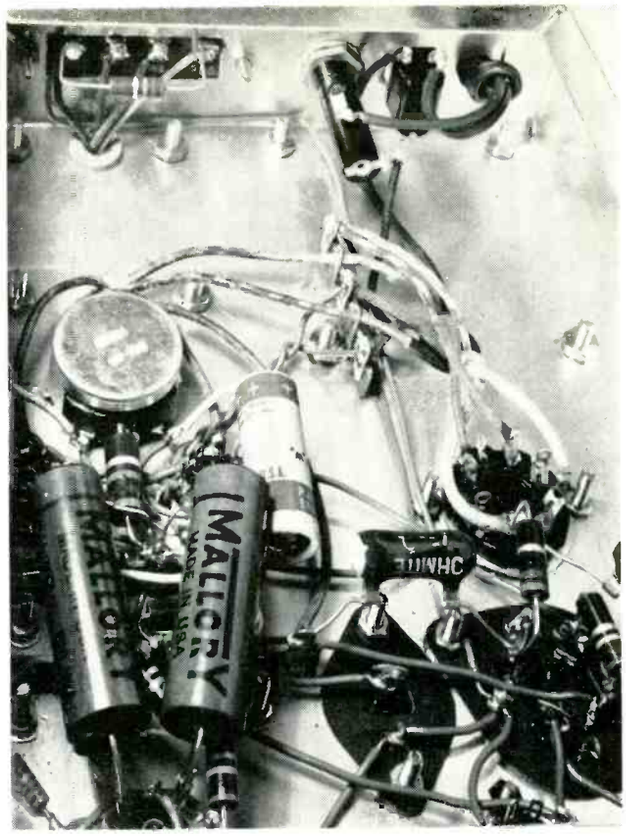


Fig. 4. Bottom view. Parts are identified on the next page.

The 50-ohm potentiometer should be adjusted for lowest intermodulation or, if a distortion meter is not available, for equal DC current through the two EL84's.

Following is a table of voltages (DC with respect to the chassis) measured when the amplifier is operating properly. Those on the 12AX7 may be expected to vary widely; ±20% difference would not be abnormal. NC means no connection; AC means filament voltage.

Voltage Chart

	1	2	3	4	5	6	7	8	9
12AX7	70	0	1	AC	AC	200	70	71	AC
EL84's	NC	NC	11	AC	AC	NC	350	NC	300

Parts List

Resistors

1 18-K, ½-w, 10%.
3 470-K, ½-w, 10%.
1 3.9-K, ½-w, 10%.
1 270-K, 1-w, 10%.
2 150-K, 1-w, 10%.
1 15-K, 1-w, 10%.
1 50-ohm, 4-watt linear pot.
1 68-K, 1-w, 10%.
1 1-K, 1-w, 10%.
1 120-ohm, 1-w, 10%.
1 150-ohm, 2-w, 10%.
1 2.5-K, 4-w, 10%.
1 750-ohm, 4-w, 10%.

by Arthur I. Zabriskie

10 WATTER

Miscellaneous

1 SPST toggle switch.
1 fuse holder and 2-ampere fuse.
1 phono input jack.
2 7-pin miniature tube sockets.
1 octal tube socket.
2 9-pin miniature tube sockets.
1 9-pin miniature tube socket, with shield.
1 7×9×2-inch aluminum chassis base.
1 power cord with plug.
1 4-terminal output-terminal board.
Screws and nuts, tie-point terminal strips, wire, solder, etc.

Capacitors

1 180-$\mu\mu$fd ceramic disc.
2 0.1-μfd, 600-v paper.
1 10-μfd, 450-v electrolytic.
2 50-μfd, 25-v electrolytic.
1 20/20/20/20-μfd, 450-v electrolytic.

Transformers, Tubes

Output transformer, Dyna A-410 or equiv.
Power transformer, Thordarson 24RO6U or equiv.
1 12AX7 or ECC83.
2 EL84's.
1 5Y3GT.
2 OA2's.

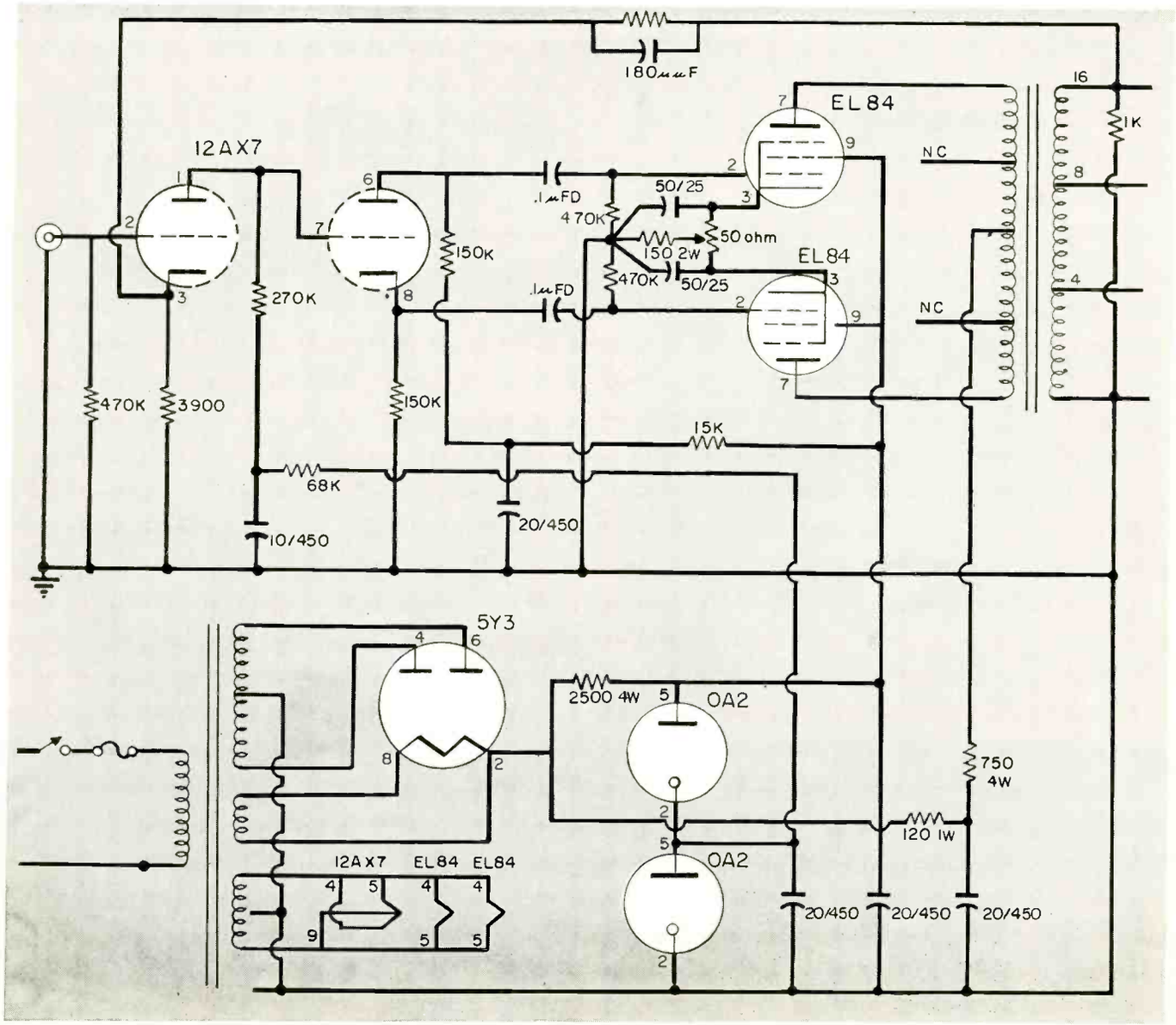
AUDIOCRAFT Test Results

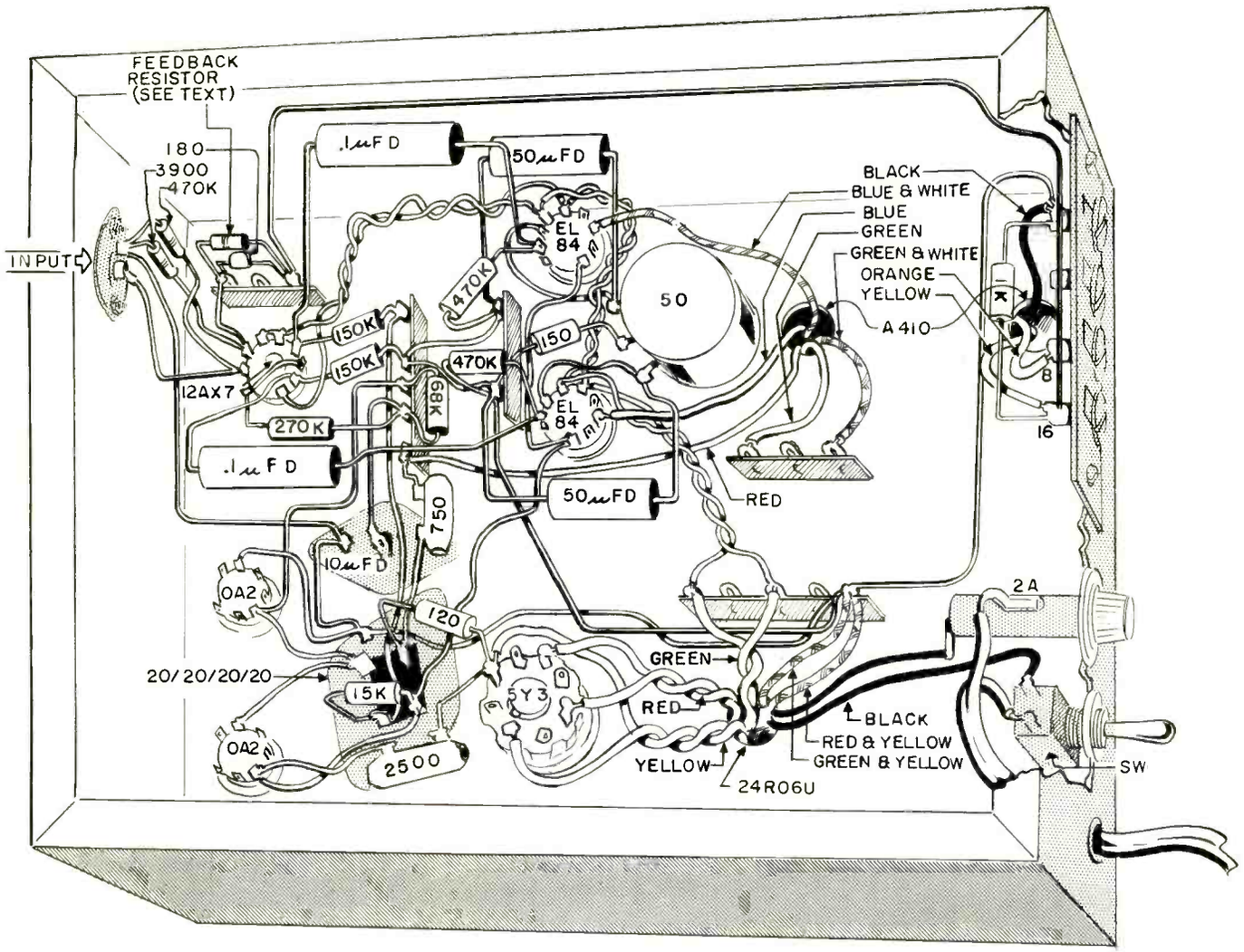
Our version of Mr. Zabriskie's amplifier is pictured in the illustrations for this article, and in the pictorial wiring diagram. We departed slightly from the original in a few places wherein it was determined by experiment that the changes would be for the better. The schematic diagram shown herewith incorporates our modifications. Our ground bus, for example, consisted simply of a wired circuit between selected terminal tie points, and connected to the chassis at only one place; see the pictorial diagram. Some resistor values were optimized also.

The most significant change, however, was in the feedback-resistor value. Originally 33 K was specified. This gave a sensitivity of 1.5 v input for 10 w output, but supplied only 16 db of over-all feedback. We found that the feedback could be increased to 30 db (on a resistive load) before oscillation began. Decreasing the value of the feedback resistor to 18 K provided what seemed to be an optimal compromise: feedback of 20 db, sensitivity of 2.5 v (which most preamps can deliver without strain), and an increase in damping factor. Further, it leaves a stability safety margin of 10 db, which is more than adequate.

If you need greater sensitivity you can increase the feedback resistor to 27 K. That produces feedback of 18 db, and 1.9 v input will drive the amplifier to 10 w output. Or, if you prefer, you can get 25 db of feedback with an 8.2-K resistor; then you'll need to put in 4.2 v to get 10 w out. The amplifier will remain stable.

Schematic diagram of the super-fi 10-watter. The feedback resistor, nearest top of drawing, is discussed in the text.





Small-parts layout and wiring. Not shown is a four-ohm output connection, simply because the Dynaco A-410 does not have one.

The more feedback you use, obviously, the lower will be the distortion in the operating range, and the less sensitive the amplifier will be. But don't try to go over 25 db or you may run into stability problems. To help you make your own choice, we have plotted IM-distortion curves for feedback which results in 2-volt and 4-volt sensitivity; these values correspond closely to feedback resistors of 27 K (18 db) and 8.2 K (25 db), respectively. In Fig. 5, for either value the distortion is below 0.1% up to 2 w, and below 0.7% at 10 w. Distortion reaches 2% at 12 w in the first case and at 14.5 w in the second. For feedback of 20 db (an 18-K resistor, specified in the parts list), the distortion curve would be intermediate between the two shown. Other tests were conducted with the 18-K value.

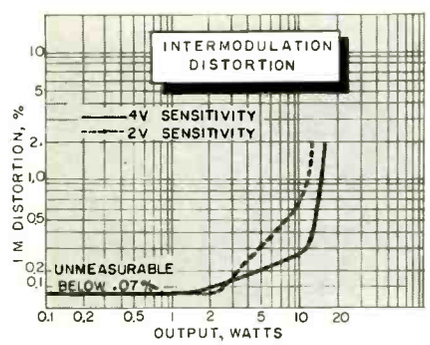
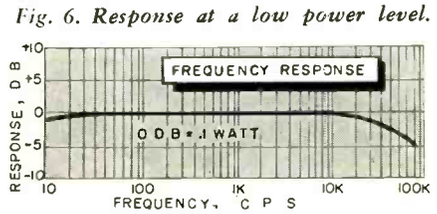


Fig. 5. IM for two feedback values.

Frequency response is shown in Fig. 6. Response is down less than 1 db at 10 cps and 30 Kc; it is down 2.5 db at 50 Kc, and 5 db at 80 Kc. This curve was taken at a low power level, of course. Note that the rolloff is smooth and peak-free, which confirms the excellent stability of this amplifier. At low frequencies stability is, as far as pulse tests can determine, perfect. High-frequency square waves show virtually no ringing, yet have sharp corners and flat tops.

Maximum continuous sine-wave power output before clipping, at various frequencies, is diagramed in Fig. 7. Over most of the range this occurs at 11 w; at 20 cps and 20 Kc, maximum output is slightly over 10 w.

Fig. 6. Response at a low power level.



With reasonably efficient speaker systems this amplifier sounds as good as its very low distortion and excellent stability would imply, at any tolerable sound level. It is just as satisfactory for speaker systems of moderate efficiency in listening rooms not excessively large. If you have a setup like one of these, and are construction-minded with an eye toward maximum value, we don't see how you can go wrong on this one. Another thought: one or two of these amplifiers could fit very well into a stereo system.

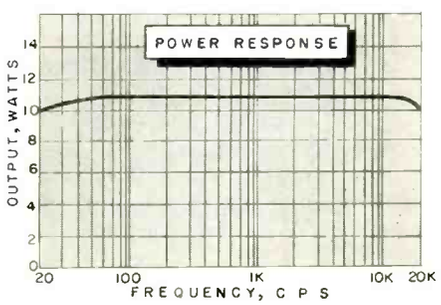


Fig. 7. The power curve is excellent.

Save your batteries and use this

POWER SUPPLY FOR TRANSISTORS

by HAROLD REED

WITH the price of power transistors decreasing to a value within the reach of electronic experimenters, there will, naturally, be increasing use of circuits employing these units.

Probably the greatest problem confronting the experimenter with power transistors, other than good stabilization and heat radiation, is a satisfactory, well-regulated, low-ripple DC power source operating from the 115-volt AC power line. The necessary voltages for power-transistor circuits are quite different from those we are used to working with.

Using electron tubes in a power amplifier we are accustomed to circuits requiring high DC voltages and relatively low currents; for transistor power amplifiers, we need low DC-supply potentials and relatively high currents. Good regulation and filtering of power supplies for transistor power amplifiers, therefore, present a problem.

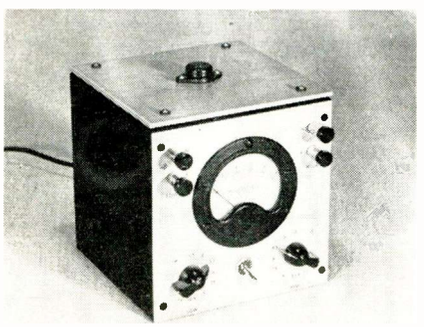


Fig. 1. Power supply, showing heat sink.

Filtering of power supplies for tube circuits can be done simply with capacitor-choke networks, and regulation is provided by electronic voltage regulators or voltage-regulator tubes. But the voltage drop across a satisfactory RC filter network passing the high current required for a power-transistor circuit would be quite large, and a choke coil capable of handling these large current values would necessarily be of an impractical size.

Pure DC from a battery overcomes these problems. An AC-operated power supply provides greater portability in certain experimental projects, however, and it can be included as part of a complete power-amplifier device. Battery-replacement costs are far from negligible when the current drain is high. A schematic diagram for a transistor power supply is given in Fig. 1. In the high-current section, the 115-volt AC supply is stepped down to 25 v by transformer T1. This is applied to the selenium-rectifier bridge circuit. The bridge arrangement provides full-wave rectification and is suitable for relatively high-power applications. Both halves of the AC input cycle are used, and efficiencies up to 75% can be obtained. With this circuit, filtering is simplified because the ripple frequency is twice that of the AC-supply frequency. Two large low-voltage capacitors, C1 and C2, are included at the rectifier output and the power-supply output, respectively.

Series regulation is obtained by employing a CBS-Hytron 2N256 power transistor in the negative branch of the circuit. The output voltage is determined by a DC reference voltage provided by a battery, B1, connected in the base leg of the transistor circuit. This battery supply actually consists of eight 1½-volt flashlight batteries connected in series. Regulated output voltages from 1½ to 12 v, in 1½-volt steps, are supplied. These reference voltages are selected by means of the tapped switch, S3.

The low-current section of the power supply, which is suitable for powering input and intermediate stages of transistor amplifiers, makes use of the same batteries that are employed for the reference voltages for the high-current section. Voltages in 1½-volt steps from 1½ to 12 v are, therefore, also available in the low-current output circuit, and the potentials are selected by switch S2. This arrangement results in a DC power supply suitable for operating a complete transistor amplifier with power input up to 6 w.

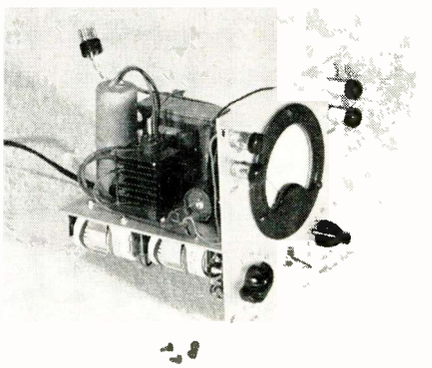


Fig. 2. Arrangement of parts in the box.

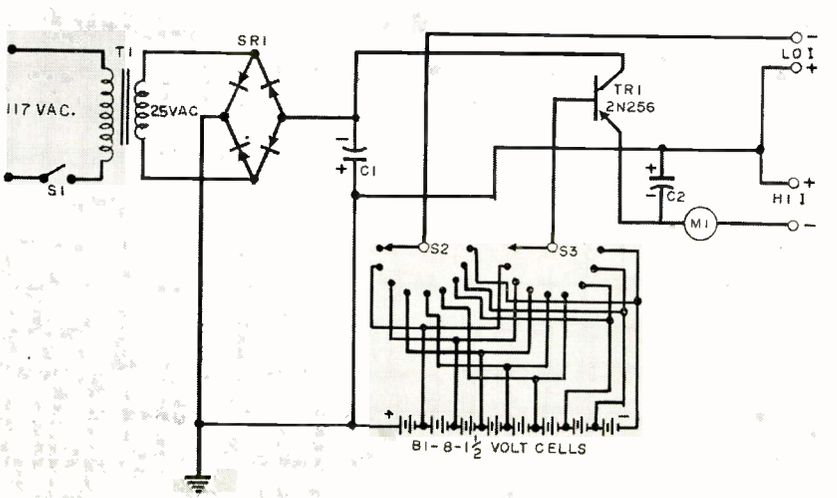
Parts List

1 SPST toggle switch.

1 transformer, Stancor P-6469, 115-volt AC to 25.2 volt, 1 amp.

1 bridge-type selenium rectifier, Radio Receptor S1B1S1G, 19 v DC, 1.4 amp.

Fig. 3. Circuit of the transistor power supply. The high-current meter is optional.



2 capacitors, Cornell-Dubilier, 500 μfd, 50 v.
2 rotary switches, Mallory No. 32112J, 1-pole, 12-position.
1 transistor, CBS-Hytron 2N256.
1 battery, flashlight or mercury-cell (see text).
1 meter, 0-500 ma DC.
1 miniature 7-pin tube socket.
1 metal cabinet, 6 × 6 × 6 in.
Battery holders, Lafayette Radio MS-173.
Output terminals.

Construction

The power supply shown was built into a 6-by-6-by-6-inch metal cabinet. This just happened to be on hand, but any suitable cabinet can be used. The two selector switches, the 500-milliampere meter, the output terminals, and the power switch are attached to the etched-aluminum front panel. Battery holders are employed for the batteries and are mounted under the 4⅞-by-5⅞-inch shelf which is attached to the front panel. The battery holders also provide solder terminals for battery connection. The transformer, selenium rectifier, and capacitors are mounted on top of the shelf. Decals identify the output terminals and the voltages obtained at the various switch positions.

A heat sink, to furnish heat radiation for the transistor, is mounted on top of the cabinet. It consists of a 6-by-6-by-⅛-inch piece of aluminum insulated from the cabinet top with fiber spacing washers; fiber shoulder washers are used under the 4-40 mounting screws. A 7-pin miniature tube socket is attached to the bottom of the aluminum plate with 4-40 screws into tapped holes in the plate. Two ¼-inch holes are then drilled through the plate, directly above contacts 1 and 5 of the socket, to pass the transistor base and emitter pins for plugging into the socket. A solder lug under one of the tube-socket mounting screws is the connection to the heat sink and, of course, the collector which is connected internally to the transistor case. A 1¼-inch hole was cut in the top of the cabinet to allow passage of the tube socket.

Test Results

The following data were recorded when using the device to power a load drawing 0.5 amps with a reference voltage of 12 volts: collector current, 500 ma; base current, 14 ma; no-load output voltage, 12 v; full-load output voltage, 11.4 v. This represents a power output of 5.7 w. Regulation under these conditions is about 5%, and the ripple at this output is 0.17%. Operating temperature on the top surface of the transistor case increased to a maximum of 60° C. This is 6° below maximum rating when using a heat sink.

With a reference voltage of 6 v, and

Continued on page 46

Ralph Bellamy, starring in "Sunrise At Campobello", listens to stereo on his Collaro changer and Goodmans Triaxonal Speaker System.

Collaro—your silent partner for Stereo

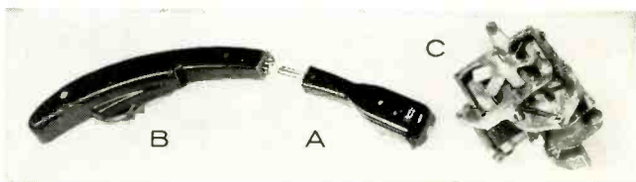
Stereo records are here. And once you listen you'll discover there's no more exciting way of listening to music. But the new stereo cartridges are unusually sensitive to turntable and changer noise. *Silence* is the requirement and silent performance is what you get when you select Collaro — the one four-speed changer truly precision-engineered to meet the rigid quality demands of stereo. Here are some outstanding Collaro features:

A. Five-terminal plug-in head. (Exclusive with Collaro.) By providing two completely independent circuits, the new five-terminal head guarantees the ultimate in noise-reduction circuitry — a vital need for stereo reproduction.

B. Counter-balanced, transcription-type tone arm. Another Collaro exclusive. Stereo cartridges require light tracking pressures. As records pile up on a changer, tracking pressure of a conventional arm tends to increase. Result may be damage to records or cartridge. This *cannot happen with the Collaro counter-balanced arm* since it varies less than a gram in pressure between the top and bottom of a stack of records. The arm will accept any standard stereo or monaural cartridge and it has no spurious resonances.

C. Motor. Dynamically balanced and so rigidly mounted that wow and flutter specifications are superior to any changer in the world. (.25% at 33⅓ RPM)

There are many other features which make Collaro your best buy in a stereo or monaural record changer. All are described in a free catalog. (See below.) There are three Collaro changers priced from $38.50 to $49.50.



For full information on Collaro stereo and monaural changers — write to Rockbar Corporation, Dept. AC-10, Mamaroneck, N. Y.

ROCKBAR Corporation

American Sales Representative for Collaro, Ltd.

Prepared by Hirsch-Houck Laboratories

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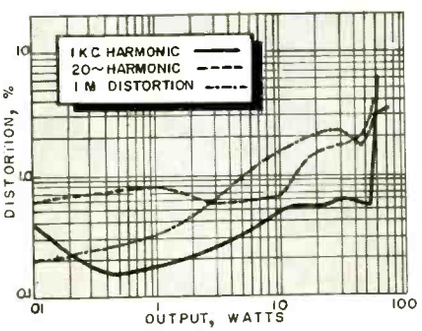
PERI-50 AMPLIFIER

The PERI-50 amplifier is a 50-watt unit, with a Dynaco output transformer and a circuit essentially the same as that of the popular Dynakit Mark II amplifier. All components, including the transformers, are mounted on a single large printed-circuit board. This in turn is mounted on a shallow metal chassis, equipped with a bottom plate and a perforated metal cover.

The PERI-50 is available in kit form for $69.75, or ready-built, and tested, for $79.95. To facilitate the already simple job of construction, the kit version is supplied with a pencil-type soldering iron and solder. The correct location of each part is indicated directly on the printed-circuit board, making this perhaps the most nearly foolproof kit we have seen. No hookup wire is used — all parts are mounted by their own leads, and the only cutting and stripping of wires is on the transformer leads.



Test Results

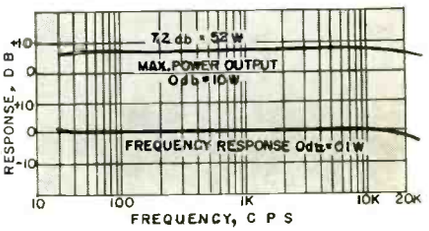
The distortion figures we obtained, though low, were considerably higher than those given in the PERI specifications. The amplifier is rated at less than 1% IM at 50 w and 0.25% at 35 w output. At those output levels we measured about 2% IM, and it did not fall below 1% until the 6-watt level. However, at the low power levels usually encountered in home use, the distortion was quite negligible. The square-wave response at both low and high frequencies was exceptionally clean and free from ringing. The amplifier was stable with capacitive loads and would deliver 28 w at 10 Kc into a 3-μfd capacitor load. In other words, this amplifier is well suited for driving both low-efficiency speakers and electrostatic speakers. Damping factor is 9.

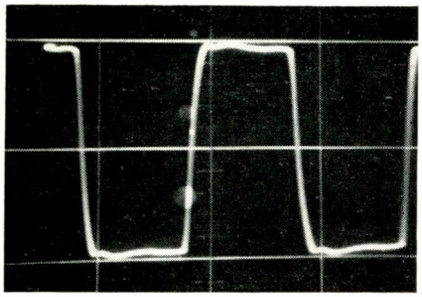
PERI-50 amplifier, out of its cage.

The output of the PERI-50 was slightly over 50 w and it would deliver the full power over the entire audio range. The tubes are operated conservatively, and, since the amplifier is relatively large, there should not be any trouble with excessive heating if adequate ventilation is provided. The filter capacitors operate at 93% of their rated voltage. Power-line leakage is only 10 μa.

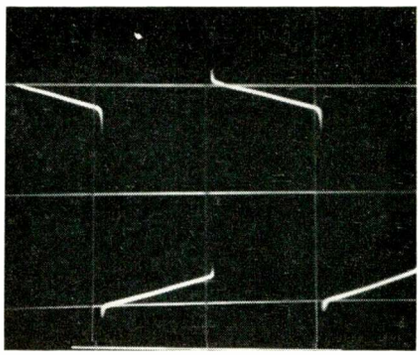
The manufacturer's data states that a 0.75-volt input signal will drive it to 50 w and 1 v will drive it to 100 w output. We found its sensitivity to be slightly lower than rated. About 1 v was needed for 50 w output, or 0.45 v for a 10-watt output. We cannot understand the claim of 1 v input driving the amplifier to 100 w output, since it cannot deliver 100 w, even by the manufacturer's specifications. Hum and noise were 72 db below 10 w, which is quite inaudible in a home environment.

The PERI-50 has a fuse in the cathode circuit of the EL34 output tubes, which is a fine idea; a fuse in this circuit will offer more positive protection against a tube "run-away" than the usual line fuse. It also has a 12-ohm resistor in series with the fuse, for setting the bias voltage correctly. According to the instructions, the bias should be set for a drop of 1.56 v across the cathode resistor, which corresponds to a current of 65 ma per tube. Unfortunately, the fuse is connected between the 12-ohm resistor and ground, so the drop across the fuse is included in the reading. This is far from negligible. When the total drop is 1.56 v, there is

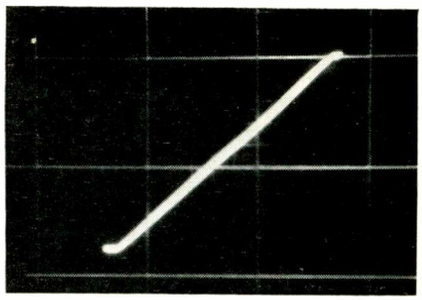




10-Kc square-wave response.



60-cps square-wave response.



Clean overload at 1 Kc.

0.6 v across the fuse and 0.96 v across the 12-ohm resistor. The EL34 tubes are drawing 40 ma apiece instead of 65 ma. It is doubtful if this will cause any obvious deterioration of sound, and it is an error in the direction of improved tube life, but it most likely reduces the available power output considerably. It may well be the cause of the higher distortion figures we obtained. However, the printed board is connected this way, and the amplifier will no doubt be so wired by anyone building it. We would suggest interchanging the positions of the fuse and the 12-ohm resistor, which should be feasible even with the printed board. Another criticism is that the 12-ohm resistor has a 10% tolerance. This is too high for such an important function as setting the operating bias of the output tubes. A 1% resistor would be desirable in this circuit.

Summary

The PERI-50 is a good-quality power amplifier at an attractive price. As a kit it is priced comparably to other similar types of amplifiers, but its low price in wired and tested form makes it an especially good buy for someone who has any doubts about his soldering technique. Frankly, the assembly of the kit is so simple that we find it hard to imagine anyone shrinking from the task, but we will concede that someone without access to a voltmeter for setting the bias may wish to get it ready-made.

Manufacturer's Comment: The new PERI units do not include a soldering iron; we have replaced this item with improved circuit components to improve the over-all efficiency. Added to the amplifier are a 10-watt, 5-ohm current-limiting resistor, a fuse and fuse holder for 117-volt AC line protection, and a 525-volt filter capacitor to replace the 500-volt unit supplied previously.

One volt RMS does drive the amplifier to 100 w peak output, which is exactly the same as 50 w RMS output. The misunderstanding here is simply one of definitions.

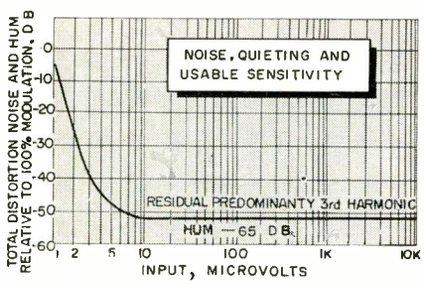
IM distortion higher than that specified is usually caused by a faulty 6AN8 tube. Present amplifiers being shipped have a 6AN8 that is prechecked and tested to meet the requirements of the input stage.

The suggestion for changing the positions of the output-stage cathode resistor and fuse is a very good one, and we recommend that this be done on all PERI amplifiers now being used or built. On current production we are reducing the value of this resistor so that, in series with the fuse, the total resistance will be the proper 12 ohms.

H. H. SCOTT 310-B FM TUNER

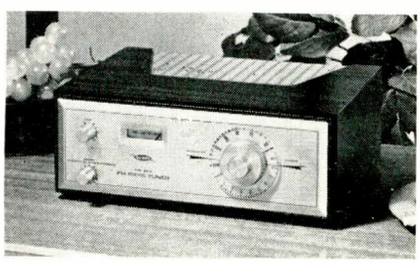
Like the other FM tuners in the H. H. Scott line, the 310-B uses wide-band limiters and a wide-band ratio detector. The RF stage and tuning section are apparently identical to those used in the 311 and 330 series tuners, and are enclosed in a shield to reduce radiation from the FM oscillator.

Its IF amplifier is more elaborate than those of the other tuners. The 310-B has three full stages of IF amplification, followed by a 6BN6 gated-beam limiter and a 6AU6 saturation limiter. The IF amplifier response shows a definite "flat top" which closely approaches the ideal response characteristic. This design allows low-distortion reception of fully



modulated FM stations, even at very low signal levels, yet the rejection of adjacent-channel interference is exceptionally good because of the steep skirts of the IF selectivity characteristic.

The wide-band detector yields a relatively low audio output, requiring the use of audio gain following it. This is accomplished by a two-stage feedback amplifier, which has a low output impedance. The 310-B features a "squelch" circuit which can be adjusted by a front-



The Scott 310-B FM tuner.

panel control to silence the audio output when the input signal is below a certain level. This eliminates the interstation hiss which many listeners find annoying.

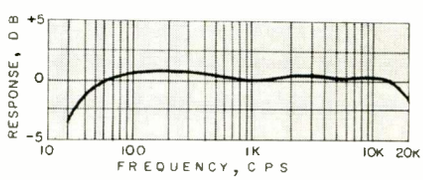
The tuning of the 310-B is exceptionally noncritical, aided by a tuning meter which reads maximum when on a station. There is no AFC, and there is also no detectable drift, from a cold start or with line-voltage variation.

Test Results

The 310-B is extremely sensitive. Only 1.6 μv of signal produce a 20-db signal-to-noise ratio, and the quieting is so abrupt that 2.1 μv yield a 30-db signal-to-noise ratio. The noise-quieting action is virtually complete with a 4-μv signal.

Just as important is the fact that the weakest signal, even one well below usual quieting levels, can be received without distortion at a full 75-Kc deviation or better. The effective sensitivity of the 310-B (the lowest signal which produces a 30-db signal-to-noise ratio and can be modulated 100% without distortion) is 2.1 μv. This is unusually good performance, and should make the 310-B especially suitable for use in fringe areas.

The frequency response of the 310-B is within $\pm$1.5 db from 30 to 20,000 cps, and falls off rapidly below 30 cps. The falloff is apparently in the audio section, and may be introduced deliberately. When the squelch circuit is used, there is a large subsonic thump or "plop" when it is tuned off a station. It is large even with the reduction in low-frequency response, and probably would be damaging to speaker cones if it were not at-



tenuated. Needless to say, the response below 30 cps could not contribute to the over-all sound in any home installation, no matter how good the speaker system, so it is not missed.

A proposed Institute of High Fidelity Manufacturers (IHFM) tuner standard provides for the measurement of what

they term "usable sensitivity." This single measurement in effect accomplishes the same purpose we had in our "effective sensitivity" measurement. The signal generator is modulated 100% (75 Kc deviation) at 400 cps and the output voltage of the tuner is measured. The 400-cps component is removed by a null-type distortion meter, and the total noise, distortion, and hum remaining is expressed as "X db" below the 100%-modulated level. This test not only measures the sensitivity of the tuner, but also tests it under fully modulated conditions, which will disclose any inadequacy of IF bandwidth or detector bandwidth. The modulating frequency of 400 cps is one at which a signal generator is likely to perform at its best and introduce a minimum of distortion.

The IHFM proposed standard defines "usable sensitivity" as the input signal required for a total noise and distortion 30 db below the fully modulated 400-cps output. This corresponds to 3% distortion. Since this test accomplishes very effectively what we have been attempting to do in our own manner, we are adopting it for future FM tuner tests.

The usable sensitivity of the 310-B (for 3% total distortion, noise, and hum) at 100% modulation is 2.2 μv. This corresponds closely to the "effective sensitivity" of 2.1 μv obtained by our former measurement method. The ultimate quieting, for signal strengths exceeding 10 μv, was 51.5 db, which corresponds to only 0.27% distortion, noise, and hum. This proved to be mostly third harmonic distortion. Hum was down about 65 db from the 100%-modulation level.

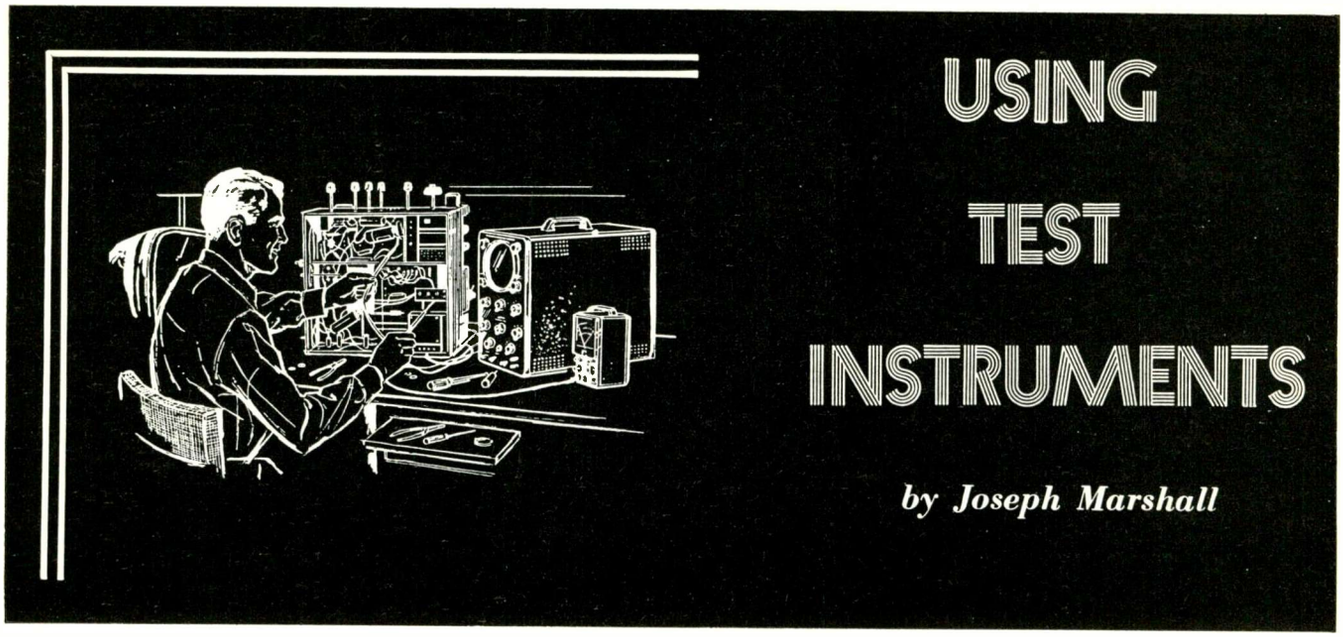
The capture ratio of the 310-B is very good, actually measuring better than the claimed 2.5 db. We found that a signal 1.7 db stronger than a second co-channel signal would take over to the extent of suppressing the modulation of the undesired signal by 30 db. This is by a large margin the best capture ratio we have measured on a commercial FM tuner.

Line leakage was virtually nil: 15 μa.

Summary

The Scott 310-B, judging by its design and performance, should be one of the finest FM tuners currently available. Our tests show it to be extremely stable, sensitive, selective, and easy to tune. For fringe-area reception, its rapid limiting and flat-topped IF response make it an especially suitable tuner. We have not encountered any difficulty with cross modulation or multiple responses in our rather strong-signal listening area, where almost all signals are at least 1,000 μv.

All things considered, we feel that the combination of very high performance and simple foolproof handling places the H. H. Scott 310-B in the top rank of FM tuners.



Signal Generators, Part IV

ONE of the most useful applications of the signal generator is in trouble-shooting a defective receiver or tuner. This is particularly valuable and time-saving in locating faults in an inoperative tuner, but is also helpful in finding faults which result in poor performance.

The procedure is very simple. A signal of appropriate frequency from the signal generator is applied to each stage of the receiver or tuner, beginning with the audio output stage and working backward through the detector, the IF stages, the converter, and the radio-frequency stages, until the faulty stage is found. The indicator is either the ear itself listening to the audio modulation through the speaker, or a VTVM connected to an appropriate point in the receiver or tuner. When the stage where the signal chain is broken is found in this fashion, the exact cause is pinpointed by voltage and resistance measurements.

Signal-Tracing AM Receivers

The procedure is very easy in the case of AM receivers or tuners. If the receiver has a self-contained speaker it can be used for the indicator. If it is a tuner with no built-in speaker, it can be connected to the hi-fi system so that the output is audible through the loudspeakers.

If the tuner is out of the system and on a test bench, a pair of headphones or a VTVM can be connected with clips to the output jack terminals. Fig. 1A is a block diagram of a typical radio receiver; Fig. 1B is that of a high-quality AM tuner intended for use in hi-fi systems. The successive signal-injection points are indicated by arrows and numbers. A wiring diagram is most helpful. If none is available a tube manual should be on hand to indicate the base connections of the tubes.

If the receiver is an old type using large metal or glass tubes with grid caps at the top, trouble shooting can be done without even removing the chassis from the cabinet because the tracing signal can be injected simply by touching each grid cap with the generator cable. More modern receivers and tuners, using single-ended tubes, whether large or miniature, will have to be removed from the cabinet or case and the bottom plate removed. In any event, once the tube-socket terminals are exposed and accessible, the tracing procedure is as follows:

1) First connect a pair of test leads to the audio-output binding posts of the signal generator. Turn the audio-output control on the generator all the way up. Do *not* turn the radio on. Attach the ground lead from the generator to the chassis of the receiver or tuner, and touch the hot terminal to the plate pin of the output tube. The audio tone should be audible through the loudspeaker. If there are two output tubes in push-pull, touch the hot lead to the plate of each tube. The volume should be the same. If no audio tone can be heard, touch the generator leads directly to the speaker voice coil. If now the audio is audible, the output transformer is faulty. If no sound is audible, the speaker is at fault.

2) Assuming you do get sound when the test signal is applied to the output-tube plate pin, turn on the radio and let it warm up. Now touch the hot lead to the grid pin of the output tube. The sound should be very much louder — indeed, assuming the generator delivers 10 or 15 v of audio, you should get nearly maximum volume. Now move the hot lead to the plate of the preceding tube, or to the other end of the coupling capacitor. The volume should remain the same. Reduce the output control on the generator until the output is barely audible and move the hot lead to the grid of the preceding tube. The volume should increase very markedly. If not, this stage is faulty. If it does increase sharply, move the hot lead to the plate of the preceding stage or the other end of the coupling capacitor. Again the sound should remain the same; if it is reduced, the capacitor is faulty.

3) When you reach the detector stage the audio signal is no longer useful. Tune the generator to the nominal frequency of the IF amplifier, usually 456 Kc. Turn the generator "coarse" control to maximum and the "fine" control about halfway on. Adjust the internal audio modulation for about 30% modulation. Connect the ground clip of the RF cable to the receiver or tuner cable and touch the hot lead to the plate of the last IF tube. If you hear no sound, sweep the generator dial down to 400 and up to 500, and if you do find a point at which sound is heard, peak the generator. It may be that the receiver IF frequency is 175 Kc or 260 Kc. If you get no sound at any frequency there is trouble in the detector circuit or the last IF transformer.

4) If all is well up to this point, reduce the generator output until the tone is barely audible and then move the hot lead to the grid of the last IF stage. The volume of the tone should increase very sharply. If not, there is trouble in this stage. Check the tube first and then the circuit parameters. But if you do get a sharp increase, move the hot lead to the plate of the preceding stage. If volume increases or remains approximately the same, the IF transformer is good. If vol-

ume is reduced or sound disappears entirely, the transformer is at fault. First try peaking it; if that does no good, make some continuity tests to see if the windings are all right. Proceed in the same way through the IF amplifier until you finish at the converter.

5) After checking at the converter plate, tune the generator to the frequency indicated on the radio or tuner dial, attach a capacitor of about 5 $\mu\mu$fd to the end of the generator probe, and touch the converter grid. Peak the generator for maximum output. If you can get no signal through the converter, check the oscillator. The simplest way to do this is to apply the probe of a high impedance VTVM — on the 15-volt range — to the grid of the oscillator tube. You should get a reading of *minus* 5 to 15 v. If you do not, the oscillator tube or circuit is at fault.

6) If the converter and oscillator are good move the generator output probe to the plate of the preceding RF stage (if there is one). The tone should remain at about the same volume. (There may be some small difference because the generator will load or detune the transformers; but if the difference is very great there is something wrong with the RF transformer or coils.) Again, reduce the generator output until the tone is barely audible, and move the injection lead to the grid of the RF stage. Again the volume should increase. Now attach the generator cable directly to the antenna terminals of the receiver or tuner. There will usually be a slight reduction; if the reduction is very large the antenna coil is suspect.

The entire series of checks outlined above can be made in two or three minutes. A dead stage is easily located and one that operates abnormally is also usually easy to spot. When a dead or faulty stage is found, the trouble can be pinpointed by measuring voltages on the tube pins and/or measuring resistances.

FM Tuners

The audio portions of FM receivers or tuners are checked exactly as described above. The procedure changes, however, when you get to the IF stages. For FM tuners with *ratio* detectors, connect the signal generator to the plate of the last IF stage through a 5-$\mu\mu$fd capacitor, tune it to 10.7 Mc, and then detune the *secondary* of the ratio-detector transformer until the modulation is audible. Peak the generator for maximum output. If you cannot hear any audio tone, there is trouble somewhere in the ratio-detector transformer or the detector tube itself. If the tone is audible, reduce the generator output until it is just barely audible, and then move the generator output cable probe to the grid of the last IF tube. The volume should rise again. Proceed now exactly as in the case of the AM tuner. When you reach the converter, change the generator frequency to whatever point in the 88- to 110-Mc band the tuner is tuned to. Continue as in the case of the AM tuner.

This procedure will not work with discriminator-type detectors, nor with ratio detectors if they are preceded by effective limiters. When operating properly, these will wipe out the AM modulation so that it is inaudible or poorly audible. A meter indicator is necessary and the high-impedance

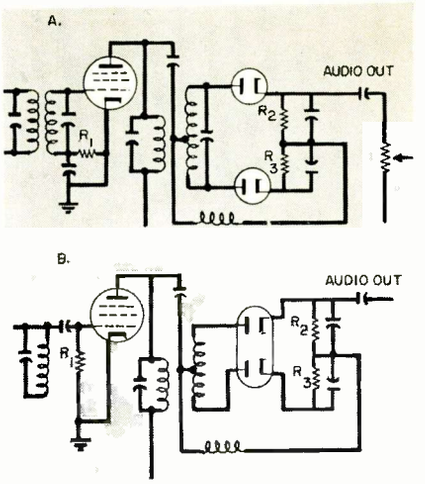
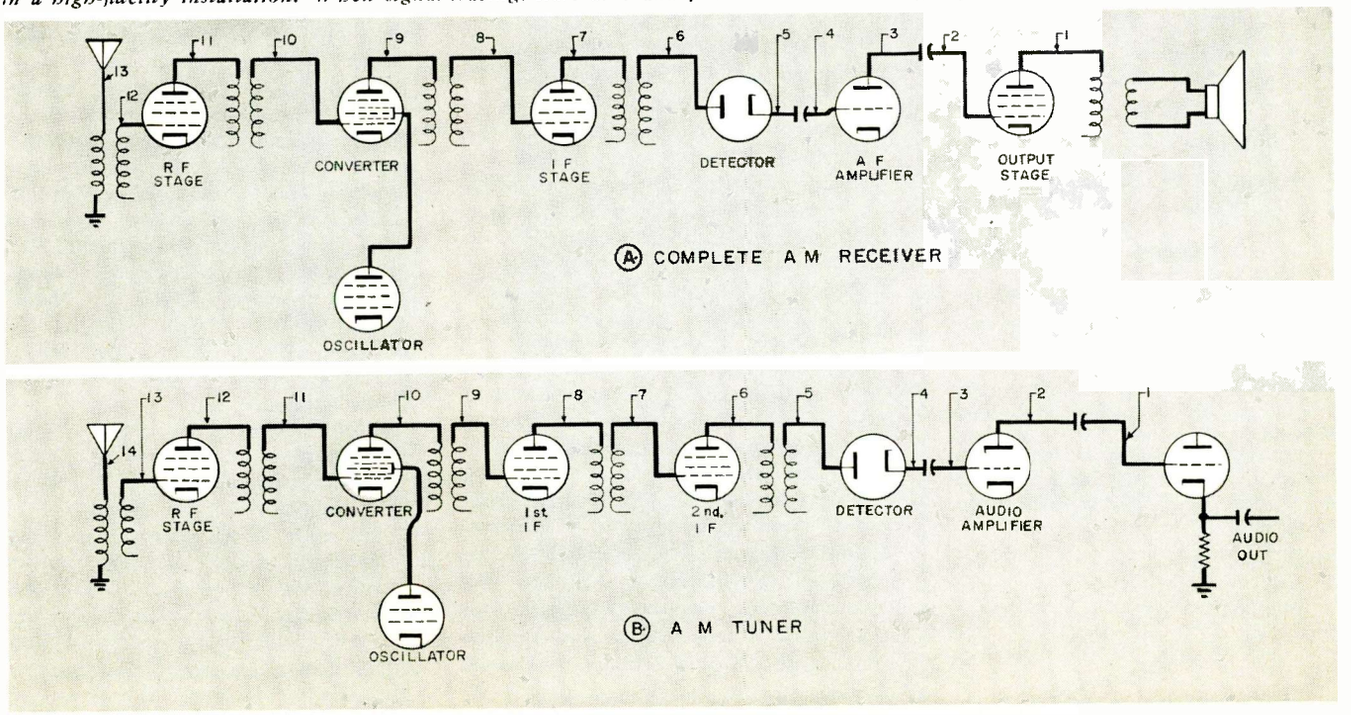


Fig. 2. Two types of FM limiter: A: *inductive, and* B: *inductive-capacitative.*

VTVM serves perfectly. To begin, connect the meter to the grid load of the last limiter stage. There are two types of limiter stages. Fig. 2A shows a stage with inductive coupling. Here the grid load is the resistor R1 in series with the bottom end of the transformer. The VTVM should be connected across this resistor. Fig. 2B shows inductive-capacitative coupling. Here the VTVM is connected from grid of the tube to ground. Connect the generator output to the plate of the preceding tube and peak it, adjusting generator output to provide a maximum swing on the 3-volt range of the VTVM. Now reduce the generator output until the meter just barely gives an indication, and move the generator output to the grid of the tube. The meter

Continued on page 46

Fig. 1. The top illustration (A) *is a block diagram of a typical AM radio receiver, and* B *represents an AM tuner likely to be found in a high-fidelity installation. When signal-tracing, start at 1 and proceed backwards stage by stage until the defect is discovered.*



The RUMBLE Seat

THE following communication touches on a matter of such immediate importance that, at the last moment before publication, we have deleted the article on speaker system level controls which was originally scheduled for this space.

To the Editor:
A complete, whole and total exception is taken by Electro-Voice to the two unqualified points cited by you in September AUDIOCRAFT. You stated that three-terminal stereo cartridges should cease to be manufactured (except for ready-to-play phono manufacturers use) and give entirely unfounded reasons for this pronouncement.

Two points for 3 terminal rejection are made: 1) Hum and 2) Electrical Shock. We ask you, in the interests of fairness to over 500,000 present users of Electro-Voice 3-Terminal Stereo Cartridges to acknowledge the exceptions taken to your statements as follows, with equal space devoted to this rebuttal as was given your original contentions.
Your statement:

> 1. HUM: "The only way you can avoid a ground loop with a three-terminal cartridge is to keep the left-channel amplifier, preamp and speaker system isolated from the corresponding units for the right channel. That pretty much rules out a ganged gain control, a balance control, or any of the channel switching that is so convenient in a stereo system."

Rebuttal — Your statement is not true *except for magnetic cartridges* with their present fantastic degradation in efficiency. This efficiency, always low, averaging 20 millivolts in monaural use, is now averaging 3 to 4 millivolts for stereo because of design problems. It is difficult to use 3-terminal wiring configuration for magnetic, reluctance, or moving coil stereo cartridges for the reason of this low level output and consequent hum. As a consequence, because of inherent design problems most manufacturers of magnetic cartridges chose 4-terminals as a production necessity and have raised as an issue the question of 4 versus 3-terminal design. They have adroitly attempted to capitalize a weakness into an advantage, claiming superiority for 4-terminal design. EV's design could be made either 3 or 4 terminal. In the EV design, the number of terminals is absolutely no consideration other than convenience to the consumer.

Regard these incontrovertible points: The output of 4 millivolts is measured at 1000 cps on a *constant velocity* test record. For RIAA equalized playing of the modern amplitude cut LP record, 36.5 db of equalization from 15 KC down to 30 cps is required. This *places the actual output of a stereo magnetic cartridge at .7 of a millivolt* after proper playback equalization! Moreover, hum bucking coils common to monaural higher level (20 mv) magnetic cartridges have been discarded of necessity for lack of space.

The efficient, modern Electro-Voice Ceramic (PZT) Stereo Cartridge is naturally flat to the RIAA characteristic of present day LP records, requires no equalization, and consequently delivers 500 millivolts. This is nearly *1000* times the output of a magnetic cartridge. (57 db higher)! In other words it has 1/1000th the susceptibility to hum, amplifier noise, microphonics, etc. *Moreover,* because there is no inductance in the Ceramic (PZT) Cartridge—*THERE IS NO 60 CPS HUM PICKUP WHATEVER!* Only a minuscule amount of 120 cps hum, almost wholly unmeasurable in its diminutive quantity, can possibly be picked up. This *electrostatic* hum is easily, completely, eliminated by the simple process of grounding a *single* shield.

The efficient, modern, *and superior* Electro-Voice Ceramic Stereo Cartridge warrants the simplicity and consumer benefit of the 3-prong easily shielded single ground. The Ceramic Stereo Cartridge challenges your statements declaiming the 3-prong configuration with over 500,000 satisfied Electro-Voice users *without a hum problem.* THIS IS MANY TIMES MORE THAN THE TOTAL OF ALL THE 4-PRONG MAGNETIC STEREO CARTRIDGES COMBINED.
Your statement:

> 2. ELECTRICAL SHOCK: "Every potential user should be warned against connecting one to an AC-DC or transformerless appliance . . . If the main sound system is wired to an earth ground, this may blow a house fuse; if not, touching any metal of the system may give the operator a severe shock and, possibly, kill him."

Mr. Editor, you obviously did not plot out, even, the simple circuitry of 4-prong

vs 3-prong cartridges in AC-DC applications before considering your statement. To be Underwriter Lab approved, AC-DC devices demand isolating components between power line and exposed metal surfaces. Observe that if a short circuit develops in the electrical isolating component (in itself a highly unlikely supposition) in a 4-prong cartridge application in an AC-DC chassis — the fuse will not blow, 115-volt AC will be exposed at the cartridge terminals, regardless of the wall-plug polarity. With 3-prong cartridges only if the AC plug is plugged in *one* way and only if the electrical isolating component failed — will a voltage be present at the cartridge terminals. Plugged in the other way, the fuse *will* blow.

This makes the 3-prong cartridge 50% safer than the 4-prong! But in reality both types are perfectly safe. And better yet for the CERAMIC 3-prong— the efficiency is so much higher than magnetics — that a non-critical ground at the tonearm *may* be employed— TOTALLY PROTECTING THE USER!

As for the use with stereo amplifiers on a single chassis with ganged controls, no technical reason can be advanced for 4-prong over 3-prong modern ceramic stereo cartridges.

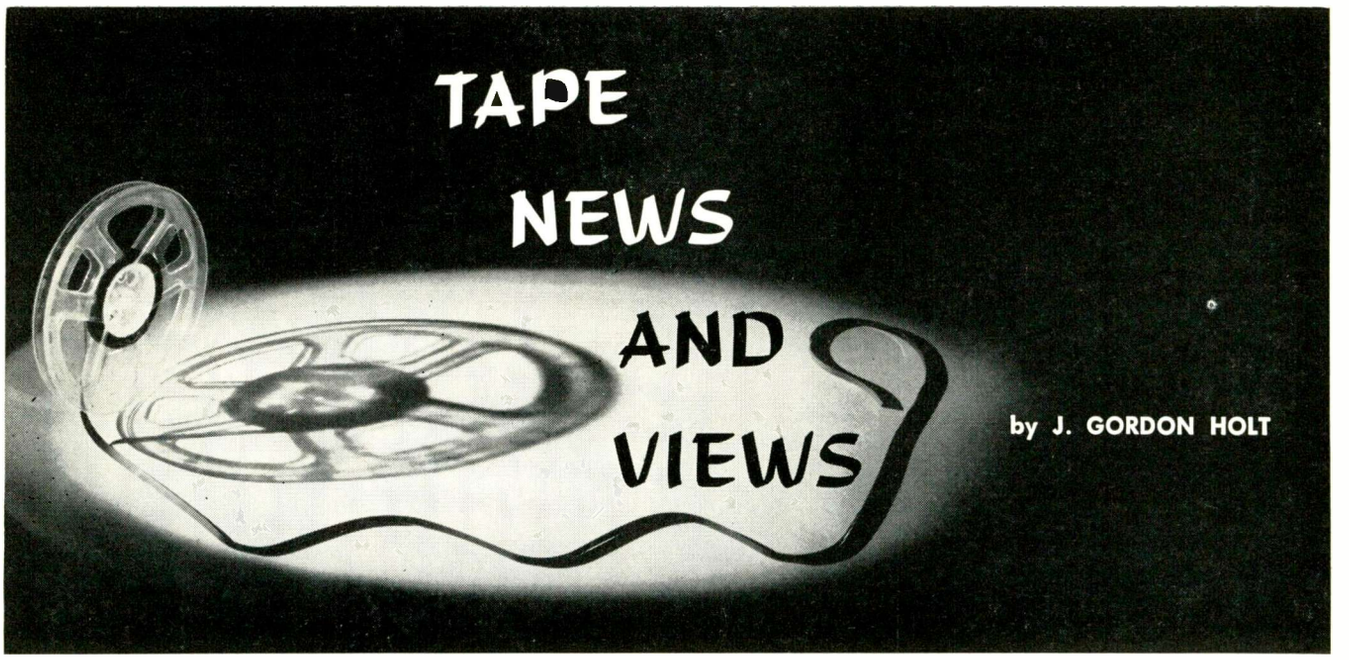
A further point to make is that among package manufacturers you will find 4-terminal stereo cartridges employed on the low-end, their least expensive a-c-d. c. units and 3-terminal stereo cartridges employed virtual exclusively on their quality merchandise with UL approval. To attempt to classify cartridges on the issue of 3 versus 4 terminals is ludicrous on the face of this fact alone.

For the record someone should point out that all high quality music reproduction equipment, component or package is straight a.c. operated and the entire safety question is specious, either 3 or 4 terminal cartridges are perfectly safe.

Lawrence LeKashman
Vice President
Electro-Voice, Inc.
Buchanan, Mich.

It is obvious that there is only one safe conclusion: do not use an AC-DC set as the second channel in a home-rigged stereo system, whether the cartridge has three or four terminals. In view of this conclusion, we feel that otherwise a 3-terminal cartridge is equally as acceptable as a 4-terminal, the final choice being based solely on considerations of performance and convenience.

— ROY ALLISON



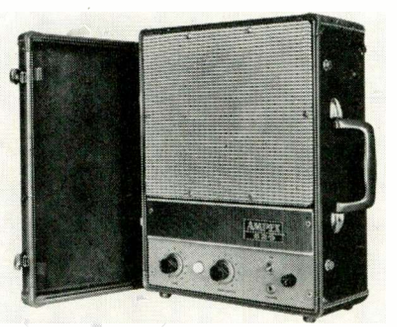
Toward better monitoring

ONE difference between a casual photographer and a professional or a skilled amateur is that, while the former will simply aim his camera like a gun and shoot whatever is in front of it, the latter (having an artistic bent) will peer through his viewfinder for some minutes, planning the composition of his picture before taking it. To the artist, the viewfinder is a picture frame; to the snapshot fan it is nothing more than a border around his picture of Aunt Agatha watering the poison-ivy bed. He uses it to make sure that his camera is aimed in the right direction, and that it isn't cutting off Aunt Agatha's head, or putting her on a bias like the leaning tower of Pisa. And he'll get his picture, too, but it probably won't be a very good picture.

Similarly, the recordist, who heeds the Call of the Community Concert, sets up his tape recorder in the high-school auditorium, and then uses a pair of cheap headphones simply to establish whether or not the sound is going to his tape recorder, is losing three quarters of the advantages of monitoring.

A professional recording studio has an acoustically isolated control room set to one side of the sound studio, and separated from it by a soundproof window. Inside the control room there is a high-quality loudspeaker whose characteristics have (ideally) been compensated to offset any acoustical peculiarities of the control booth, and to insure the closest possible approach to ideal frequency-response linearity. Thus, when setting up for a recording session, an engineer in the studio may make adjustments in microphone placement while somebody else listens to the results over the monitor speaker. There isn't any need to make test recordings; all that's necessary is to arrange the mikes until the signal heard over the monitor speaker sounds as desired.

For the amateur recordist, obviously, it is not this easy. He has no specially treated studio and no soundproof control room, and must do most of his live recording at remote locations such as the local high-school auditorium or church.



The Ampex 620.

Unless he has the opportunity to record in these places regularly, he is not likely to have the opportunity to experiment with microphone placement. Chances are he'll set up his recorder, wander around in a fit of indecision for a while, and then put his mike or mikes where logic dictates that they *should* work best. Unfortunately, acoustics are rarely logical, and judgment is rarely perfect, with the result that the quality of the recording is largely left to chance.

The next best thing to recording "blind," so to speak, is recording some rehearsals of the group before the actual performance. This gives an opportunity to experiment with several mike setups (making careful notes of each), cart the equipment home, and listen analytically to the results. Then if more woodwinds are needed, or if there is too much echo, corrective measures may be tried at the next rehearsal and the results re-evaluated through the home system. If all goes well, and the right compensations are made, the final tape will probably be very good.

However, it isn't usually practical or possible to record several rehearsals of the performing group; about the best that can be hoped for in most cases is to squeeze in a test recording session at the dress rehearsal, the night or afternoon before the final performance. This means that mike setups must be evaluated on the spot, and that's when good monitoring equipment is needed.

It should not be necessary to point out that, if you are trying to make a recording that will sound good on your home system, any evaluative listening on the spot should be done with a speaker or set of headphones which sound like your main loudspeaker system. If your speaker system is on the brilliant side, the monitor speaker or headphones should be also. Finding a small speaker or a pair of headphones to match the balance of the main system is not too difficult, but something that *can* be problematical is finding a decent place from which to listen.

If a tape recorder is set up directly in front of or to one side of the stage, the full force of sound from the musicians will drown out the sound coming through your headphones, regardless of

how loud these may be. (And most good headphones aren't very loud.) Also, it is obvious that you can't use a loudspeaker for monitoring under these conditions because, as soon as you get it turned up loud enough to hear, it will become a source of annoyance and distraction to persons sitting near you on the stage or in the audience. Or it may actually be picked up by the microphone, causing the howl or metallic ringing of acoustic feedback — perfectly good grounds for having you and your equipment kicked off the premises.

The ideal location for the recorder and monitoring equipment at any remote recording job is in a room behind or to one side of the stage, and the less of the on-stage proceedings that can be heard from that room, the better. This, by the way, is one reason I have always used and advocated using low-impedance microphones; their cables can be run practically any distance without loss of quality. The little-back-room location has several advantages: apart from the fact that it enables you to hear *only* what is coming through your monitor (and thus, what is going into the recorder), it allows you to go about your business of marking tape boxes, cleaning heads, trimming your fingernails, or (sometimes) smoking a cigarette without distracting others. It also prevents the intermission-time gathering of interested individuals who, were they to spot you in the auditorium, would immediately corner you and bombard you with helpful suggestions or brilliantly penetrating questions.

For monophonic recording, headphones or a small loudspeaker will serve equally well for monitoring. A good pair of headphones, such as the Brush 205-A1 or BA-206, the Permoflux HD-1, or the British Industries Type K headset, is favored by most recordists partly because phones are less expensive and far less bulky than are speaker systems of comparable quality, and partly because they are not affected by room acoustics, as are loudspeakers. Both the Brush BA-206 and the Permoflux phones have smooth, wide-range frequency-response characteristics, and both tend to be on the bright side. Both are adequately sensitive, although the crystal elements in the Brush phones are fragile, and will split if overloaded or applied to a source of DC voltage. The Permoflux phones are capable of producing much higher volume levels than the Brush BA-206, but there are few listeners who could tolerate the maximum level of even the Brush phones for long periods of time. Functionally, the main difference between them (apart from price) is in working impedance. All Brush phones are high-impedance, with values ranging between 50,000 and 150,000 ohms. The

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Sound-Fanciers' Guide

by R. D. Darrell

Hi-Fi Show Pre-Echoes

Even if my otherwise well-supplied listening room and cellar workshop lack a reliable wide-range, low-distortion crystal ball, I run little risk of expulsion from the Guild of Audio Prognosticators in prophesying well in advance of the season's opening that nothing else in the big hi-fi shows will be plugged as vigorously or arouse as intense public curiosity as stereo discs and stereo equipment. I can't say that I'm *wholly* overjoyed by this prospect, since I fear that the past year's impressive achievements in stereo-tape recording and reproduction techniques (to say nothing of monophonic techniques) will be unjustly neglected. Nevertheless, I can rejoice mightily that after a somewhat unpromising start, stereo discs already have made such sensational strides that even the most reluctant or skeptical audiophile simply can't afford to lag far behind their triumphal bandwagon progress.

Stereo discs are pouring from the presses so fast that no one reviewer can manage to hear all or even most of them, and of course many of those that will be demonstrated at the shows are either unannounced or unavailable at this time. But whatever other show stoppers are still to come, I can safely bet that the roster will include several real gems I've had spinning on my own turntable. If you're already set up for 45/45 playback at home, I strongly recommend your hearing at least some of these before you visit the shows themselves, for there is no better preparation for judging — on the basis of known materials — the comparative merits of the bewildering variety of stereo pickups and preamps to be unveiled there. In any case, these are discs which effectively display the present state of the recording art and most rigorously test the capabilities of the currently available reproducing equipment.

Among the big symphonic showpieces, last month's recommendations now must be augmented by Ormandy's superb performance of Prokofiev's Fifth (Columbia MS 6004), the latest and most scintillating yet of Ansermet's recordings of Stravinsky's *Petrouchka* (London CS 6009), and the longtime Fiedler favorite, the Offenbach-Rosenthal *Gaité Parisienne* (RCA Victor LSC 1817).

And among the novelties and miscellaneous lighter works: the pioneering Dukes' of Dixieland Vol. 3, *Marching Along* (Audio Fidelity AFSD 1851), is now companioned by Richard Schory's *Re-Percussion,* no less glittering in its appearance under the new Concert Discs label (CS 21) than in its earlier Concertapes reel; London's *Journey into Stereo Sound* (PS 100), which I have learned since writing last month's copy not only is available for general sale, rather than dealers' demonstrations only, but already has zoomed up into the best-seller lists; Les Baxter's Hollywoodian travelogues, *Ports of Pleasure* (Capitol ST 868); Pee Wee Russell's imaginative improvisations in *Portrait of Pee Wee* (Counterpoint CPST 562); Ken Moule's *Jazz at Toad Hall* (London PS 108), which couples a batch of good but not extraordinary British dance pieces with a far more distinctive jazz suite based on Kenneth Grahame's *Wind in the Willows;* Jimmy Giuffre's "wanly loitering" clarinet (and baritone and tenor sax) in lyrical soliloquies on tunes from *The Music Man* (Atlantic SD 1276); and, less for its often schmalzy music than for its novel, however throbby, Electro-Theremin solos by Paul Tanner, the *Music for Heavenly Bodies* on one of Omega's handsomely packaged first disc releases (OSL 4).

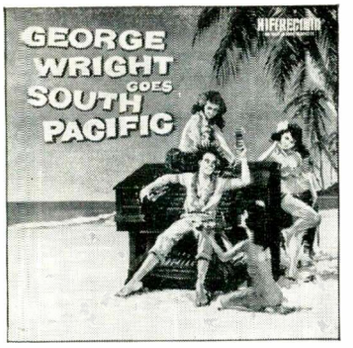
Stereo Quintessences

Yet many of the most profoundly impressive musical as well as sonic stereo-disc achievements to date are less well suited to bits-and-pieces demonstrations amid the usual hi-fi-show pandemonium. Dramatically exciting as the apocalyptic brass-band and timpani climaxes in Berlioz's *Requiem* may seem when heard under even such circumstances, the eloquent restraint of Scherchen's monumental performance, as well as the rich beauty and spaciousness of the Westminster-Véga recording (WST 201, two 12-in.), made in the same chapel of L'Hôtel des Invalides, Paris, for which the score was originally created, simply cannot be fully grasped except in one's own living room where the *Requiem* can be memorably experienced free from all distractions in its entirety.

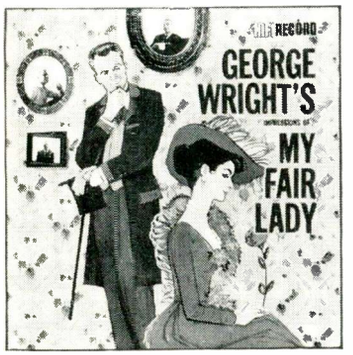
And stereo's unique ability to transform one's living-room wall into a proscenium opening up on the magical world of the theater never can be enjoyed for its full dramatic realism in tantalizing samples. As yet we've had no entirely satisfactory opera in the new medium, but the complete D'Oyly-Carte *Mikado* (London OSA 1201, two 12-inch) not only foreshadows the imminent triumphs in this repertory, but for the first time on records brings us a Gilbert and Sullivan operetta that charms its listeners with the expansive gusto of the finest stage performances. The soloists here are not exceptional in themselves, and few individual scenes can be effectively isolated for demonstration purposes, but hearing this gloriously spirited presentation from beginning to end is a fresh and exciting

Continued on page 45

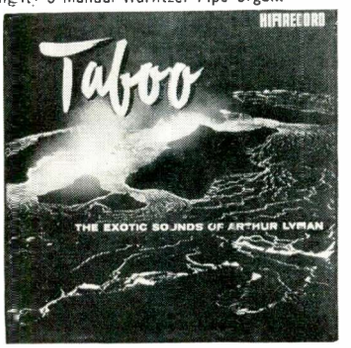
R000 BIG DIXIE—Harry Zimmerman's Big band plays the biggest, wildest, Dixie and Blues you've ever heard. Sensational sounding brass!



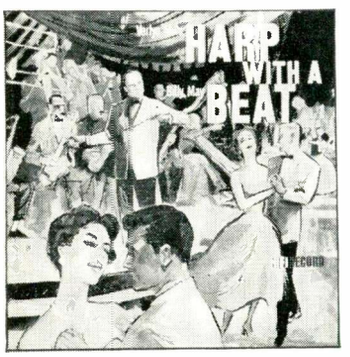
R716 GEORGE WRIGHT GOES SOUTH PACIFIC—A new slant on the score from the famous Broadway musical. George Wright's 2 million selling popularity scores another hit on the mighty 5 Manual Wurlitzer Pipe Organ.



R715 GEORGE WRIGHT'S IMPRESSIONS OF MY FAIR LADY—Off-beat interpretations played on the mighty Wurlitzer 5 Manual Theater Pipe Organ as only Wright can do it.

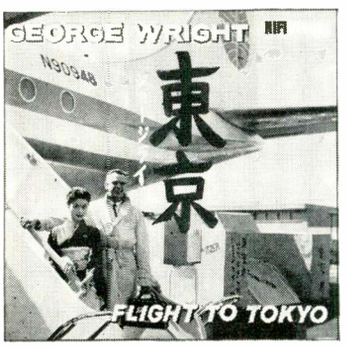


R806 TABOO—The fabulous, exotic sounds of Arthur Lyman's Hawaiian Village Group recorded in Henry J. Kaiser's aluminum dome, Honolulu.

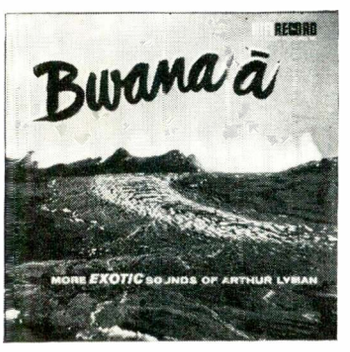


R606 VERLYE MILLS HARP WITH A BILLY MAY BEAT—Big band Billy May pile driver brass with Verlye Mills jazz harp.

R805 JAZZ'N RAZZ MA TAZZ—Red-hot rhythms from the Roaring twenties with George Wright's Varsity 5.



R—FLIGHT TO TOKYO—New, zany Oriental sounds from the mighty Wurlitzer 5 Manual Pipe Organ by the Inimitable George Wright.



R808 BWANA A—Recorded in Henry J. Kaiser's aluminum dome, Honolulu, Arthur Lyman again captures the exotic sounds of his #1 best seller Taboo.

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Drilling Screw Holes

Many hobbyists, like myself, avoid using sheet-metal or self-tapping screws because they do not know the proper size hole to drill. The table below gives the necessary information including the correct drill number for two materials, various thicknesses, and four screw sizes. The materials designated are those commonly used in chassis. Note that these types of screws are not recommended for certain thicknesses of aluminum. A table to convert gauge numbers to thickness in inches is also given.

		Thickness of Material in Inches				
		.015 to .018	.019 to .040	.041 to .056	.057 to .071	.072 to .089
Material	Screw Size					
		Self-Tapping Screws, Drill Sizes				
Sheet Steel	4-40	44	44	44	42	42
	6-32	37	37	37	33	33
	8-32	30	30	30	28	28
	10-24	25	25	25	23	23
Sheet Aluminum	4-40				41	41
	6-32				32	32
	8-32				27	27
	10-24				20	20
		Sheet-Metal Screws, Drill Sizes				
Sheet Steel	4-24	44	42	41	39	38
	6-20	37	36	34	32	31
	8-18	32	32	30	29	28
	10-16	27	27	27	24	22
Sheet Aluminum	4-24				39	38
	6-20				32	31
	8-18				27	27
	10-16				22	22

Gauge No.	Steel* Thickness, Inches	Aluminum** Thickness, Inches
12	.1046	.0808
14	.0747	.0641
16	.0598	.0508
18	.0478	.0403
20	.0359	.0320
22	.0299	.0253

* U.S. Standard Sheet-Metal Gage

** American or Brown and Sharpe Wire Gage

R. G. Chaplick
Silver Spring, Md.

Lining Speaker Enclosures

Here's a way to use ordinary inexpensive rock-wool bats of insulation to line speaker enclosures. Carefully tear away the protective paper from the bats and lay the exposed wool in place in the cabinet. Then cut small squares of heavy paper (about the weight of the cover stock of this magazine) and lay them at regular intervals over the surface. Now you can tack or staple through the paper and through the insulation, holding the insulation firmly in position without tearing through.

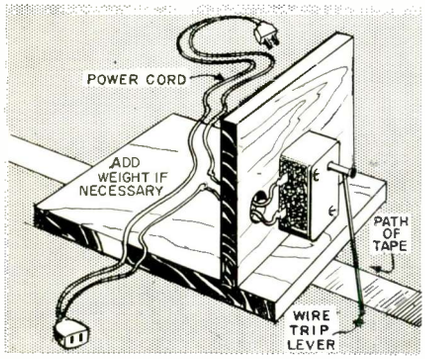
L. E. Johnston
Madison, Wis.

Automatic Cutoff for Recorder

I have just devised an automatic cutoff for my Pentron tape deck, which should be adaptable to almost any recorder on the market. It consists of a microswitch on a 5-foot extension cord, in series with the power input; this is more convenient than placing it directly on the tape cord. The switch I used is made by Micro Switch Co. of Freeport, Illinois, and is rated at 5 amps, 125 or 250 v AC, with about 2 grams necessary to operate it. It is a single-pole, single-throw, normally open switch, but a single-pole, double-throw would work just as well. Acro

makes a switch that looks similar (1CMD1-2AXX-A22, 2.5 grams, 3 amps, 125 v AC).

I placed the switch on a wooden frame, and then put the whole assembly on the machine in such a way that the trip wire rides against the tape, closing the circuit. When the tape has run out or broken, the pressure is off and the switch opens the circuit again. I then



Details of recorder switch.

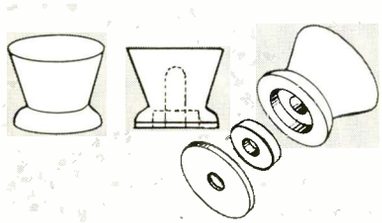
ran the trip wire against the smooth side of the tape; for further protection a length of plastic insulation was placed over the wire trip lever. The wooden base may be merely set on the recorder or it may be attached if the machine is used in the vertical position.

G. Frederic Hoffman
Philipsburg, Pa.

Reel Knobs

My tape deck was designed for vertical or horizontal mounting, but when it is in the vertical position the reels do not stay in place. Two rubber grommets held them on, but were difficult to put on and take off. The illustrated knob does the job nicely. I shaped the knob on a lathe, but an empty thread spool will do as well.

The center hole is bored for a loose fit on the reel shaft. A second hole, whose diameter and depth are determined by the grommet, is bored or chiseled concentric with the first hole. The



Home made reel Knobs.

grommet is held in place by a metal plate, bored for a loose fit on the shaft, and then is fastened to the knob with contact cement.

Use a twisting, pushing motion to put the knobs in place. As an added benefit, the knobs reduce mechanical noise from rewinding.

James W. Slabaugh
Reading, Minn.

STEREO COMPATIBILITY

Continued from page 19

motion is more complex. There is some wear on the base of the ball tip, besides the usual wear on the sides, and the latter extends farther fore and aft than it does on a stylus playing conventional records. One of the main reasons for more rapid wear is the fact that stereo-cartridge stylus asemblies, in general, have greater moving mass. Although every effort has been made to cut down the mass of the stylus assembly, it is still somewhat higher on the average than that of a conventional cartridge.

Stylus wear varied greatly from cartridge to cartridge, according to the specific moving mass and compliance. The more vertical compliance, the less wear for a given amount of mass. Pinch effect is an important consideration with stereo records. It is detrimental to sound, but is an unavoidable consequence of the recording/reproducing cycle we use for disc records. In addition, this type of motion is an essential part of the complex stylus motion on a stereo record. Vertical stylus freedom is important to both stereo reproduction and reduced stylus wear, and, of course, also influences record wear.

One of the more important considerations recently has been the use of stereo cartridges on conventional records. Since I was concerned primarily with wear on stereo cartridges and records, this was not one of the questions I had intended to discuss. But while testing the stereo cartridges, monophonic records were played to determine the stylus wear on them, and incidental to this, observations were made concerning the quality of reproduction obtained. They are interesting enough to mention briefly before continuing with stereo-stylus wear.

As was to be expected, the stereo cartridge's generally greater moving mass and lower lateral compliance made it inferior on monophonic records as compared to conventional cartridges. Highs had a slightly greater tendency to "break up," and there was a little more distortion. Lows were not too greatly affected, although there was a detectable difference. The most notable difference, however, was in the greater amount of surface noise with stereo cartridges. Because of the vertical sensitivity, dust, surface hiss, and scratches were more annoying than with a good monophonic cartridge. The ideal conventional cartridge has no vertical output and high vertical compliance. The stereo cartridge has the latter, but also has the same amount of vertical output as lateral output. Thus, the scratch filter on the preamp became quite useful.

Rumble too became a problem. Many older lateral discs have quite a bit of rumble *recorded* on them. This is detected with a conventional cartridge quite easily. It is more readily apparent with a stereo cartridge, because vertical recording-table rumble is cut in a vertical manner, even on a lateral record. What was worse, however, was the rumble of the record-rotating device. This will be covered in full detail in Part III of this series.

It should be noted that much of this noise is eliminated if the two output channels of a stereo cartridge are paralleled when playing a monophonic disc, thereby eliminating the vertical output. But by and large, a stereo cartridge does not perform quite so well on monophonic discs as does a monophonic cartridge. A monophonic cartridge, therefore, probably should remain an essential part of a component high-fidelity system. It can be used to play monophonic records, while the stereo cartridge is used to play only stereo records. To be sure, a monophonic record does often sound better when it is played on a stereo *system*, both channels carrying the same program. But this can be done via the preamp rather than the cartridge.

In time, surely, stereo cartridges will be improved to such an extent that they will be able to replace monophonic cartridges for all purposes. And even now, most package systems will be able to get along perfectly well with a stereo cartridge only.

Getting back to stylus wear: the stereo-cartridge stylus wears out faster on a monophonic record than does a monophonic-cartridge stylus, for the same reason that it wears more rapidly on a stereo disc — the mass of the stylus assembly is greater, and the compliance less, on an average basis.

I have never gone along with the 4,000-hour life claimed for a conventional diamond microgroove stylus. In my experience, the average diamond remains in perfect condition no more than 500 hours. Even that long a playing life is obtained only when exceptional care is given to keep the records clean and stylus force correct. More often than not, a diamond stylus begins to damage a record after 350 hours or so. Of course, this refers to a 1-mil stylus. With a 0.7-mil stylus, the average life runs slightly better than 400 hours without groove damage. A 0.7-mil diamond in a stereo cartridge lasts 300 hours quite safely. A 0.5-mil stylus is good for both sides of better than 400 12-inch stereo LP's. This is still quite good stylus life, nearly comparable to monophonic results.

The stereo record also wears a bit more rapidly than its conventional counterpart, as we have seen. Having a much more complex groove shape and forcing a stylus with greater mass and

lesser compliance to follow this more complex path, it is bound to suffer greater wear. But because the stylus-tip radius and the average stylus force have both been reduced somewhat, the difference between the life of a stereo record and a monophonic record is slight. With care, the life of a stereo record can be nearly as long and useful as that of a monophonic record. As a matter of fact, with the constantly improved vinyl and other materials being used for pressing records, stereo records may well, in the very near future, have a longer life than the conventional LP's we know so well.

I found one major fault with some stereo records that I had hoped not to. Each time a disc is pressed, the metal stamper wears a bit. As the stamper is used, it becomes progressively more worn and it makes worse and worse discs. Excessive use of stampers has always been a source of trouble, and has been the subject of complaint after complaint. If you wondered whether the introduction of stereo records would end this practice, it hasn't.

I have been speaking on a relative basis all through these two articles, comparing stereo discs and equipment with present monophonic discs and equipment, which — on a purely technical basis — have reached a very high degree of excellence. Even if the stereo units aren't quite as good yet, still they are of amazingly high quality, very close, in fact, to the corresponding recorded stereo tapes in A-B comparisons. And when the fact that they *are* stereo is taken into consideration, I have no hesitancy in saying that I prefer early stereo discs and cartridges, for the increased listening pleasure they give, to monophonic discs. They will get better, but even now they are well worth investing in.

Next month will be published the third and final portion of this study of compatibility of stereo records and the devices used to play them. At this time, I would like to thank the record makers who have been of invaluable aid in carrying out the tests noted herein. These were Capitol, Esoteric, Decca, Counterpoint, Vanguard, RCA Victor, and London. I would particularly like to thank the following people in the New York and Hollywood offices of Capitol Records: Irv Joel, Don Plunkett, Bill Muster: and the engineering and sales staffs they head.

I would also like to thank the following manufacturers of high-fidelity components: Audiogersh, Gray, Fisher, Acoustic Research, H. H. Scott, Thorens, Pickering, Shure, Sonotone, Electro-Voice, Stephens, University, Altec-Lansing, Ronette, Bell, Heath, Fairchild, GE, and Norelco. Without their cooperation, this task would have been difficult if not impossible.

TAPE NEWS

Continued from page 35

Permoflux ones are available in 8-ohm or 600-ohm models, for use with high-fidelity power amplifiers or professional-type low-impedance lines fed by transformers.

Less sensitive and more fragile than the BA-206 is the Brush 205-A1, which is markedly different in sonic balance. These phones incorporate built-in bass boost, which compensates for the poor acoustical coupling between the ears and the phones. Their over-all sound is much like that of some of the finest loudspeaker systems — full, natural, and softly subdued (as opposed to brilliant). These, too, are very smooth in response and wide in range, but are more difficult to use as quality monitors than are the other phones I've mentioned, simply because their output is much lower. They *must* be used in quiet surroundings when you want to hear the signal primarily through the phones.

I've never tried the British Industries Model K phones, so I can't say what they are like. I've heard from reliable sources that they are very good, but their sonic balance is something I won't attempt to speculate about. Perhaps I can report on them at a later time. The Model K's, by the way, are also low-Z types, available at 52 ohms (the significance of this value escapes me) and 600 ohms.

For speaker monitoring, practically any small loudspeaker and low-powered amplifier can be used, as long as the speaker's sonic flavor is like that of the main system at home. The speaker and amplifier may be housed in a single small carrying case, if there is adequate ventilation around the amplifier. An ideal unit for on-the-spot loudspeaker monitoring is the Ampex 620 speaker-amplifier system. This consists of a small amplifier and a specially baffled loudspeaker, both housed in a light, compact carrying case. The speaker is electrically equalized to extend its high-frequency range and to offset the bass loss incurred by the small enclosure, and the over-all sound is remarkably good. A well-thought-out tone-control system on the amplifier provides a wide variation in over-all response, and this control may be used to preset the 620 to match the sound of the main loudspeaker. The only difficulties are that transient response and distortion at higher-than-moderate levels are not quite what they could be. It's still the best thing I've found for monitoring, and I know of several people who use them in their homes as their main playback systems.

Because headphone listening is an aural phenomenon unto itself, it takes time to become accustomed to the sound of even the best headphones. Anyone who is going to be using headphones

for recorded-quality monitoring should train his ears, so to speak, by extensive listening through them at home to records or tapes with which he is completely familiar. The sound on these recordings won't seem to be the same as when they are reproduced via the main speaker system, but if the phones are generally similar to the main speaker, it should not take long to develop facility in interpreting headphone sound in terms of loudspeaker sound.

Monitoring stereophonic recordings is another problem altogether, and I'll reserve that topic for a later column. At this point, even though I haven't done as much experimenting as I would like to, I *have* found that loudspeakers are almost a necessity, unless you have the ability to apply very appreciable mental corrections to what you're hearing. A good, natural-sounding stereo recording is singularly *un*natural through headphones, and a stereo recording that sounds natural through phones will usually be found to have totally inadequate spread or depth. As I said, it *can* be done with phones, but loudspeakers are much easier to cope with as well as being easier on the ear lobes.

The Sony Condenser Microphone

I had heard a lot of enthusiastic reports and rumors about the almost-legendary Sony microphone, and heard them from

Sony power supply and microphone.

so many sources that I began to wonder if there wasn't something to them. I obtained two and tried them, with an Ampex 601-2, for some stereo recording of several different types of program material.

At this stage, I am too enthusiastic about them to be able to view them in proper perspective, so I think I'd better wait until I've used them some more before reporting extensively on them. Thus far, about the only things I *have* established are: (1) they are about the most natural-sounding and least colored microphones I've encountered to date, (2) they are superb reproducers of piano, organ, strings, voice, and outdoor noise of all sorts, (3) their transient response seems about as good as anything I've heard, and (4) their noise level, while high enough to be audible at high gain-control settings, is well below the tape-hiss level on my recorder. In short, this just *may* be the best microphone that's come along so far.

READERS' FORUM

Continued from page 17

generalizations that are being made that record changers, per se, are not completely compatible with stereo cartridges is an incorrect one. The few quality record changers being offered to the high-fidelity enthusiast can and will continue to meet the very rigid demands imposed for stereo high-fidelity reproduction as well as it has done for monophonic high fidelity.

Stanley G. Neufeld
Rockbar Corp.
Mamaroneck, N.Y.

Gentlemen:
I wish to compliment you on your series of articles authored by Mr. Joel Ehrlich; they are without equal for completeness and clearness.

I wrote to Mr. Ehrlich in response to his offer (in the June issue) to answer any questions regarding stereo, and I was amazed at the thoroughness with which he replied to my queries. I had actually expected little since it was free, but his courtesy could not have been greater.

Under separate cover I have sent a check to cover my subscription to AUDIOCRAFT, and without meaning to slight the rest of the magazine, would like to say that Mr. Ehrlich's articles (and courtesy) are responsible.

Darrell E. Rains
Santa Cruz, Calif.

GROUNDED EAR

Continued from page 4

not be duplicated by any careful workman.

The amplifier is a slightly modified version of a design that has been in the Dynaco catalogue for some time. It has the same front end as the Marks II and III (with very slight modifications to trim the feedback loops), and four KT88's in push-pull parallel working into a Dynaco A-450 transformer. The circuit can be obtained from Dynaco Inc., 617 N. 41st St., Philadelphia, Pa.

Such low distortion is achieved by a mode of operation which I hereby title "Exalted Class A" for obvious reasons. The bias is moved down to bring the tubes on the edge of Class-A operation. With 480 v on plates and screens, the bias is adjusted for a current of 90 ma per tube, or 360 ma for the four. This is slightly (10%) above the dissipation ratings of the tubes. It would be of little consequence for the type of intermittent operation usual in hi-fi listening, and probably the decreased tube life would be a small price to pay in continuous operation for the exceptional performance.

The tremendous improvement in distortion characteristics is apparently due in part to the greater linearity of Class-A operation with these specific tubes, and in part to the lower drive requirements which reduce inverter and driver distortion.

David Hafler of Dynaco, an outspoken advocate of high amplifier power, does not see much market for a 120-watt amplifier — even one this good — but it may be of interest for recording and laboratory usage. However, owners of Mark III's may possibly achieve a similar improvement by changing bias for a reading of 2 v across the cathode resistor, or a current of 90 ma per tube. The "Exalted Class A" operation does *not* exalt EL34's, however. And please note that dissipation ratings are exceeded on the KT88's; the tubes will run hotter, and tube life may be shorter.

SOUND FANCIER

Continued from page 36

adventure in theater-going — and it is only after the curtain has fallen that one begins to appreciate the consummate musical and technical skill involved.

Similarly, stereo's quieter virtues of tonal purity and transparency, which inevitably are lost or overlooked in blatant public displays, are best savored at leisure in quiet surroundings. Besides Boult's Beethoven *Pastorale,* and Vivaldi's Bassoon Concertos and *The Season's,* which I singled out for special commendation last month, we now have the radiantly glowing string tones of *Apollon Musagète* (London CS 6034) in an ideal realization of what well may be the finest of all Ansermet's contributions to the Stravinskian discography; an exuberant version of the Rossini-Respighi *Boutique Fantasque* (London CS 6005), in which Georg Solti and the Israel Philharmonic capture the full color and infectious zest of this irresistible ballet score, and, in the field of folk music, a *Follow the Drinking Gourds* program (Counterpoint CPST 560) of American Negro work and camp-meeting songs, exceptional for its engaging freshness of both materials and their presentation.

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TEST INSTRUMENTS

Continued from page 31

reading should rise markedly. Move to the plate of the preceding tube; the reading should remain about the same. (Again, detuning by the generator cable may make a small difference; but if the difference is very great the transformer is either faulty or badly misaligned.) Reduce generator output again and proceed through the earlier stages as detailed above.

If the FM tuner passes all the tests back to the antenna in good shape, the presumption is that the trouble is in the detector stage. Move the VTVM leads across either R2 or R3 (in Figs. 2A and 2B). Inject the generator signal into the grid of the limiter. If you get no reading on the meter, move injection to the plate of the limiter. If you get a reading now, the trouble is in the limiter. If there still is no indication, the trouble is in the discriminator transformer or the detector itself.

Special Cases

Some older FM-AM tuners and receivers used a common IF and audio channel for both AM and FM. When such a receiver is dead for both AM and FM there are three possible causes of trouble: 1) there is a fault in the power-supply section; 2) there is trouble in the audio section which is common to both; 3) there is trouble in the (usually one) IF stage which is common to both AM and FM.

If only the AM or FM is inoperative, proceed to trace with the generator as detailed above for whichever mode is inoperative. In other words, if AM is out, trace as detailed above for AM; if FM is out, trace as detailed for FM. Many newer tuners, on the other hand, have completely independent AM and FM sections and not even the audio is common. When these are inoperative on both AM and FM the trouble is certainly in the power supply, which is the only element in common. Otherwise, treat them as two separate tuners.

POWER SUPPLY

Continued from page 25

a load drawing 250 ma, the no-load voltage measured 6 v and full-load output voltage was 5.7 v. This is a power output of 1.4 w and, as before, a regulation of about 5% is obtained.

Variations and Suggestions

In the unit shown in the pictures, some of the items were obtained from a collection of miscellaneous component parts. The constructor may also have some of these parts on hand. A parts list is

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PRECISION Test equipment 10-54P, MCP98, E200C. Ship COD. J. Locascio, 8561 66th Rd., Forest Hills, N.Y.

WANTED: Speaker system and AM/FM tuner reasonable. Leo Diamond, Apt. 10C, 205 West 88th St., New York 24, N.Y.

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included which lists items readily available that will give equivalent results.

At maximum rated power dissipation of the transistor, the heat sink previously described *must* be used. If the power dissipation is somewhat lower than the maximum rating, the transistor might be mounted directly on top of the metal cabinet, but insulated from it with thin mica. It is recommended that any crackle or flat paint finish on the cabinet top be removed under the transistor to obtain maximum heat radiation. Since the heat radiation is reduced with this method, due to the mica insulation, care must be exercised in regard to the power demand of the load.

Slightly higher output current can be taken from the power supply. For instance, an output current of 700 ma at 12 v amounts to a power of 8.4 w, which is near the maximum dissipation rating of the transistor. When approaching this maximum rating, it is recommended that a thermometer be attached to the transistor case in order to observe that the maximum temperature rating of 66° C. (151° F.) is not exceeded. A higher output current will require a higher-current meter; alternatively, the 500-milliampere meter specified may be provided with a shunt resistance and calibrated to measure higher currents.

Although the reference potentials for the high-current regulated output and the entire current for the other output are supplied by flashlight cells, the builder may use mercury cells for this purpose. They are available in various voltages, and certain of these cells will give longer life. Also, it is not often necessary to have all the voltage steps shown. These were included because they made available most of the DC voltages normally used in transistor experimentation. The steps may be chosen as required, or a single reference voltage used. As an example, three 4-volt mercury cells may be used in series. They would give regulated output voltages of about 4, 8, and 12 v, and these potentials would also be available at the low-current output terminals.

If mercury cells were used, the power supply might be built into a smaller package. But when operating close to the maximum rating of the transistor, there should be no skimping in the heat sink. Retain the same metallic mass by proportionately increasing the thickness of the metal plate as the plate size is reduced. The transistor, operating at high power levels must not be mounted inside the cabinet where it would not receive sufficient ventilation.

The builder may, therefore, consider the schematic diagram in Fig. 1 as a basic circuit arrangement, and apply modifications as individually required, remembering not to exceed the maximum power or temperature ratings of the transistor.

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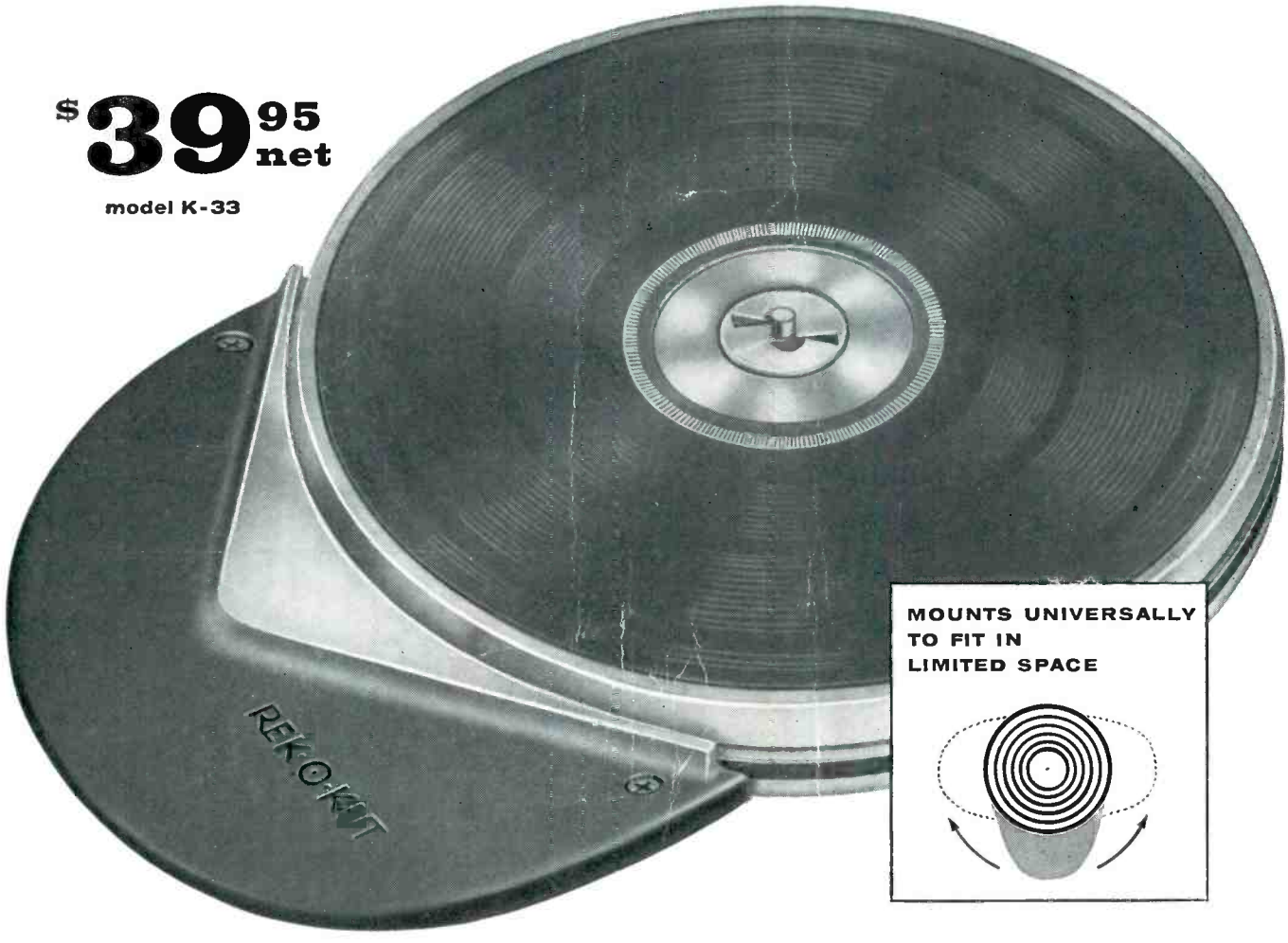

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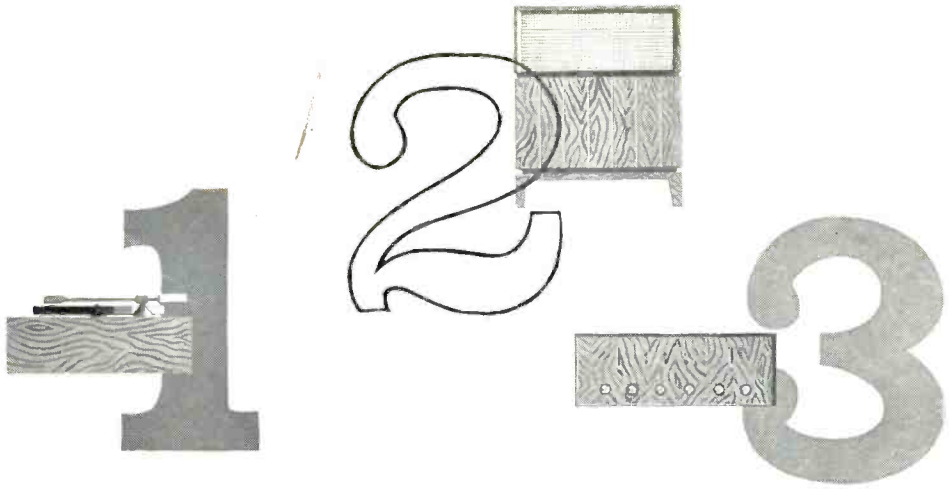

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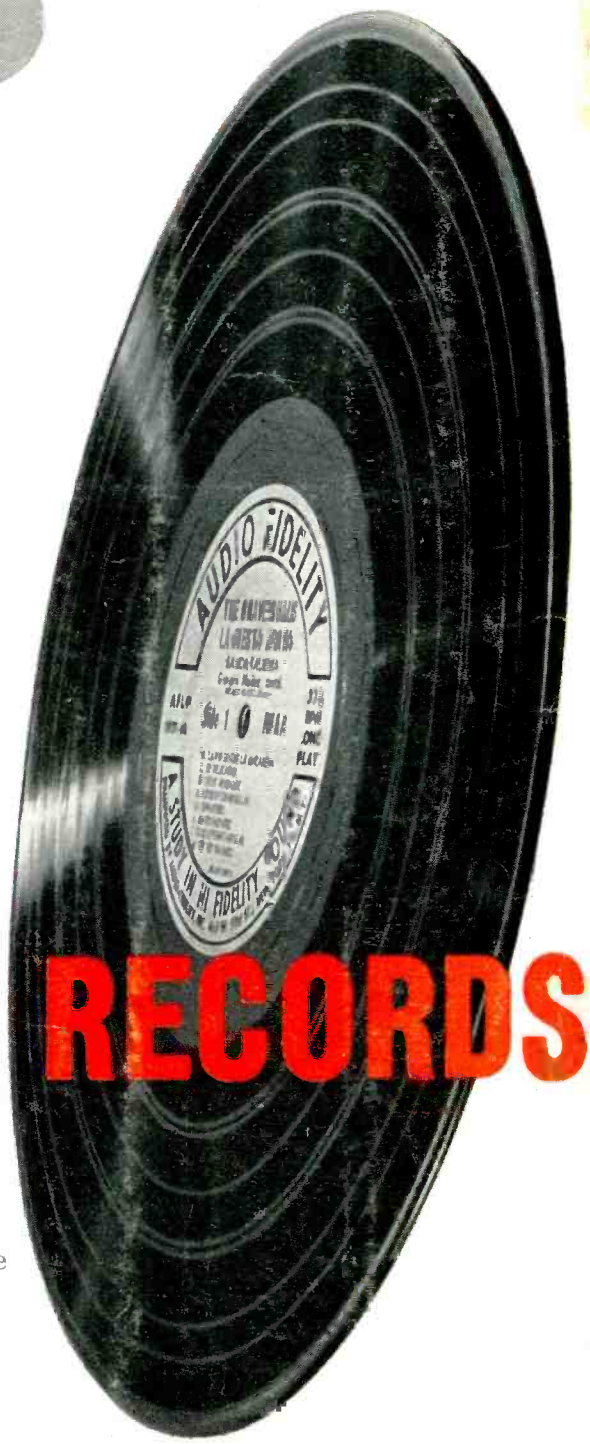

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