All about stereo records

audiocraft

for the HI FI hobbyist

You can make an FM antenna for a dollar

Attenuator box for precise signal control

Assembling University's KEN—15 enclosure kit

An amplifier for small listening rooms

FEBRUARY 1958 • 35 CENTS

* New Transcription-Type Tone Arm Makes Collaro World's First True High Fidelity Changer

Because the record player is so critical in a fine music system, you cannot afford to compromise with quality. Your loudspeaker may reproduce 20 to 20,000 cps; your amplifier may put out 50 watts of undistorted power—but **the music begins** at the record player. That's why today's high fidelity systems require the all new Collaro changer with the revolutionary transcription-type tone arm.

The new arm is one-piece, counter-balanced and will take any standard cartridge. Resonances are below the audible level. Between the top and bottom of a stack of records there's a difference of less than 1 gram in the tracking weight as compared with 4 to 8 grams on conventional changers. This insures better performance for your precious records and longer life for your expensive styli.

It's worth noting that Collaro quality is so well recognized that leading American manufacturers of fine console units incorporate Collaro into their instruments in order to achieve the best possible performance in a record player.

In addition to the transcription-type arm, the Collaro Continental features:

Four speeds, manual switch that permits playing single record or portion of a record; jam proof mechanism, hold the arm in mid-cycle and it won't jam; automatic intermix, plays 7", 10" or 12" records in any order; automatic shut-off after last record has been played; wow and flutter specifications, ¼ (0.25%) RMS at 33⅓ RPM, superior to any changer in the world; muting switch and pop filter to eliminate extraneous noises; extra heavy duty 4-pole induction motor; heavy rim-weighted, balanced turntable for fly wheel action; removable heavy rubber turntable mat; pre-wiring for easy installation; attractive two tone color scheme to fit any decor; factory custom-testing for wow, flutter, stylus pressure and correct set-down position. Reflecting their custom English craftsmanship Collaro changers are tropicalized to operate under adverse weather and humidity conditions. The base, in blond or mahogany, is optional at slightly extra cost and the Collaro mounts easily and quickly on a pre-cut mounting board or base.

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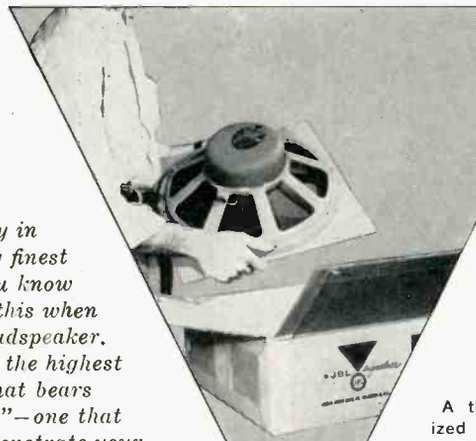
You will put many hours into learning the fundamentals, and then the fine points of high fidelity. You will spend your time and energy freely in building the very finest sound system you know how. Remember this when choosing your loudspeaker. Get a speaker of the highest precision — one that bears the symbol "JBL" — one that is worthy to demonstrate your own best efforts. JBL precision and advanced design are responsible for JBL efficiency — highest in the world. JBL efficiency gives you the smoothest, cleanest, most realistically lifelike sound you can get.



MODEL D123
12″ EXTENDED RANGE LOUDSPEAKER

An outstanding value, the D123 at first glance is most unusual because of its shallow structure — only 3⅝″. More unusual is the crisp, clean bass it generates. Listening will develop great respect for the D123's smooth response, excellent handling of transients, and pleasingly lucid highs.

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A thrilling piece of miniaturized precision craftsmanship. As perfect in its details as larger JBL units. A true precision transducer in every sense of the term. Properly enclosed, the D208 (eight ohms, D216 is 16 ohm model) gives impressive, rich, full range coverage of audio frequency range.

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The only speaker of its kind . . . only one made with a 4″ voice coil . . . only single unit speaker to give you complete, true high fidelity coverage of the entire audio spectrum. Your basic speaker. Use alone at first, later add JBL high frequency unit and dividing network for supreme excellence of JBL 2-way system.

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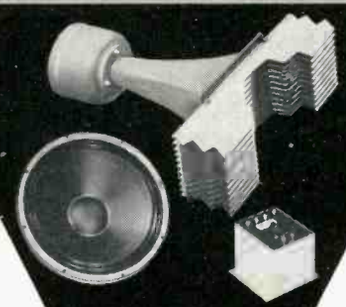

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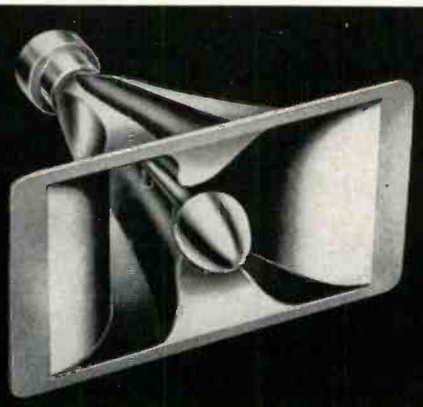

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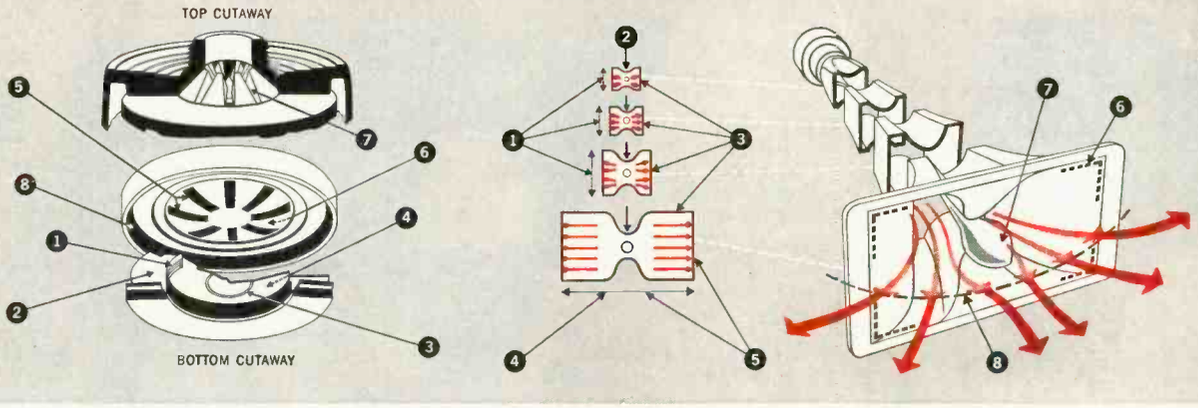

Exclusive features of the T-50

1 2 Special type aluminum voice coil for high fidelity and long life

3 4 **The only known "front concave" hypersonic diaphragm with absolutely uniform path lengths**

5 6 **The only hypersonic acoustic head with "radial slots" to achieve absolutely no high frequency cancellation**

7 **The only one piece integral hypersonic mixing chamber available today for super precision close tolerances**

8 Rim-centering for long life

SPECIFICATIONS: Response: 600 cps to inaudibility; **Recommended crossover:** 700 cps; **Power capacity:** 50 watts, integrated program; **Diameter:** 4¼"; **Depth:** 4⅛"; **Throat:** 1⅜"-18; **$49.50 net**

** Patent pending*

Exclusive features of the H-600

1 2 Initial expansion vertical

3 4 Horn contours** in horizontal direction

5 6 Ultimate expansion in horizontal direction

7 Front plane equalizer**

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*** Exclusive with University*

SPECIFICATIONS: Air column: 7¾"; **Horn Cut-off:** 600 cps; **Recommended crossover:** 700 cps; **Dispersion:** 125° horiz. x 55° vert.; **Bell mouth:** 8¾" x 4¾" over-all; **Depth (less driver):** 7¾"; **Throat:** 1⅜"-18 thread; **$18.00 net**

† U.S. patent #2,690,231

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THE MAGAZINE FOR THE HI-FI HOBBYIST

FEBRUARY 1958

Volume 3 *Number 2*

THIS MONTH'S COVER: In case you are wondering, our tubeless diamond pickup tracks at about 123 pounds; the KEN-15 enclosures are micropoised; and the stereo disc was born of pure asphalt. Any more questions? Photo by Phil Geraci.

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The Grounded Ear

What's new for your future in sound reproduction?

by Joseph Marshall

A Small-Room Amplifier

Readers of this department know that I have a high regard for EL84 tubes. Recently I put together an amplifier using a pair of them for use by one of my daughters in a typical apartment-sized living room. The amplifier's performance explains why I like these tubes so much. Because others might find the amplifier interesting, enough details are given here that it can be duplicated.

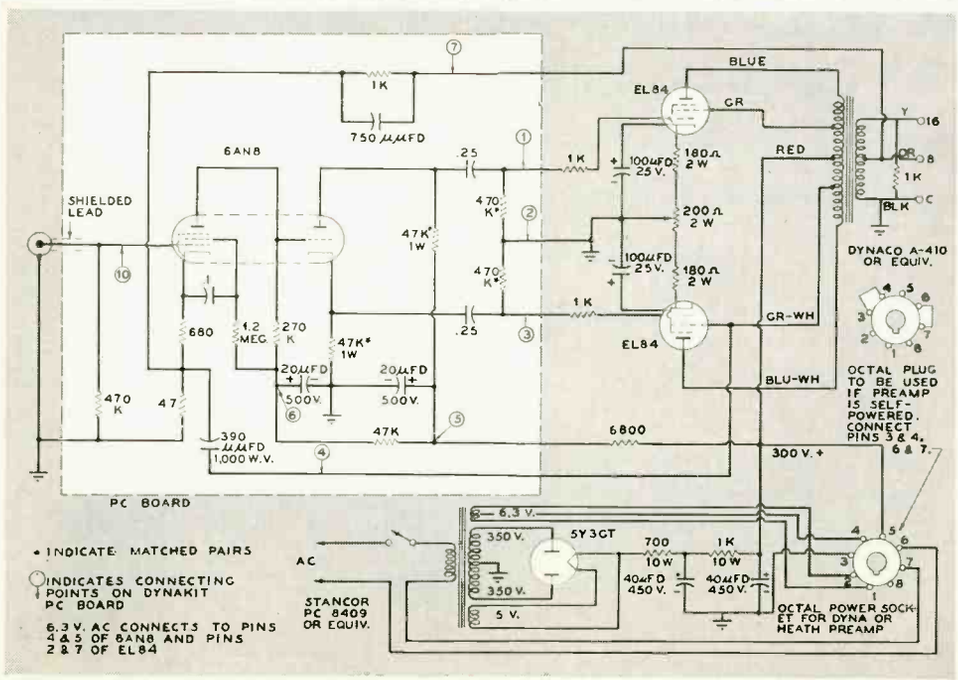
Fig. 1 is the circuit. The front end is exactly the same as that of the Dynakit Mark II and Mark III — except the grid resistors for the output tubes, which are changed from 100 K to 470 K. I used the Dynakit printed-circuit board which is available from the manufacturer for $10 (Dynaco Inc., 617 N. 41st St., Philadelphia 4, Pa.). It is no trick to change the two resistors. They should be matched as closely as possible — the same reading on an ohmmeter will be good enough. The circuit is so simple, however, that those who do not mind a little extra work and time may prefer to start from scratch and can save at least $5 by doing so.

The EL84's work into a Dynakit A-410 output transformer that I had on hand. An Acrosound TO-310 or Peerless S-232-Q will also work well, but it might be necessary to readjust the feedback loop. There are a lot of other output transformers with primary impedances between 6 K and 9 K, and Ultra-Linear taps, intended for or used with 807's and 6L6's in earlier hi-fi amplifiers. There will also work, although, again, it may be necessary to change the feedback.

The output tubes are biased and bypassed independently, and a pot is provided for obtaining exact current balance. Using independent bias limits the out-of-balance DC current in the transformer primary and thereby improves performance at very low frequencies. While AC balancing is not essential it may provide a further reduction in distortion. The best way to balance is for least intermodulation distortion at about 8 watts output. Alternatively, a voltmeter connected from cathode to cathode can serve as an indicator; adjust the control for zero voltage difference. The bias will run between 11 and 12 volts for supply voltages between 300 and 325 volts.

I used a choke for filtering, but a 1,000-ohm 10-watt resistor will provide good results. A four-section 450-volt capacitor with 40-, 40-, 20-, and 20-μfd sections provides for all filtering. Other values could be used but would change the decoupling and might affect low-frequency stability. The first two capacitors, at least, should be in the 40- to 50-μfd range.

Fig. 1. Schematic of apartment-sized amplifier. White block is Dynakit PC board.



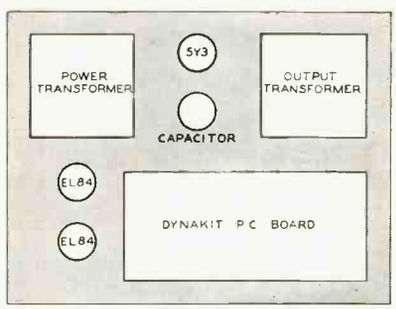


Fig. 2. Components should be arranged as above to fit 7×9×2-inch chassis.

If the Dynakit PC board and the other specified components are used, construction is completely uncritical. I used a much-too-big 8-by-11-by-3-inch chassis I happened to have on hand, but a 7-by-9-by-2-inch one will be plenty big enough if the parts are arranged as shown in Fig. 2. The PC board is grounded at one point, where one of the screws fastens it to the chassis. Put a solder lug under the nut which holds this screw, and run a ground bus of bare wire from this to the ground terminal of the voice coil. Make all grounds to this bus. No adjustment is necessary except to balance as I have indicated.

If you use output transformers other than those mentioned you may need to readjust the feedback loop. The amount of feedback is most easily varied by moving the loop to the other taps on the voice-coil winding of the output transformer. High-frequency instability is most easily corrected by changing the capacitance of the inner loop, which

runs from the screen of the lower EL84 to the cathode of the input tube. If a 20-Kc square wave is rounded off too much, use another capacitor between 390 and 1,000 $\mu\mu$fd in series to reduce the total capacitance. This extra capacitor can serve in lieu of the connecting wire. If there is too much ringing, try increasing the capacitance; one end of a 100- to 500-$\mu\mu$fd capacitor can be connected to the screen terminal at the tube socket, and the other touched to the point on the PC board where the two cathode resistors and the feedback loops came together. This point is represented by the line of foil at the very top of the board, just underneath the words DYNACO AUDIO AMPLIFIER PAT. PEND. When the right value is found, one end can be soldered to the socket lug and the other to whichever of the five wire-ends on the line is the most convenient. Increasing the capacitance across the 1,000-ohm feedback resistor may also help. This can be done by putting a capacitor (200 $\mu\mu$fd or higher) from the same line mentioned above to eyelet No. 7 or the wire that runs from this eyelet to the voice-coil tap. Low-frequency stability is most easily handled by *reducing* the value of the output-tube-cathode bypass capacitors.

The curves (Figs. 3, 4, and 5) show the measured performance. Except for the small peak at 8 cps the response is within 1 db from 3 to 65,000 cps at 1 watt. Ten watts are available without clipping or deformation from 20 to 20,000 cps. The output at the clipping point is 12 watts at 400 cps. Appreciable output is available outside the audible range.

Distortion at the maximum output point — just below clipping — is extremely flat except at the very ends. It will be noted that 0.7% harmonic is not exceeded between 25 and 13,000 cps, and 1% is exceeded only below 22 and above 18,000 cps. At an output of 1 watt the distortion plus noise is just barely readable at about .025% except at 20,000 cps where it is only 0.1% including noise. IM distortion is 1% at 10 watts, 0.5% at 6 watts, and below 0.1% at 2 watts and less.

Only 400 mv are needed to drive the amplifier to full output. With a good

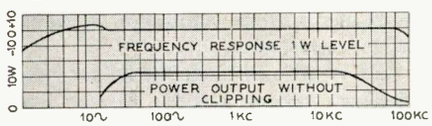


Fig. 3. The top graph shows frequency response at 1 watt. Lower graph shows undistorted power at 10 watts output.

preamp, therefore, the total distortion is never appreciably greater than the distortion of the amplifier alone. For example, at an output level of 1 watt the total distortion plus noise from the low-level phono input of a Dynakit preamp to the output of this amplifier is only

Continued on page 36

by RICHARD D. KELLER

book reviews

The Cathode Ray Oscilloscope

Ed. by J. Czech; pub. by Philips Technical Library, New York; 340 pages; $8.50.

Another well-illustrated volume joins the ranks of those concerned with using an oscilloscope effectively. This one goes several steps beyond most, however, by giving details of the design and construction of oscilloscope circuits as well as the techniques of oscilloscopic measurements and investigations. As such, it is highly useful to the design and application engineer who should know the potentialities and limitations of the test equipment he is working with in order to interpret properly the results he sees.

Illustrations are plentiful and exceptionally well executed; full interpretations of the beautifully presented oscillograms, of which there are over 600 in all, are given. The book contains extensive references (mostly European), is extremely well indexed, and includes directions for building several oscilloscopes featuring European parts. But since the engineering principles and application techniques are universal, and because the real value of an oscilloscope depends essentially on how much its potentialities are understood, this book is highly recommended reading for anyone using this versatile instrument.

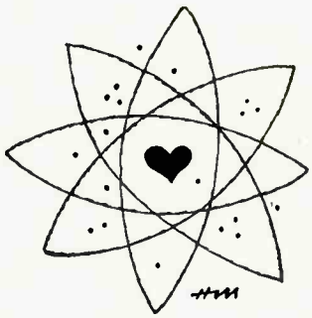
An Introduction to Junction Transistor Theory

R. D. Middlebrook; pub. by John Wiley and Sons, Inc., New York; 296 pages; $8.50.

This text provides a qualitative and quantitative approach to junction-transistor theory.

The mathematical development starts with basic semiconductor principles, and continues through the p-n junctions, to the final ideal transistor model. For the electronic engineer, it is one of the first books to bridge the gap from the more theoretical and erudite aspects of solid-state physics to the practical application of such theories. As pointed out by the author, the demand for engineers well versed in this rapidly expanding field already far exceeds the supply.

The emphasis of the book is on the basic equivalent circuit or ideal transistor model developed by the author for use in the design of small-signal amplifiers. Such a transistor model is basic and highly useful for a simplified explanation of complete and complex transistor phenomena. The equivalent circuit given is not sufficient to cover all the significant ramifications of some of the newer transistor types, such as the diffused base, drift, etc.; but as an introduction to a relatively new field, this book lives up to its title very handsomely.



An Introduction to Semiconductors

Ed. by W. Crawford Dunlap, Jr.; pub. by John Wiley and Sons, Inc., New York; 417 pages; $11.75.

An excellent survey-type text for the engineer-physicist engaged in semiconductor work. The emphasis is primarily on semiconductor materials rather than devices.

The book includes basic concepts of solid-state physics, properties and preparation of semiconducting materials, methods of measurement, and several chapters of practical applications for transistor and rectifier devices.

The approach is almost entirely physical, with a minimum amount of formal theory, detail, and mathematics necessary to convey the subject matter adequately.

Electricity and Electronics — Basic

Ed. by William B. Steinberg and Walter B. Ford; pub. by American Technical Society, Chicago; 245 pages; $4.50.

This book is a fine example of the current American trend in school textbooks towards using large print, copious illustrations and photographs, and many everyday examples to capture and hold the student's attention away from TV, jukeboxes, and corner movies. It is nonmathematical yet nicely comprehensive, and contains many projects of "interesting things to do," which are worth while and extremely helpful to the beginner. The home hobbyist would also find some of these easy "winter-night" projects instructive and entertaining. Review questions at the end of each chapter aid the nontechnical reader in seeing that he has grasped the significance of the basic principles contained therein.

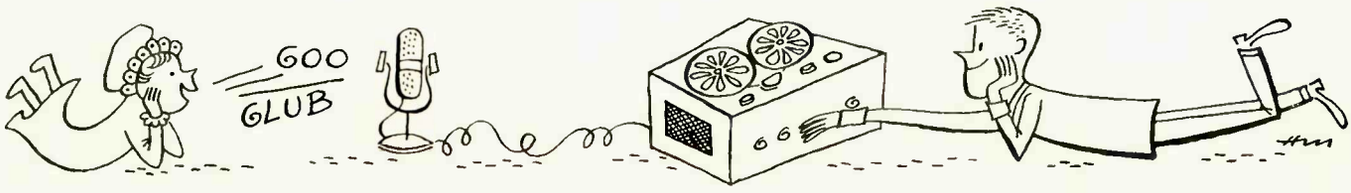
Basic Electricity

Ed. by Rufus P. Turner; pub. by Rinehart and Company, Inc., New York; 396 pages; $6.50.

Basic Electricity is essentially intended as a text for beginning students in trade schools and technical institutes. As such it is similar in scope and material to *Electricity and Electronics — Basic*, but on a slightly more advanced plane, with fewer photographs and pictures, more graphs and schematics, and some basic mathematics as well.

The large print and practical applications should appeal to modern-day educators, and the chapter summaries and questions will be helpful to technical-school instructors.

All in all, this book should provide a thorough background for further study in the fields of electricity, electronics, radio, television, and industrial automation.



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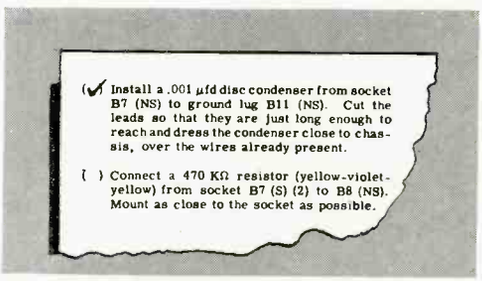

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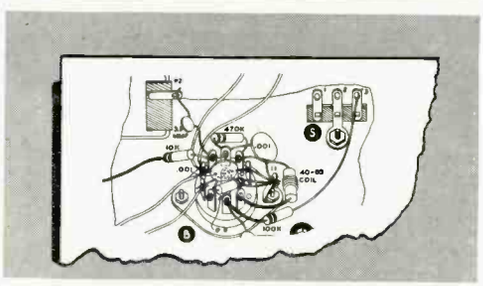

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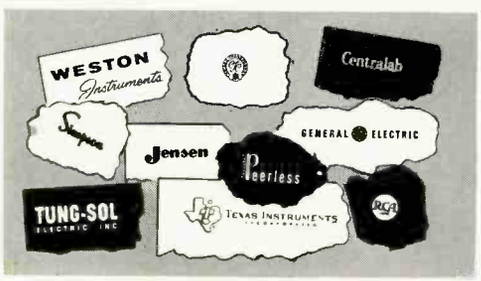

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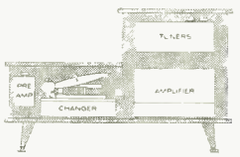
CE-1C Mahogany
CE-1CB Birch

CONTEMPORARY

CE-1T Mahogany

TRADITIONAL



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MODEL FM-3A $25.95 (with cabinet)

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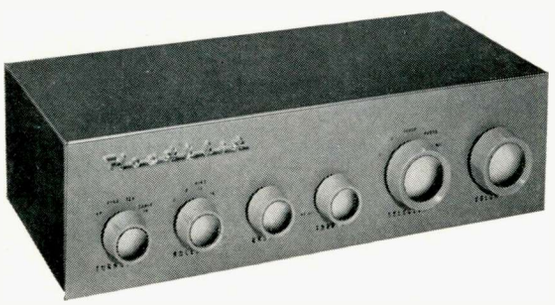
MODEL BC-1A $25.95 (with cabinet)



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.

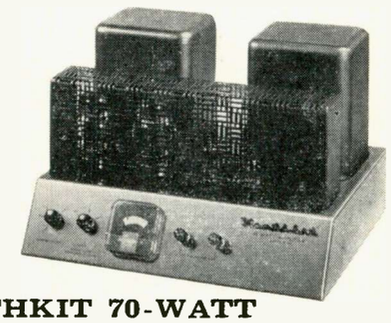
MODEL WA-P2 $19.75 (with cabinet)

pioneer in "do-it-yourself" electronics

HEATH

a subsidiary of Daystrom, Inc.

COMPANY • **BENTON HARBOR 18, MICHIGAN**



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

MODEL W-5M

$59.75

high fidelity amplifier kits

MODEL W-6M

$109.95

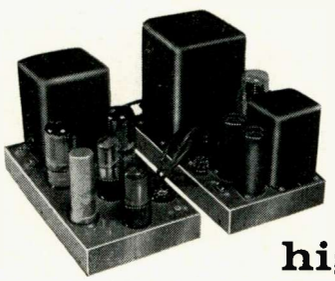
To provide you with an amplifier of top-flight performance, yet at the lowest possible cost, Heath has combined the latest design techniques with the highest quality materials to bring you the W-5M. As a critical listener you will thrill to the near-distortionless reproduction from one of the most outstanding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

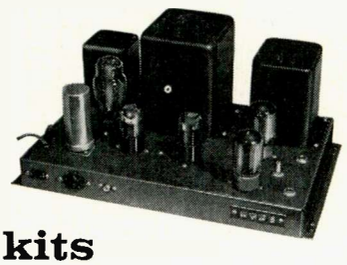
$49.75



HEATHKIT SINGLE-CHASSIS

MODEL W4-AM

$39.75

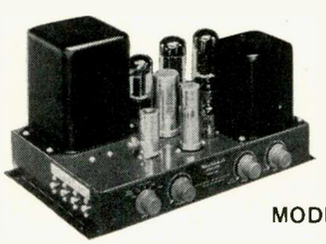


HEATHKIT

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

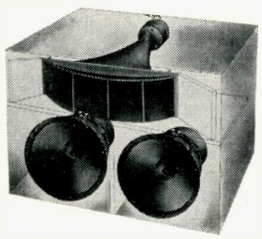
MODEL XO-1 **$18.95**

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.

HEATHKIT "LEGATO"

high fidelity speaker system kit

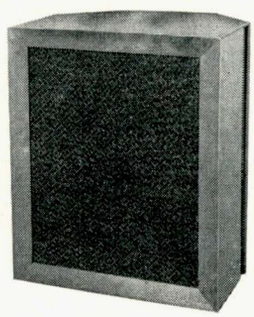
Wrap yourself in a blanket of high fidelity music in its true form. Thrill to sparkling treble tones, rich, resonant bass chords or the spine-tingling clash of percussion instruments in this masterpiece of sound reproduction. In the creation of the Legato no stone has been left unturned to bring you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



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

HEATHKIT
BASIC RANGE

HEATHKIT
RANGE EXTENDING



high fidelity speaker system kits

MODEL SS-1 $39.95

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

MODEL SS-1B $99.95

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

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

pioneer in "do-it-yourself" electronics

a subsidiary of Daystrom, Inc.

☐ Please send the Free HEATHKIT catalog.

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

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address

city & state

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.

Audionews

STEREO PICKUP CARTRIDGE

The first commercially available American-made stereo cartridges are now in limited production at Fairchild Recording Equipment Company.

Developed to play back the 45/45 Westrex stereo records, the Fairchild model has two coils, one placed inside the other, and mounted at right angles to each other at 45° to the vertical axis. Vertical components produce an equal and in-phase output from both coils while lateral components produce an equal but out-of-phase voltage from both coils. The cartridge may also be used with either standard vertical or lateral recordings.

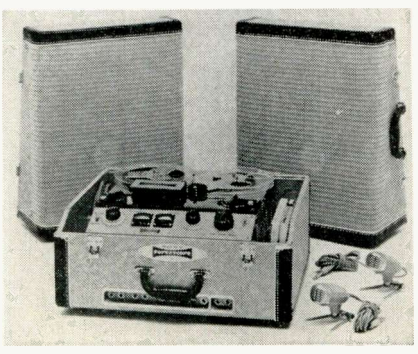
Crosstalk between channels is attenuated by approximately 20 db at 1 Kc. The cartridge uses a ½-mil diamond stylus and has approximately 3 millivolts output per channel.

Because of its physical size it cannot be mounted in standard playback arms. For this reason and because of other problems associated with compliance, resonance, and tone-arm mass, Fairchild supplies the cartridge mounted in a specially modified arm. Known as the *Model 603*, the combination arm and cartridge is available on a limited basis at $250 (whew!).

SUPERSCOPE STERECORDER

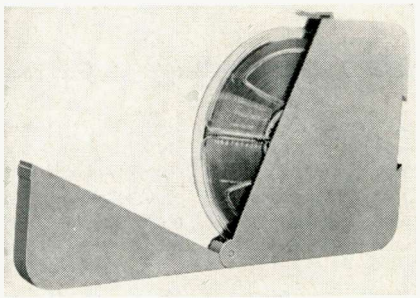
The *Sterecorder*, introduced by Superscope, Incorporated, is a low-cost stereo recording and playback system in a single unit. Priced at $549, the system comes equipped with two matched high-impedance dynamic microphones. Independent channels for preamplification and power amplification are built in. The drive mechanism, powered by a heavy-duty hysteresis-synchronous motor, operates on the rim-drive principle; the large pinch roller and capstan are said to reduce flutter and wow below 0.2%. Frequency response is said to be 50 to 12,000 cps. Also included are an in-line erase head, instantaneous stop lever, automatic tape lifter to protect heads during rewind and fast forward, built-in head demagnetizer, and built-in monitor speaker. Tape speeds provided are 3¾ ips and 7½ ips. A second carrying case, optional at extra cost, contains two matched James B. Lansing 12-inch wide-range speakers in separate enclosures. Further information on the Sterecorder is available from the manufacturer.

Sterecorder with matching loudspeakers.



SONORAMIC TAPE AND CONTAINER

Many special features have been included in the *Sonoramic* tape container now being offered by Ferrodynamics for its line of Sonoramic recording tapes. Made of shatter-proof, high-impact polystyrene plastic, the box is hinged at the front and closes tightly to protect tapes from dust and dirt. Storing will be no problem; these containers will fit into bookshelves, stack on a table, or hang on a wall by means of a dovetail slot in the back and a fitted strip available from the manufacturer. Pressure-sensitive index labels and a tape-time ruler for measurement of elapsed and remaining time are also included.



Tape container with handy hinged front.

Sonoramic tape of three types is available on 7-inch reels: 1½-mil acetate (1200 ft.) for most home and professional use, 1-mil Mylar (1800 ft.) for maximum strength and immunity to heat and humidity; ½-mil Mylar (2400 ft.) for extra recording time under low tension. The tape is said to have high resistance to abrasion, print-through, and cupping; noncritical bias; and lifetime lubrication.

FISHER AUDIO CONTROL

Fisher Radio Corporation is currently marketing the *Model 90-C* master audio control which supersedes the Model 80-C.

The unit features eleven controls and seven inputs. Controls include BASS, TREBLE, LOUDNESS, PRESENCE, VOLUME (as well as five independent mixer-level controls), a rumble filter, push-button channel selectors, and mixing and fading controls.

Harmonic and intermodulation distortion are said to be virtually nonmeasurable. The unit is completely self-powered and has a magnetically shielded and potted transformer. Sufficient amplification is provided for playback directly from the tape-playback head. A separate high-gain mike preamp is supplied for mixing.

Fisher 90-C features eleven controls.

The 90-C is 12¾ in. wide by 8¼ deep by 4¼ high and is priced at $119.50; a mahogany or blond cabinet is available optionally at $9.95 (prices slightly higher in West).

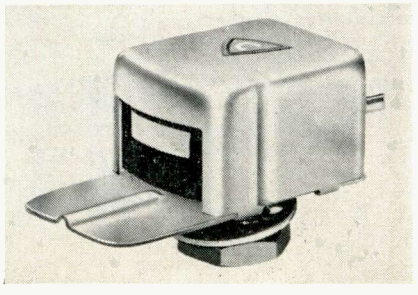
AR-2 BROCHURE

Acoustic Research, Incorporated, manufacturer of the AR-1 and AR-2 speaker systems, has prepared a new four-page *brochure* on the AR-2. This leaflet includes a brief explanation of the acoustic-suspension design, harmonic-distortion and frequency-response curves, and excerpts from press comments on the AR-2; it is free for the asking.

CREST TAPE HEADS

Production of a new line of high-output magnetic tape-recording heads has been announced by Crest Electronics. The line includes monaural and stereophonic record, playback, record-playback, and erase models. A built-in tape guide allows the tape to ride smoothly with only

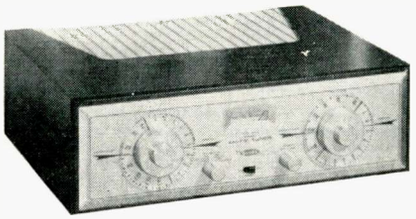
High-output heads are fully shielded.



gravity affecting it, and there is full shielding on all sides except the playing surface for good hum attenuation. Crest reports that they have been able to manufacture laminated pole pieces of alloy instead of solid mu metal without a substantial increase in cost.

SCOTT STEREO TUNER

The latest model of the H. H. Scott *Model 330* FM-AM stereo tuner is now in production. New engineering design has raised FM sensitivity to 2 μv for 20 db quieting, according to the manufacturer. AM and FM sections are completely separate, to accommodate FM-AM stereo broadcasts; also, there are provisions for multiplex so that the tuner will be able to handle any future type of stereo broadcasting. Sensitivity of the AM section is said to be 1 μv for usable audio output. The new detector design is said to assure freedom from distortion at highest modulation percentages and at highest frequencies. There is a 10-Kc whistle filter; the three-position adjustable IF band width includes wide range, normal, and distance.

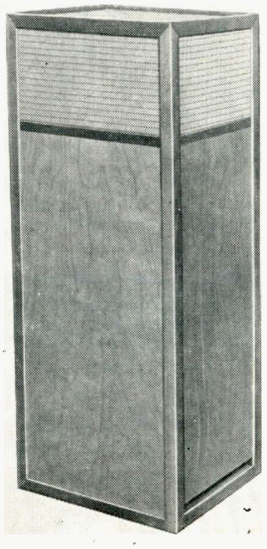


Stereo tuner provides for multiplex.

EICO SPEAKER SYSTEM

EICO is presenting a unique new speaker system designated the HFS-2 Standard. The woofer is an 8½-inch unit rear-loaded by a slot-loaded split conical horn 12 ft. in length; the tweeter is a separate coaxially mounted free-floating cone plus a fixed inner-loading cone mounted in the open above the horn-mechanism box.

Speaker system uses little floor space.



The speaker can be satisfactorily driven by a 10-watt amplifier, but its power-handling capacity is 30 watts continuous with 60 watts on peaks. Frequency response is said to be essentially flat from 45 to 20,000 cps. An unusual feature is its essential nondirectivity.

Measuring 36 by 15¼ by 11½ in., and weighing 45 lbs., the HFS-2 can be bought for $139.95 in mahogany, walnut, or blond-birch finish.

ARGONNE CATALOGUE

Recently published by Argonne Electronics is a 12-page catalogue, *ARC-7*, with a new price list covering their entire line of miniaturized components, specialty and audio items. Among other things described are microphones, earphones, pickup arms and cartridges, multitesters, and remote volume controls.

SAVBIT-ALLOY SOLDER

Ersin Multicore 5-core solder, marketed in this country by British Industries Corporation, is now being made with a patented *Savbit* copper-loaded alloy. It is said to reduce wear on soldering-iron tips by 9/10 and to have a strength that is slightly greater than the usual tin-lead alloys; the melting point is virtually the same.

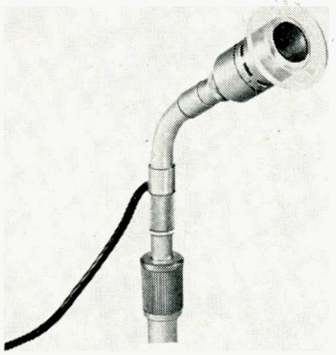
Reduces wear on soldering-iron tips.

RESLO DYNAMIC MICROPHONE

A new microphone being distributed by the Fen-tone Corporation is the Reslo *DPH* dynamic mike. It is not a cardioid, but a semidirectional, pressure dynamic unit, primarily designed for PA work and good for recording as well. A plastic baffle ring increases the effective size of the face without increasing the physical size of the microphone. The DPH is said to be shock proof and to have a substantially linear response from 20 to 15,000 cps, —54 db output at high impedance and —55 db at 50 ohms referred to high impedance.

It is available at a net price of $85 in a satin chrome finish and with impedances of 50 ohms or Hi-Z.

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.



Plastic baffle increases size of face.

COMPONENTS GI SPECIAL

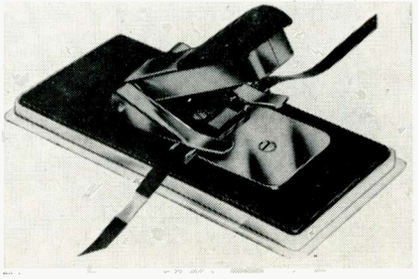
Components Corporation has announced the availability of a new turntable, the *GI Special.* Specially designed to meet the need of Armed Forces personnel who are occasionally located in low power frequency areas, the unit may be operated on 50 or 60 cps by shifting the belt to the appropriate step on the turntable's pulley. Speed is 33⅓ rpm. The turntable sells for $44.50.

IRISH TAPE SPLICER

The *Irish Tape Splicer*, a professional device for editing magnetic recording tape, in now being manufactured by ORRadio Industries.

It is easy to handle and will make a neat splice in seconds. Two rounded indentations are cut in the splice, giving it a narrow waist and leaving the edges of the tape which contact parts of the recorder free of adhesive. The splicer may be removed from its base and mounted directly on any tape recorder. Price is $8.85.

May be mounted directly on recorder.



FREE! LAFAYETTE CATALOG

A Must For Every Hi-Fi Enthusiast

NEW 180 PAGE ELECTRONIC CATALOG FEATURING THE BEST BUYS IN THE BUSINESS

The newest and largest assortment of Electronic, Radio and TV parts, Hi-Fi and Public Address Components and systems, Test Equipment, tubes, Transistor Kits and miniaturized components for transistor circuitry, Ham Equipment, Builders Kits, Tools, Books, Microscopes, Binoculars, Telescopes, Cameras, and Drafting Equipment.—**ALL AT LOWEST PRICES**—Catering to the economy minded dealer, serviceman, engineer, technician, experimenter and hobbyist. **CRAMMED FULL OF MONEY SAVING BUYS. SEND FOR YOUR FREE COPY TODAY.**

New! YEARS AHEAD! *Lafayette* STEREO TUNER KIT

THE MOST FLEXIBLE TUNER EVER DESIGNED

KT-500 IN KIT FORM **74.50**

- Separately Tuned FM and AM Sections
- Dual Cathode Follower Output
- Armstrong Circuit with FM/AFC and AFC Defeat
- 12 Tuned Circuits

More than a year of research, planning and engineering went into the making of the Lafayette Stereo Tuner. Its unique flexibility permits the reception of binaural broadcasting (simultaneous transmission on both FM and AM), the independent operation of both the FM and AM sections at the same time, and the ordinary reception of either FM or AM. The AM and FM sections are separately tuned, each with a separate 3-gang tuning condenser, separate flywheel tuning and separate volume control for proper balancing when used for binaural programs. Simplified accurate knife-edge tuning is provided by magic eye which operates independently on FM and AM. Automatic frequency control "locks in" FM signal permanently. Aside from its unique flexibility, this is, above all else, a quality high-fidelity tuner incorporating features found exclusively in the highest priced tuners.

FM specifications include grounded-grid triode low noise front end with triode mixer, double-tuned dual limiters with Foster-Seeley discriminator, less than 1% harmonic distortion, frequency response 20-20,000 cps ± ½ db, full 200 kc bandwidth and sensitivity of 2 microvolts for 30 db quieting with full limiting at one microvolt. AM specifications include 3 stages of AVC, 10 kc whistle filter, built-in ferrite loop antenna, less than 1% harmonic distortion, sensitivity of 5 microvolts, 8 kc bandwidth and frequency response 20-5000 cps ± 3 db.

The 5 controls of the KT-500 are FM Volume, AM Volume, FM Tuning, AM Tuning and 5-position Function Selector Switch. Tastefully styled with gold-brass escutcheon having dark maroon background plus matching maroon knobs with gold inserts. The Lafayette Stereo Tuner was designed with the builder in mind. Two separate printed circuit boards make construction and wiring simple, even for such a complex unit. Complete kit includes all parts and metal cover, a step-by-step instruction manual, schematic and pictorial diagrams. Size is 13¾" W x 10⅜" D x 4½" H. Shpg. wt., 18 lbs.

The new Lafayette Model KT-500 Stereo FM-AM Tuner is a companion piece to the Models KT-300 Audio Control Center Kit and KT-400 70-watt Basic Amplifier Kit and the "Triumvirate" of these 3 units form the heart of a top quality stereo hi-fi system.

KT-500.....Net **74.50**

KT-300 IN KIT FORM **39.50**

LAFAYETTE MASTER AUDIO CONTROL CENTER with BINAURAL CHANNEL AND DUAL VOLUME CONTROL.

- Self-Powered
- DC On All Filaments
- 24 Positions of Equalization
- Tape Head Input, High Impedance
- Dual Cathode Follower Output Stages

This is not only the finest hi-fi preamp characterized by unmatched features, but it has been functionally designed to keep pace with the conversion of your present hi-fi system to binaural (Stereophonic) sound. Incorporates an extra channel and dual volume control for binaural reproduction. Features include DC on all tube filaments, negative-feedback in every stage, dual cathode follower output stages and latest printed circuit construction. Less than 0.09% IM distortion and less than 0.07 harmonic distortion at 1V. Hum and noise level better than 80 db below 3V. Uniformly flat frequency response over entire audible spectrum. 7 inputs for every type of phono, tuner or tape. Tasteful styling, brilliantly executed. Size 12¾ x 9⅛ x 3¾". Shpg. wt., 10½ lbs.

KT-300—Lafayette Master Audio Control Kit Complete with cage and detailed assembly instructions. ..... Net **39.50**

LT-30—Same as above completely wired and tested with cage and instruction manual. Net **59.50**

KT-400 IN KIT FORM **69.50**

DELUXE 70 WATT BASIC AMPLIFIER

- Conservatively Rated At 70 Watts
- Inverse Feedback
- Variable Damping
- Metered Balance And Bias Adjust Controls
- Available In Kit and Wired Form

Here's ultra-stability in a 70 watt basic power amplifier employing highest quality components conservatively rated to insure performance and long life. Features matched pair KT 88's and wire range linear Chicago output transformer, variable damping control, meter for bias and balance and gold finish chassis; Frequency response 10-100,000 cps ± 1db. Hum and noise 90 db below full output. IM distortion less than 1½% at 70 watts, less than 0.3% below 30 watts. Harmonic distortion less than 2% at 70 watts from 20 to 20,000 cps ± 1 db. Output impedance 4, 8 and 16 ohms. Handsome decorative cage perforated for proper ventilation. Size 14½ x 10 x 7⅜" including cage and knobs. Shpg. wt., 40 lbs.

KT-400—Lafayette 70 watt Deluxe Basic Amplifier Kit complete with cage and detailed assembly instructions. .....Net **69.50**

LA-70—Same as above completely wired and tested with cage and instruction manual. Net **94.50**

HIGH FREQUENCY TWEETER WITH ACOUSTIC LENS

New! DIRECT IMPORTATION MAKES THIS PRICE POSSIBLE!

14.95

- FREQUENCY RESPONSE FROM 2000 CPS TO BEYOND AUDIBILITY
- LOUVERED ACOUSTIC LENS FOR UNIFORM SOUND DISPERSION
- HANDLES 25 WATTS OF POWER
- PRICED EXCEPTIONALLY LOW

New high frequency tweeter featuring a louvered acoustic lens for uniform sound dispersion and capable of handling up to 25 watts of distortion-free power. The directional tendency of high frequency notes is overcome by the natural wide dispersion angle of the short horn and the acoustic lens which disperses and radiates the high notes smoothly throughout the entire listening area. The lens is detachable for panel mounting, with a separate base for the tweeter furnished for external mounting where desired. Aluminum voice coil has 16 ohms impedance. Size: 4¼" long x 3" diameter, lens extends 2½". Requires a crossover network, preferably one with a level control, such as the LN-2. With full instructions. Shpg. wt., 5 lbs.

HW-7 .....Net **14.95**

Lafayette Radio **DEPT AC-B** 165-08 LIBERTY AVE. JAMAICA 33, N. Y.

☐ Send FREE LAFAYETTE Catalog 305

Name .....

Address .....

City..... *Zone*.... *State*.....

CUT OUT AND MAIL TODAY

Gentlemen:
A short time ago I found myself in the same state of confusion reported by Mr. Adolph Rebensburg in "Readers' Forum," December AUDIOCRAFT. I had read the test results article on the Knight-Kit FM Tuner, and had pretty well talked myself into having a go at it. This was no simple job of self-persuasion, since my wife won't even trust me to repair a light switch.

Then those pessimists at Consumers Reports got to me too. I hate to admit it, but my faith was somewhat shaken. In fact, after reading their article on FM tuners, I wondered if the whole thing weren't just a mad dream.

But then the irresistible desire to try the Knight-Kit overcame my indecision and I sent my order to Allied Radio. When I got my hands full of resistors, capacitors, printed circuits and the like, I felt like a real genius. As old Magoo says, "A child could do it."

As happens to all kit builders, I suppose, the disarming simplicity of building the thing makes one wonder if it really will work. But work it did, *and well.*

Not being blessed (or cursed) with a truckload of test gear, I gave it, nevertheless, the most critical test I could devise. I sat down and listened to it. To my admittedly unprofessional ear, sharpened by only a year of the "incredible realism of stereophonic sound," this FM tuner gave me a new and enjoyable source of good music. In short, it sounds good. So what else do I need?

If it's any comfort to reader Rebensburg, and if he has not already done so, I'd advise him to build that Knight-Kit and forget about Consumers Union. I don't imagine they are particularly happy people anyway.

Aaron L. Andrews, D.V.M.
Ashland, Ohio

Gentlemen:
I have enjoyed AUDIOCRAFT from the first issue. Although I have no technical electronic knowledge, I have successfully constructed several kits based on advertisements in your publication. Now that you've started it, I feel you're the one to ask for a solution to a problem!

I would like to construct the Dynakit preamp, but have no provision for power take-off from my (nonstandard) amplifier. For this and other reasons, I

Continued on page 38

New hope for AM listeners

IN a time when good-music broadcasting on FM has expanded to a point at which it provides an important secondary source of wide-range, distortion-free program material for most of us who enjoy such music well reproduced, listeners who are forced to rely on AM radio alone have been left out in the cold. An occasional AM station does broadcast wide-range signals, but, beyond a few miles from the transmitter, interference from other stations makes it impossible to take advantage of the increased fidelity. With its sensitivity to electrical noises also, greatly increased after-dark distortion from selective fading, and maximum usable response range of about 4,500 cps, conventional AM today can fairly be called a high-fidelity medium only for a limited number of listeners: those who happen to live close to a wide-range AM station and also have hi-fi AM tuners.

A new development in AM broadcasting technique may, however, make this situation a lot better. It is known as the compatible single-sideband (CSSB) system. After more than a year of successful operation on the Voice of America million-watt transmitter in Munich, Germany, and the 50-Kw station, WMGM, New York, WABC (New York) and WSM (Nashville) have decided to make full-time tests of the new system. If these tests turn out well too, CSSB will certainly be adopted on a wide scale.

Conventional AM transmission consists of the main carrier frequency together with a double set of sidebands; these sidebands are located above and below the carrier frequency, separated from it by intervals equal to the audio frequencies being transmitted. If a 1-Mc carrier is amplitude-modulated by a 5,000-cps audio tone, for example, the transmission would consist of a lower sideband at 0.995 Mc, the 1-Mc carrier, and an upper sideband at 1.005 Mc. This would occupy a channel 10 Kc wide. Since AM stations are assigned frequencies only 10 Kc apart, any audio-modulation frequencies above 5 Kc may (and often do) encounter interference from other stations, particularly after dark. And when fading affects one set of sidebands more than the other, intolerable distortion is produced.

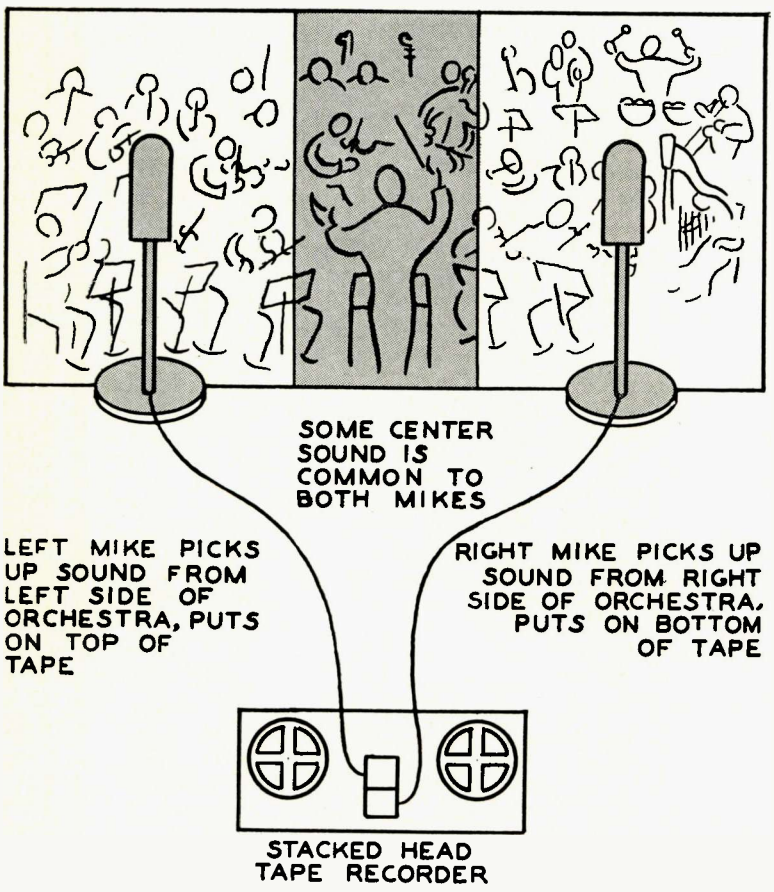
It should be noted that these two groups of sidebands are mirror images of one another so that, theoretically, all the necessary intelligence is contained in each. If a special type of receiver is used, one set of sidebands can be eliminated at the transmitter. This is known as a single-sideband (SSB) system. SSB has been used by amateur radio operators and in communications systems for several years. Since it requires only half the frequency band width of a standard AM system for an equivalent audio-modulation range, the following choices are available: the number of stations can be doubled or the interference can be markedly reduced, if the upper audio-frequency limit is held the same; alternatively, for the same number of stations, the upper audio-frequency limit can be doubled. Further, the distortion caused by selective fading is drastically reduced. Not least in importance, both sideband groups consume transmitter power; by eliminating one of them, the effective power of the transmitter is increased, thereby improving the signal-to-noise ratio of the system. A further increase in effective power can be obtained by eliminating the carrier frequency also (this is called a *suppressed-carrier* SSB system).

Attractive as these systems are in theory, they are impractical for regular AM broadcasting because they would require replacement of all existing receivers. That's where CSSB enters the picture. By an ingenious alteration of the AM transmitter, a single-sideband signal is produced which has the same envelope shape as a standard AM signal. It can, accordingly, be received without distortion on a standard AM receiver or tuner. Advantages claimed for CSSB transmissions (which are apparently obtained in practice) are reduced noise and interference, greatly reduced distortion — particularly fading distortion — and improved frequency response, even on existing table-model receivers.

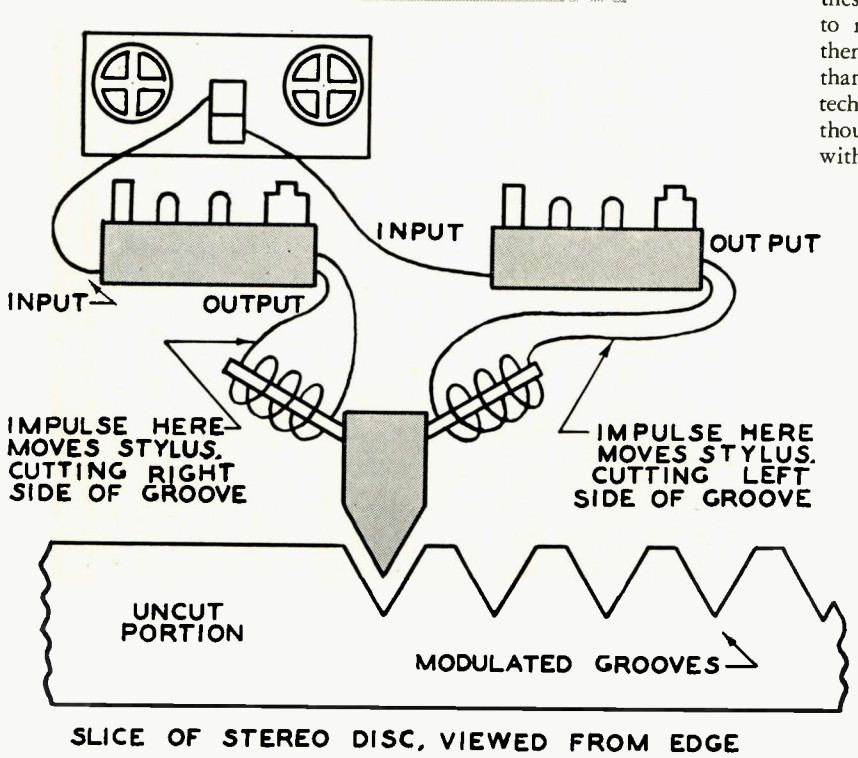
When CSSB takes over AM, as it probably will, the industry will have a choice to make: whether to retain the present AM broadcast channel width, with the advantages outlined above; or to reduce the channel width in order to make room for more stations and permit the manufacture of simpler, less expensive receivers. The decision will depend in large measure on how listeners feel about it and how strongly they make their opinions known. — R.A.

All About

RECORDING IN STEREO



STEREO DISC PROCESSING



There's been many a rumor lately about a mysterious process which puts stereo sound on records. Here are the facts.

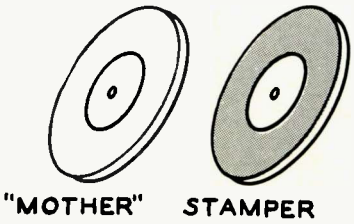
by JOEL EHRLICH

OF the many recent advances in high-fidelity music reproduction, perhaps the most significant has been the growth of stereo. This is all the more remarkable because it has involved the use of tape, and tape has never been accepted by the public at large as a home-music medium. The average person thinks of tape in connection with radio and TV technology, requiring highly complex controls and knowledge far above that of the average man. If stereo on tape has grown so fast despite this public attitude (justified or not), then obviously there is great interest in stereo sound itself. And just as evidently, the forthcoming introduction of monogroove stereo discs has been perfectly timed.

Methods of Stereo Recording

Stereo itself is nothing new. It has been around since the late 20's and early 30's, when the Bell Telephone Laboratories conducted some experiments with stereophonic and binaural sound reproduction. (*Binaural* means two-eared, i.e., listening with two ears or with earphones. *Stereophonic* implies multiple-channel reproduction heard via loudspeakers. When I refer to *stereo* I will follow the industry convention in meaning two-channel sound reproduced with loudspeakers.)

The Bell experiments proved invaluable to the industry years later when it began work with stereo in earnest. From these early experiments, we can determine why sound appears to move from one source to another as the level between them is varied, and why some stereo recordings sound better than others. They are also the basis for many pseudostereo techniques. Thus, we got an early start with stereo, even though more work was done with binaural listening than with stereo. Since there was then no such thing as tape as



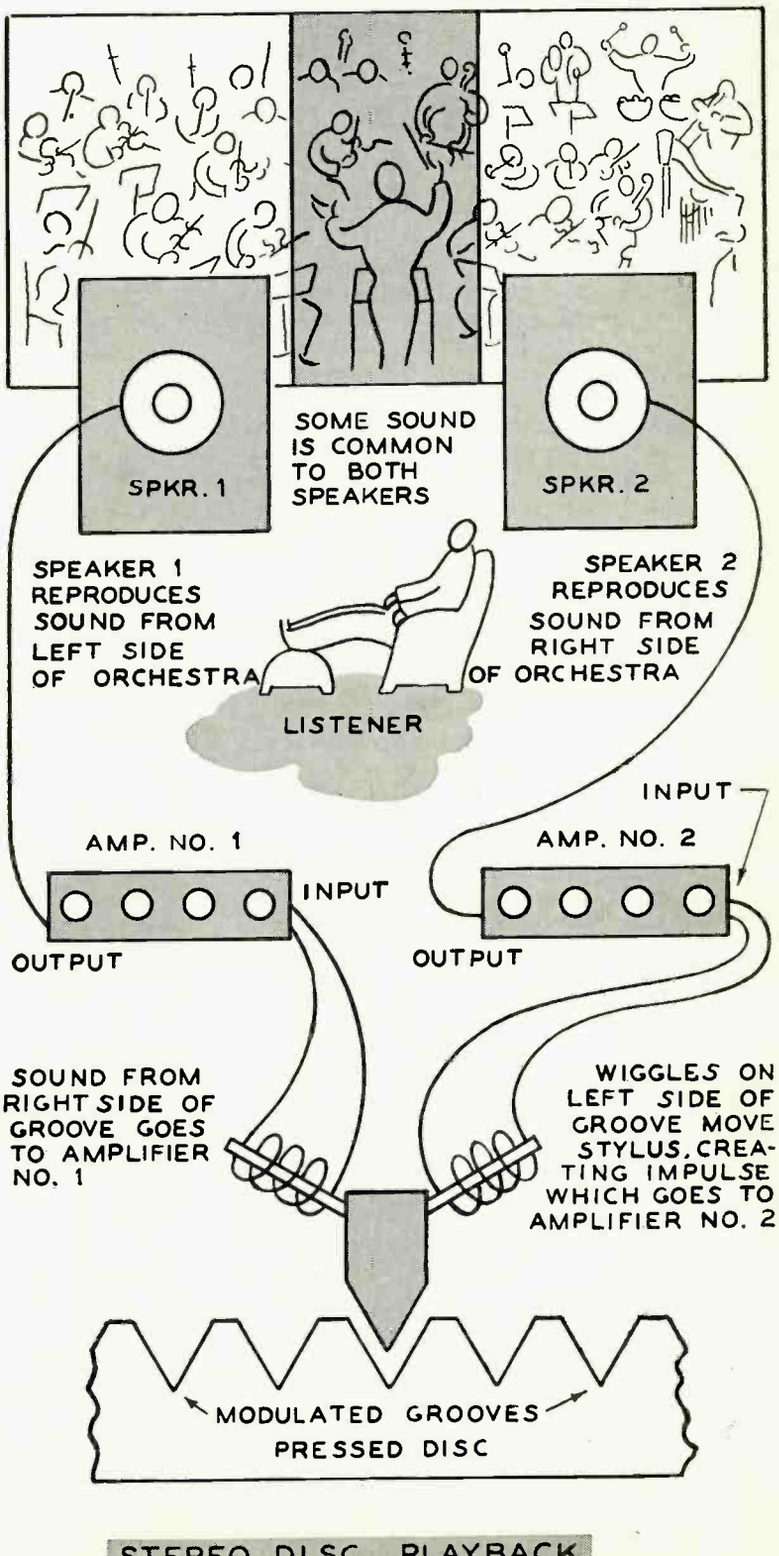
Stereo Discs

we know it now, all the Bell work was with live sources. At the same time in England, EMI was carrying on similar experiments, but they recorded the sound on discs.

Everyone is familiar with conventional lateral-groove records, but let us review the technique quickly. A signal to be recorded is amplified and fed to a recording cutter stylus. Through one of several electromechanical means, this signal causes side-to-side (lateral) motion of the stylus, which produces lateral undulations of the groove spiraling from the outer edge of the disc toward the center. This is only one method of getting sound onto a disc. Another is by vertical groove modulation, in which the signal causes the cutting stylus to extend from and retract into the cutter. Thus, the signal causes hills and dales to be cut into the spiral groove. A combination of the two systems will produce two independent signals in a single groove. We need two independent channels for stereo, and EMI put them on discs by using various combinations of groove motion. At the time, records were quite new and the results were less than satisfactory, but it was a start. The vertical/lateral system was quickly forgotten by the public which, in fact, had heard very little about it.

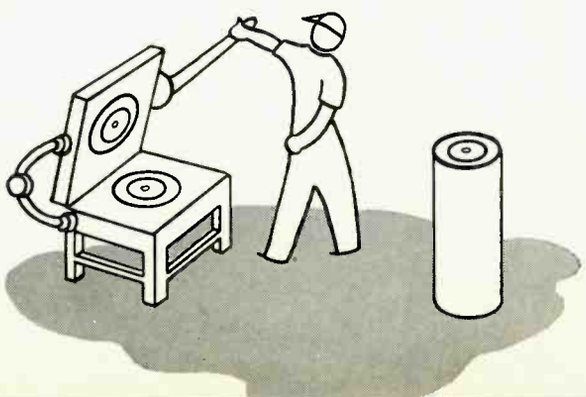
The next time stereo recording received notice was in conjunction with an industrial tape recorder made by Magnecord for a Detroit motor company. The machine was able to record two independent tracks on a single tape. Since it was desirable to use standard ¼-inch tape, the recorder developed had two half-track heads. The upper-track head was placed in its regular position behind a full-track erase; 1¼ in. behind it was the second (or lower-track) head. Since this provided for two simultaneous channels, Magnecord engineers promptly called this a stereo tape recorder. Most units were sold to universities and laboratories, but some found their way into radio stations and some homes. It wasn't very long before recorded stereo tapes were released for playback on these and other such machines. And stereo was on its way.

This was, of course, what we call staggered stereo. People who wanted to record as well as play tapes on these machines soon began finding fault with them. For one thing, it was



STEREO DISC PLAYBACK

PRESSINGS FROM STAMPER ARE MADE IN THE USUAL WAY



First on the scene — Audio Fidelity Records announces it's first stereo disc release — AFLP 1872, "The Dukes of Dixieland and Railroad Sounds"

almost impossible to edit the tape — the two tracks were just far enough apart to make an almost impossible splice. Besides, it required the use of two separate heads. The industry began working on a stacked stereo head having two gaps, one directly over the other: actually, two heads in one.

Then stereo discs came up again. This time it was an American development by Emory Cook. His system was unusual, yet simple. One channel was cut on the outer half of a conventional laterally cut record, and the other channel was cut on the inner half of the same record side. To play back it required two complete sound systems (this is always the case with stereo): two cartridges, two amplifiers, and two speaker systems. One cartridge was mounted in a "sidecar" affixed to the inside of a conventional tone arm in line with the regular cartridge. In this manner it was possible to play the inner band while the conventional cartridge tracked the outer band. Both were normal microgroove cartridges. The prime difficulty was getting both styli into the proper relative parts of the lead grooves at the same time, or, in other words, to synchronize the two channels. It was virtually impossible to begin playing the record at any place except the beginning. This system was purely for the high-fidelity enthusiast since it could not be adapted to record changers.

Meanwhile the stereo tape market was growing strongly. While stacked heads were not yet on the market, almost any tape machine could be converted for staggered stereo playback, and many were. A number of firms began making stereo tapes for these machines and we saw the beginning of another industry.

Besides the record noted above (cut by the Westrex system), there have been several announcements of new Westrex-system cartridges as we go to press December 24.

Fairchild was the first to make it official, with a press release on the Model 603 moving-coil cartridge-and-arm combination, priced initially at $250. Pickering has demonstrated the Stanton 45x45 stereo cartridge, which will not be released until more stereo records are available; tentative price is $60. Fen-Tone will have a stereo B&O cartridge out in February, at $35, and Electro-Voice's Model 61 will be available in February also; it will cost $17.50 with a diamond stylus.

While it was almost wholly within the audio industry, it was new and strong — a very healthy child. Stacked heads appeared; we began to see more and more stacked-head machines on the market and more and more manufacturers of recorded tapes for them. Today, stereo is almost synonymous with tape.

In the period between the early experiments with the stereo discs in England and the time of the stereo tape, things had not been completely quiet. In England, Sugden started to work with V/L recording after EMI went to a new method. The Sugden system is the same as that described previously, except that it is brought up to date with modern magnetic feedback cutters and vinyl discs. It has the same shortcomings, but let us forget them for now and present them later in summary with the shortcomings of all systems.

EMI went to work on an entirely new system, not in the least resembling any other. It is not even true stereo, but pseudo stereo; yet it is very difficult to tell the difference. There are two recording microphones used. One is a dynamic mike that faces the source. It is a true pressure mike, not a cardioid or any of the other patterned dynamic microphones that have appeared. The other is a velocity microphone aligned across the source; this is a conventional bidirectional ribbon mike, sensitive to the velocity of the moving air particles. The dynamic picks up the sound to be recorded and its signal is transferred to the lateral channel of a V/L recording. The velocity mike is sensitive to the direction from which the signal originates. It feeds the vertical channel of the same record groove.

There are several methods of playback. The first involves the use of three speakers, one facing the listening area and the other two speakers behind it and facing outward toward the sides. Alternatively, with a special amplifier, normal stereo speaker position can be used. The special amplifier decides, from the information in the vertical channel, which speaker gets the majority of the signal. Phase relationships are also determined by the signal that the data channel feeds to the special amplifier.

EMI developed this system to overcome the major disadvantage of the conventional V/L system. To have an arm capable of tracking all record faults, such as warp, dirt, groove obstruction, etc., it is necessary to have an arm with great vertical compliance (i.e., one capable of fast vertical movement to track such irregularities). But to reproduce low frequencies cut in a vertical manner, the arm should not follow fast vertical motion. Thus — a paradox! To have high

Fig. 1. Westrex cutter, with vacuum device to remove chip.

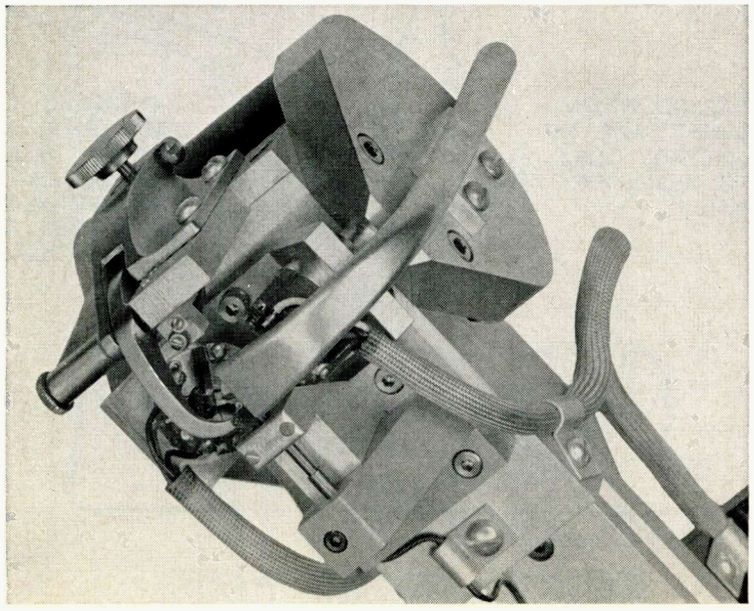
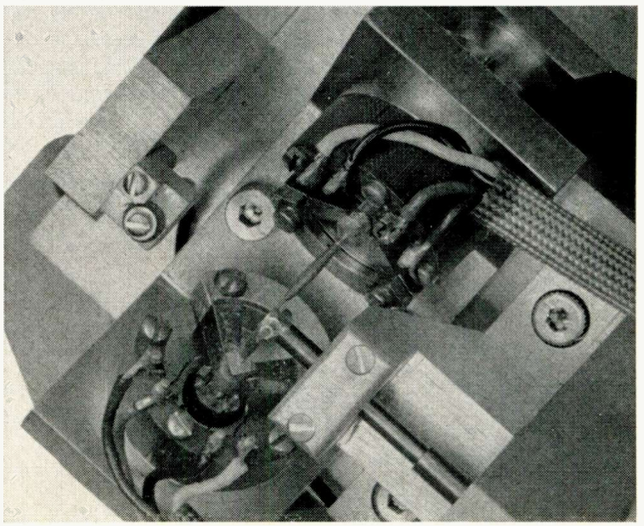


Fig. 2. Stylus close-up shows separate coils for each channel.



vertical arm compliance is to reproduce no low frequencies in the vertical channel. If the pickup assembly does reproduce low frequencies in the vertical channel, it will ruin warped records and destroy styli on these warped records.

In addition, most scratch and pop is actually dirt and other groove obstructions forcing the stylus to hop over or around them. Thus, most of these sounds originate in the vertical channel. A cartridge with high vertical compliance yet low vertical sensitivity will reproduce fewer of these sounds than one lacking in these qualities. A cartridge having high vertical sensitivity is bound to reproduce all these sounds. That is just the situation we have in the vertical channel of a V/L reproducer. EMI, therefore, turned to a data/signal system with data on the vertical channel only, to avoid these difficulties. Lack of low frequencies, scratch, and pop should not bother the amplifier and, since they are not reproduced as sound, we find good reason for the move by EMI.

Still, the Sugden system (standard V/L) does sound good, and it is difficult to find fault with the low-frequency reproduction although the scratch is higher than that to which we are accustomed.

Decca of England (London in the U.S.) also has a V/L system, probably the most fully tested and ready of all those described in this article. I attended a demonstration of this system and, even though I was aware of the shortcomings of any V/L system, could find no apparent fault. The separation was good, on the order of 40 to 45 db, and the sound was superb. Towards the end of the record the vertical channel did pick up some hash from pinch effect in the lateral channel; otherwise, there was no fault to be found with the sound. On closer listening, it was determined that there was no low-frequency output from the vertical channel but, since low frequencies have such long wave lengths, it is impossible to determine the direction from which low frequencies come anyway. As for the scratch and pop, the record must have been quite exceptional; there was none to speak of until the last third of the record.

Very soon after this, Westrex presented its system before the 1957 AES convention. I was even more astonished. Here was an all-new system which, while not so fully developed as the London system, was theoretically more advanced. Although the sound of the Westrex system was not as good as that of the London system, there was good reason for this: Westrex, it should be noted, designs and manufactures record cutters; they do not, however, specialize or even deal in record cutting or pressing. The idea was conceived early in February of 1957, and the first cutter was made soon afterward. From that time, the engineers were doing more demonstrating of the system than perfecting of it. Some discs were cut by the engineers, and hurriedly pressed by Capitol for the demonstration. The discs were cut from Decca, Capitol, and RCA Victor stereo demonstration tapes by a simple transfer with little effort to equalize. In addition, the cutter was one of the first crude models. Thus, we heard a demonstration of hurried pressings of hurriedly cut discs made with no attempt to obtain good sound, cut with an early model of the cutter and played with a crude hand-made prototype reproducer. We did not expect to have it sound especially good.

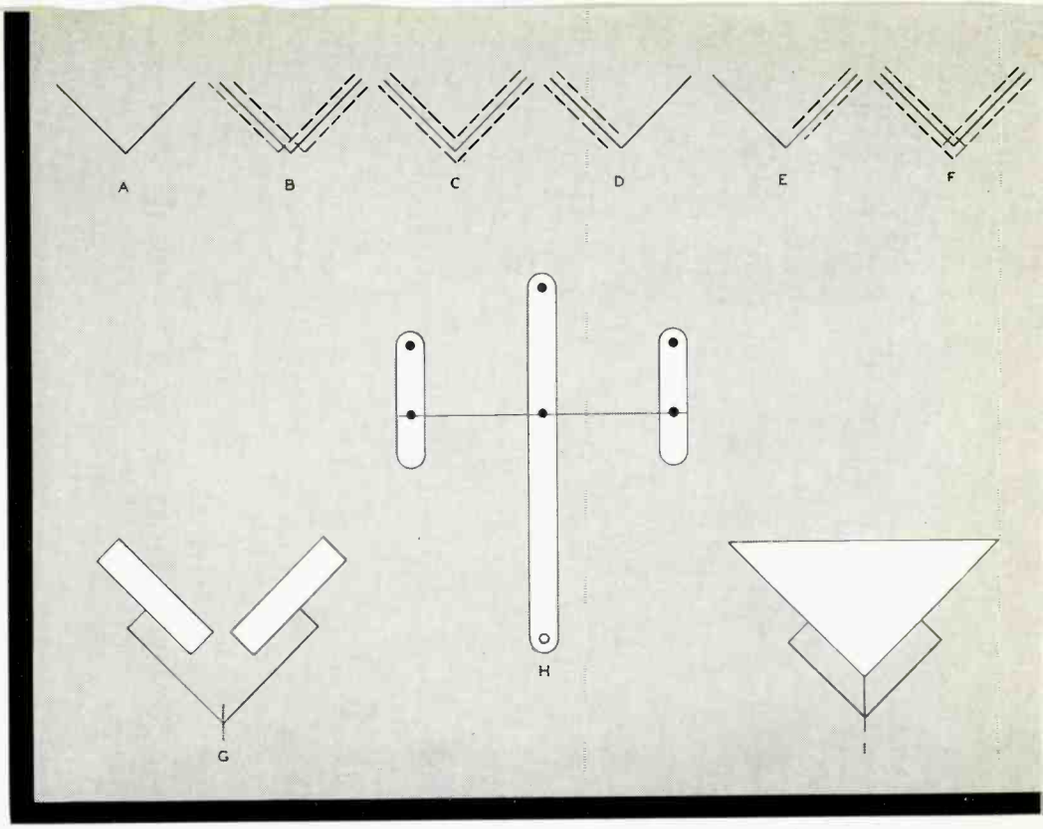


Fig. 4. Diagrams illustrate action of Westrex cutter in forming two-channel groove.

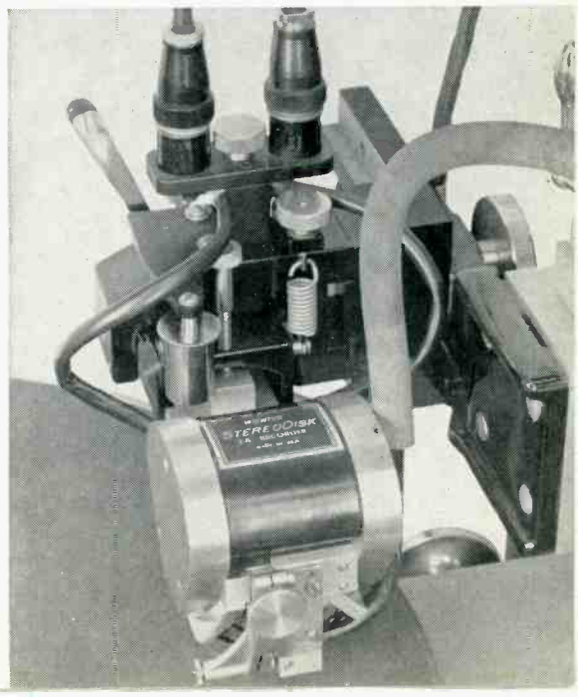
But the theory was as sound as could be. There were a few who were unimpressed or disappointed; I heard some remarks to the effect that stereo discs wouldn't get very far. These people were badly mistaken. They failed to take into account the newness of the system and the hurried work that had been done for this demonstration. Unfortunately, the people who left early were, generally, those who would be affected most by the demonstration. They were the manufacturers of stereo tapes.

Fortunately, the manufacturers of cartridges sat through the demonstration and were deeply impressed. I, for one, have instructed my engineers to begin work on a Westrex system reproducer, and I hope that by the time this article appears the cartridge will be ready for production. Monogroove stereo discs are closer than most people think. At the time I write this (November, 1957) there are no less than 12 Westrex cutters in the hands of major record manufacturers (see Figs. 1, 2, and 3.)

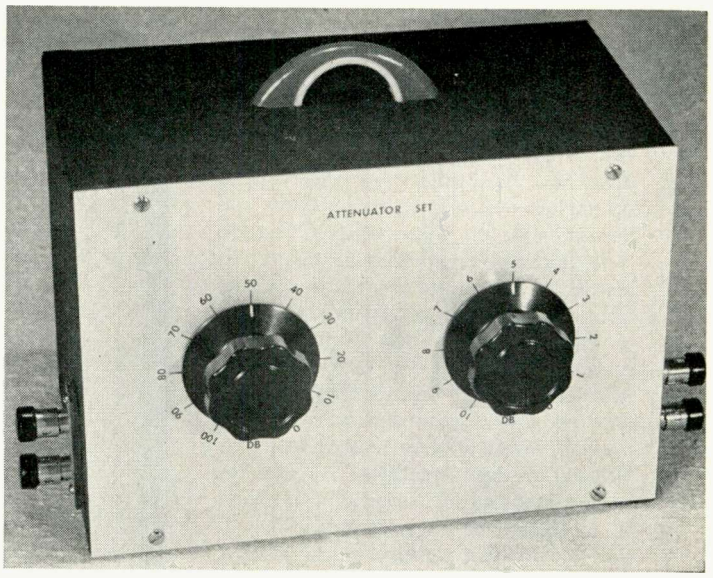
The Westrex stereo cutter is a simple modification of a V/L system. It is called a *45/45* or *vector* system. The signal is cut on the two groove walls as shown in Fig. 4. A shows an unmodulated groove, while B shows the groove with lateral modulations. C is the groove with vertical modulations. D shows it with one channel cut by the vector method, and E shows the groove with the other vector channel cut. Note that each channel occupies its own groove wall. F shows the result of cutting the two vector channels. As can be seen, each channel drives the playback stylus diagonally from the groove. Thus, to illustrate very simply the method of playback, let us take two cartridges of conventional nature and turn them 45° from their normal playing position. Now link the two styli together under the bottom of the two cartridges (Fig. 4G). Then put another stylus midway along the link. Thus we obtain the assembly of Figs. 4H and 4I. As can be seen, the moving mass of the playback

Continued on page 43

Fig. 3. Cutter mounted on turntable.



Make and Use an Attenuator Set



by HAROLD REED

A constant-impedance decade attenuator set is a useful device in audio-test, maintenance, and design work. Although employed extensively in laboratories, it is not usually a part of the average experimenter's collection of measuring and test equipment. This is probably because it seems to be a relatively expensive item — especially when the prospective buyer realizes it is basically just a box with a couple of variable attenuators. However, the serious audio experimenter can make a very accurate instrument of this type at little expense, and with little effort, from the data given in this article. Once he has used this extremely useful device, he would not be without it. All component parts of the unit are commercially available.

A decibel attenuator set can be built around regular T resistive networks or bridged-T circuits. The regular T network, shown in Fig. 1, requires that three different resistors be switched for each switch setting of an attenuator. The bridged-T circuit, Fig. 2, has an advantage in that only two different resistors

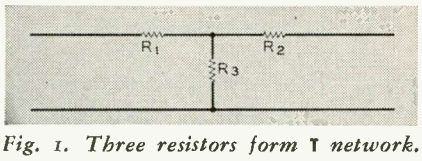


Fig. 1. Three resistors form T network.

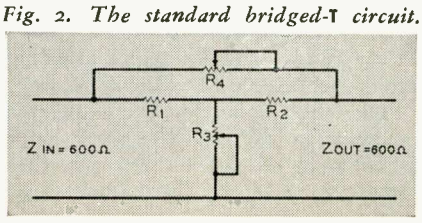
need to be switched into the circuit for each switch step. With this circuit, the values of the series resistors, R_1 and R_2, are each equal to the input and output impedance of the circuit; the bridge and shunt resistances are varied to obtain the desired attenuation.

The device shown here consists of two such variable attenuators (Fig. 3), one providing a total attenuation of 10 db in steps of 1 db, and the second giving a total attenuation of 100 db in steps of 10 db. These are connected in series, producing an instrument which has variable attenuation from zero db to 110 db in steps of 1 db.

The simple arithmetic used in designing the attenuator set is given in the following paragraph. However, the resistor values necessary for building a 600-ohm instrument have been worked out and are tabulated in Tables 1 and 2, so the constructor, if he desires, may ignore these equations. They will be useful to the reader who may wish to design an attenuator of other impedance value. It should be noted, too, that all the attenuators of the complete set can be built and used individually, if desired, without incorporating them into the complete instrument.

As pointed out previously, in the bridged-T circuit configuration the series resistors are each equal to the input and output impedance of the attenuator. Hence, in Fig. 2, R_1 and R_2 would be 600 ohms. The value of the variable shunt resistance, R_3, is found by solving the equation $R_3 = Z \div (K - 1)$. Variable bridge resistance R_4 is found by $R_4 = Z(K - 1)$. In these equations the value of Z is equal to the attenuator

Fig. 2. The standard bridged-T circuit.



impedance. K represents decibels expressed as voltage ratios. Therefore, $K = 10^{db/20}$. Tables giving the values of K from 1 to 100 db are published in several handbooks.* The reader may refer to these if he does not care to work them out for himself.

Attenuator Set Design

As mentioned previously, the attenuator consists of two variable attenuators, one providing up to 10 db attenuation in 1-db steps, and the other giving a maximum of 100 db attenuation in 10-db steps. The circuit, switching arrangement, and resistor values for a 600-ohm instrument are in Fig. 4. Two switches are used: the 10-db attenuator employs a 2-pole, 11-position switch; and the 100-db attenuator requires a 4-pole, 11-position switch. Actually, the 100-db attenuator is made up of two 50-db attenuators. The reason for this method of construction is that, if it is attempted to design a 100-db attenuator as a single unit, some of the resistor values obtained by solving the design equations turn out to be impractical values, in the

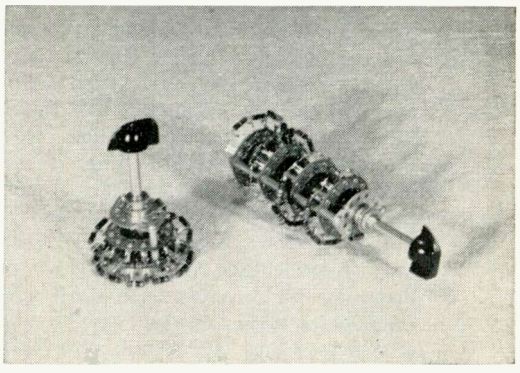


Fig. 3. Shown here are the completely wired switches used in attenuator set.

*Radio Corporation of America, *Radiotron Designer's Handbook*, 4th ed.; Harrison, N.J., 1952.

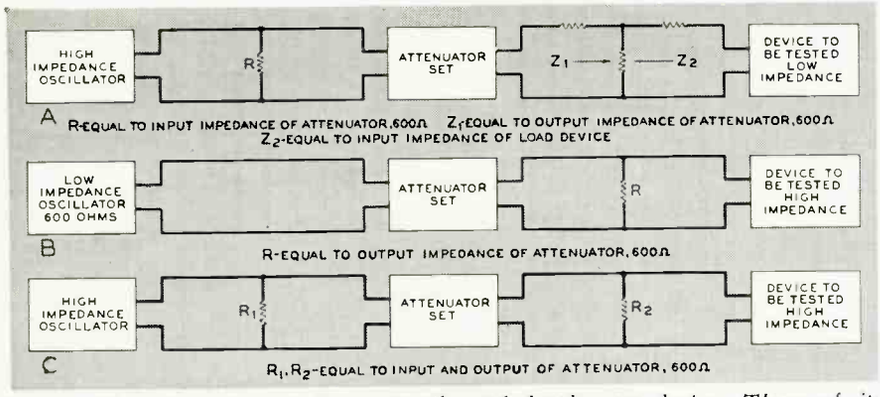


Fig. 5. The attenuator set is a versatile and handy test device. Three of its many possible uses are shown here. The text explains how to find resistor values.

order of very small fractions of 1 ohm. Both the bridge and shunt legs consist of a series string. After the first attenuator step, in each case, the resistance value needed in the circuit is provided by the sum of the resistances that are switched into the circuit. This will be better understood upon examining Tables 1 and 2.

The first column of the tables gives the switch step. Column 2 lists the attenuation in decibels. The third column gives the RETMA resistor values for R_3, and the fourth column shows the RETMA resistors for R_4 (referring to Fig. 2).

Additional compensating resistors may be used in parallel or series with any particular resistors to obtain the correct resistance value for any step, if the proper attenuation is not obtained. With 5% resistors, I made a 10-db attenuator with an accuracy of 0.5% at maximum attenuation with just one extra shunting resistor. The accuracy of a 100-db attenuator was in the order of 1% at maximum with no compensating resistors required.

Construction

Building the attenuator is simple. The switches and input-output terminals are in a 5-by-6-by-9-inch metal cabinet. The 6-by-9-inch panel is etched aluminum, with decals to indicate db attenuation for each switch position. All resistors, of ½-watt size, are soldered directly to the switch terminals (Fig. 4). Soldering should be done quickly with a good clean iron so as not to overheat the resistors. If the constructor needs a device

Continued on page 41

Table 1

10-DB Attenuator Section

Switch Step	Attenuation, db	Resistors for R3, RETMA ohms	Resistors for R4, RETMA ohms
1	0	0	0
2	1	2,700	75
3	2	820	82
4	3	430	91
5	4	240	100
6	5	160	120
7	6	120	130
8	7	91	150
9	8	68	160
10	9	51	180
11	10	270	200

Total computed resistance, R_3 — 4,917 ohms
Total computed resistance, R_4 — 1,297 ohms

Table 2

50-DB Attenuator Sections (2)

Switch Step	Attenuation, db	Resistors for R3, RETMA ohms	Resistors for R4, RETMA ohms
1	0	0	0
2, 7	10, 60	220	1,300
3, 8	20, 70	47	4,300
4, 9	30, 80	13	13,000
5, 10	40, 90	3.9	43,000
6, 11	50, 100	2.0	130,000

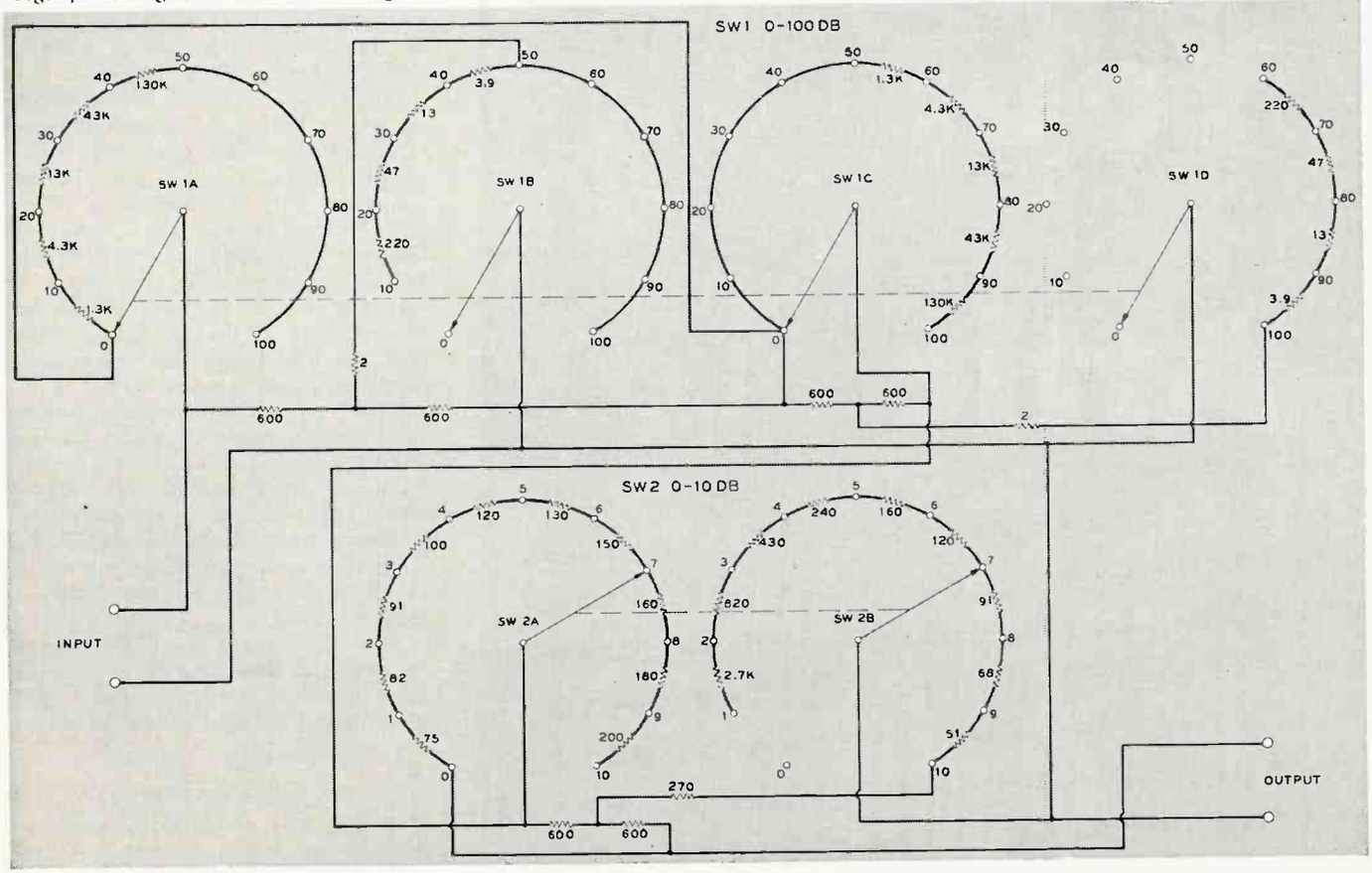
Total computed resistance, R_3 — 277 ohms
Total computed resistance, R_4 — 189,138 ohms

Table 3

Input: 1 Volt, 1,000 cps

Attenuation, db	Output volts	Attenuation db	Output volts
1	0.8913	8	0.3981
2	0.7943	9	0.3548
3	0.7079	10	0.3162
4	0.6310	20	0.1000
5	0.5623	30	0.0316
6	0.5012	40	0.0100
7	0.4467	50	0.0032

Fig. 4. Enlarged schematic drawing of switching circuitry which gives attenuator set its precise control over signal voltages.

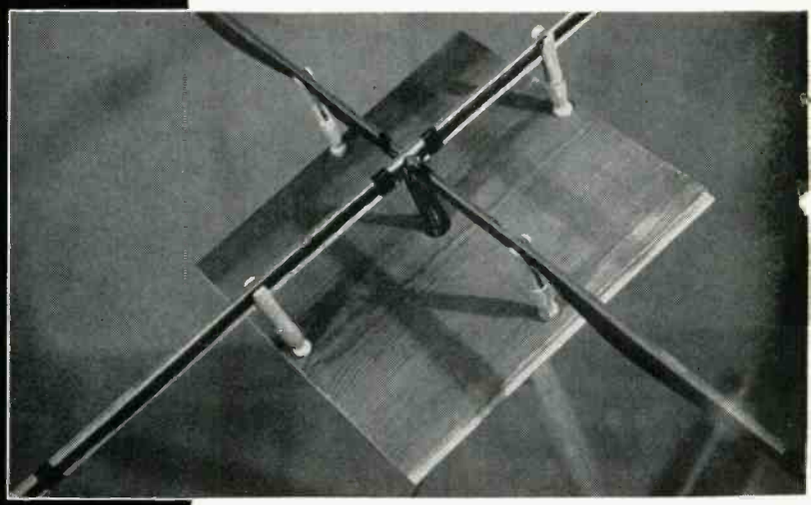


Make this simple-to-construct

FM Antenna For Your Attic

with clothespins and 300-ohm twin lead.

by EDWARD T. DELL, Jr.



METROPOLITAN-AREA FM listeners often use a folded dipole made of 300-ohm twin lead as an antenna. Many of us have made dozens of them for ourselves and friends. The one disadvantage of such an antenna is its directional characteristic. If you live between several transmitters you will notice a difference in signal strength when the T is rotated parallel to the ground. If you live outside the metropolitan area this directional characteristic is fine, but right in town it can be difficult. Looking at Amphenol's crossed folded dipole, which is nearly omnidirectional, I became curious as to whether a homemade model would be practical.

It can be made, and it will increase the signal strength of most stations from 15% to 25%, as well as make the signals receivable from almost any point on the compass. The cost is about a dollar. Materials appear in Fig. 1.

A dipole should ideally be cut to half the wave length of the carrier frequency of the station. This must be a compromise length, of course, since stations are spread over the band from 88 to 108 Mc. In essence, this antenna is simply two flat dipoles mounted at right angles, coupled together, and cut to a length that is the middle point of the two extremes of the FM band, which is 98 Mc. This length, about 50 in., was calculated according to the formula $L = 4{,}900/f$, where L = length in inches, and f = the carrier frequency in Mc. If the stations in your area have a smaller frequency spread than the full band — say, 101.5 to 96.9 Mc — you may figure your own length by finding the middle point between the extremes and using the formula above to find the length of the cross arms.

Since the antenna is omnidirectional, the two cross arms must be 90° out of phase, requiring a phasing stub of ¼ wave length, or one-half the length of the cross arms.

Construction

Strip the ends of all three pieces of the 300-ohm twin lead for about ½ in.

Twist together the two wires at each end of the two 51-inch lengths of twin lead and solder them. This will make two continuous loops of wire. Now find the exact middle point of one of the wires in each loop and cut this. Cut the plastic so as to make the wires free for about ⅜ in. and strip them. Cut away the plastic between the wires of the twin lead for a width of about ¾ in. and to within 1/16 in. of the uncut side of the loop; see Fig. 2A.

The two 51-inch pieces of wood can be bought in almost any hardware store or lumber-supply house as decorative molding. Such molding comes fluted on one side, but any wood members about this size will do. These two pieces must be notched in the middle so as to fit together and allow the twin lead to pass through. The depth of the notch must be one-half the width of the piece. The width of the notch is determined by adding the thickness of the wood used to the thickness of the twin lead plus 1/16 in.; see Fig. 2B.

Tape the two previously prepared lengths of twin lead to these members; three or four turns at three places or so on each side of the notches will be adequate. Match the notches in the twin lead to those on the wood members.

Now prepare the 12-inch square of wood as shown in Fig. 2C. Attach the four clothespins, heads down, to the board in the middle of each side of the square (6 in. from the corners) with the prongs pointing upward. Put a screw through the board into the head of each pin. The clothespins should be drilled first with a small drill to avoid splitting them with the screws. While fastening the clothespins, the slot of the pins should be aligned with the center of the board.

The notches of the long pieces with the twin lead taped to them can be fitted together carefully making a large plus sign. Carefully press the arms of this plus sign down into the prongs of the clothespins, as shown in Fig. 2D, making sure that the point at which the arms cross is the center of the board over the ¾-inch hole. It will not be necessary to fasten the arms of the crosspiece together; the pins will hold them in place very nicely.

Attach a lead of sufficient length to reach the tuner as follows. Strip the two wires at one end for about ½ in. and cut a V into the plastic between the wires that is about 3 in. deep. Pass this end up through the hole in the square base. Standing at one end of one of the cross arms, call this 6 o'clock. The other arms will be 9, 12, and 3 o'clock. Attach lead-in wires (going to the tuner) at 6 o'clock and 12 o'clock. Fold the 25-inch piece of twin lead in half, and pass the stripped ends up through the hole in the base, after cutting deep 3-inch V's at each end in the plastic between the previously stripped wires. One wire of this piece should connect 9 o'clock and 12 o'clock together and the other wire should connect 3 o'clock and 6 o'clock together. Solder all these connections. Let the loop of this wire (the phasing stub) hang down through the hole in the base, as shown in Figs. 2E and 3.

Solder a couple of spade lugs to the other end of the lead-in wire and attach them to the tuner's antenna terminals.

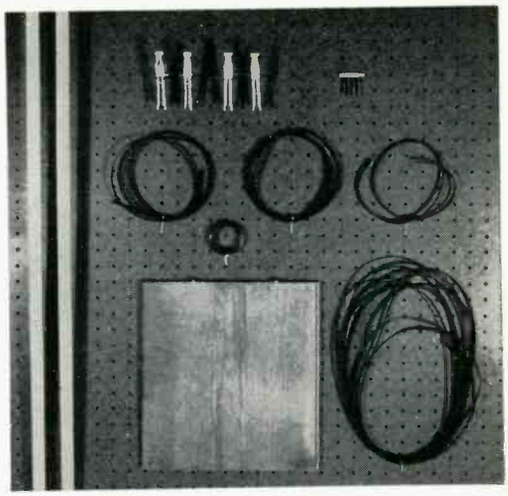


Fig. 1. Parts used to build FM antenna.

Connect it across the lead-in and run a heavy copper wire (No. 14 or larger) from the arrester ground lug to a water pipe (cold side) or to a 2-foot iron stake driven into the ground.

The antenna can also be installed in a large closet or other storage space. You might even make an elaborate mobile out of it, paint it cleverly, and hang it from the living-room chandelier.

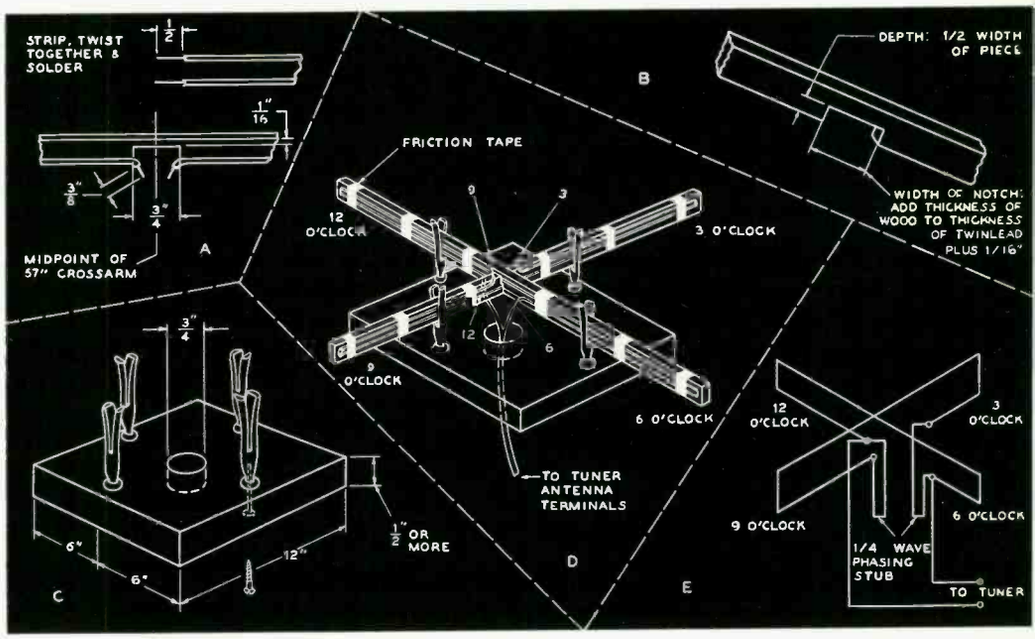
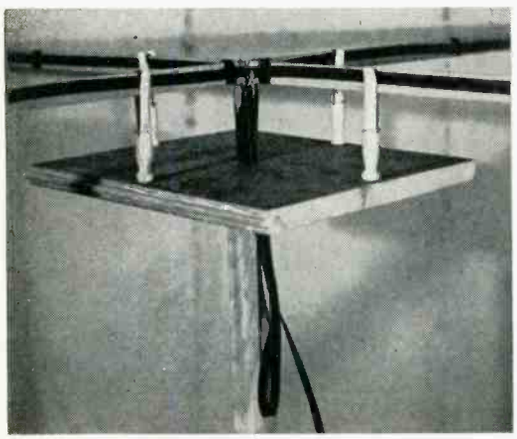


Fig. 2. Five steps in antenna construction. See text for complete details.

Fig. 3. Close-up of completed antenna.



One caution: the more vertical the lead-in can be, the better. Long horizontal runs tend to pick up interference. Twisting the lead-in two turns every 3 ft. will reduce its receptivity to interference.

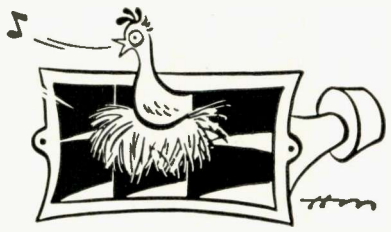
This antenna has very slight directional characteristics and can be turned a bit to give the strongest reception from the station most often listened to. The turn is usually less than 15°.

If you mount the antenna in the attic, simply fasten it to a 1-by-2-inch wood upright with a screw through the base of the antenna. A sturdier version, protected by plastic spray, should work very well mounted outside. If the antenna is mounted in the attic or in a high place, a lightning arrester should be used.

Materials

- 2 pieces 3/16-by-⅜-inch wood, 51 in. long.
- 1 piece approx. 12 in. sq. by ½ in. or more thick.
- 4 old-fashioned clothespins (not the spring type).
- 4 flathead wood screws ½ in. longer than the thickness of the 12-inch-square piece.
- 2 pieces 300-ohm twin lead (the common flat plastic type) 51 in. long plus sufficient length to reach the tuner from the location of the antenna.
- 1 piece 300-ohm twin lead 25 in. long.
- 3 ft. friction tape.

Reviews of highest-fi disc and tape records



Sound-Fanciers' Guide

by R. D. DARRELL

More "Tool" Recordings

Conceding that it's next to impossible to define high fidelity, and difficult even to explain — to the uninitiated — what it's all about, I still feel that the recording companies have been downright pusillanimous in dodging their obvious responsibility to supply recorded hi-fi primers. Oh, yes, I realize that there are plenty of available "Studies," "Adventures," etc., in high fidelity, but these are essentially demonstrations — of which there never has been any lack (as back files of this column alone can testify), and in which the verbal explanations, descriptions, and pep talks are provided, if at all, mainly in accompanying booklets. With the notable exception of Tyler Turner's *This is High Fidelity* (Vox DL 130, cited in the very first appearance of the SFG in July 1956), there has been up to now no *self-explanatory* LP which introduces high fidelity in general as *All About Tape on Tape* and the *How to Use Your Tape Recorder* LP (reviewed here last November) introduce tape technology to the novice.

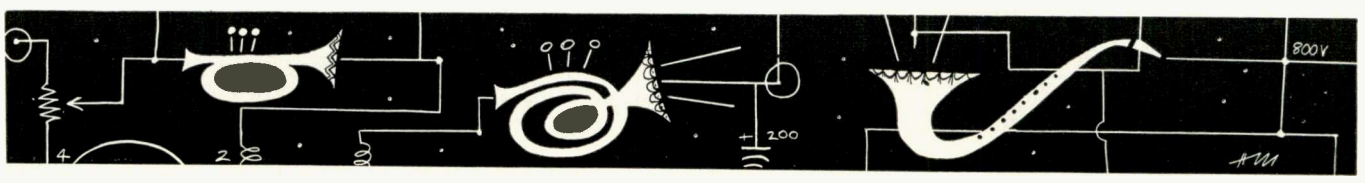
The reason for this failure is, of course, the fantastic difficulty of doing the job right and in immediately intelligible verbal and sonic terms — a difficulty which, in the end, defeats the best of intentions and efforts in a second attempt to answer the basic question, *Why Hi-Fi?*, in a Consultant LP (CR 102) issued by Meigs of Cincinnati. But at least the attempt is made here, and very ingeniously too, for what this disc essays is a simple introduction for the neophyte, who can learn as he listens to a sonically illustrated conversation in which Steve Palmer, a hi-fi *aficionado*, instructs a complete novice, Barbara Cameron, and an otherwise unidentified Henry (probably Hank Fischer, author of the script), who is a somewhat more experienced audiophile.

The information here is all very elementary, as it should be, but the folksy touch is pretty heavy and few real hi-fi ignoramuses are likely to be quite as gushily naïve or as easily impressed as Barbara is here. The principal deficiency, however, is the quality of the demonstration materials themselves, which hardly are calculated to impress anyone already familiar with the best in present-day sound reproduction. Nevertheless, there is considerable primer information here and the disc makes a convenient gift for any of your non-hi-fi friends who are more susceptible to dramatized instruction than to that more directly available in books. But if their response is at all favorable, it should be quickly stimulated further, and deeper, by the far more detailed, authoritative, and sonically impressive *This is High Fidelity.*

Another "audio-aid" release of a quite different sort, purportedly to enlighten more advanced audiophiles about actual symphonic recording procedures, is *Hi-Fi in the Making: Boult Rehearses and Performs Britten's "Young Person's Guide to the Orchestra"* (Westminister XWN 18372). This may seem an odd choice for comment here and now, since it first appeared nearly a year ago and was pretty severely dismissed in most of the reviews I've seen. But after originally deciding to pass it up, my curiosity finally got the better of me and I decided to discover for myself whether it would strike me as unfavorably as it did the majority of my colleagues. And so it does — at least insofar as the final recorded performances of the Britten work goes (it has been done much better elsewhere, both with and without the narration originally devised for a British Information Service sound film) and also in the decidedly cavalier treatment Sir Adrian receives from the recording director, Kurt List, in the rehearsal session. Just as a rehearsal, too, this example offers far fewer insights into the conductor's technique than those which distinguish the Bruno Walter rehearsal of Mozart's *Linz* Symphony (included in the Columbia album DSL 224 of 1955).

Nevertheless, the present disc does provide some notion of how a recorded performance is prepared and of the vital role the recording director plays — if not always quite so imperiously as by List in this instance. Certainly it doesn't deserve to be dismissed as conclusively as it has been in the audio press; rather, it warrants a recommendation, albeit one with considerable reservations, for study by anyone genuinely interested in learning more about recording practices and the strange co-operation required between performing artists and recording-company directors. I have attended quite a few recording sessions myself and always have found them immeasurably instructive; indeed, I know nothing that sharpens one's ears to keener acuities or that forces one to examine instinctive tonal reactions more searchingly. So, at the very least, the present recording enables any audiophile, to whom live sessions are inaccessible, an invaluable opportunity to overhear what went on in one actual (if perhaps atypical) instance.

A third and more current item in this "tool" category is more specialized: a 4-inch reel of test tape produced by the International Magnetic Electronics Company, of Minneapolis, to check the proper installation of one of their Steradapter kits for converting an ordinary tape recorder to in-line stereo playback. It starts off with a long-held 5-Kc tone for azimuth alignment of the heads, and another long-held but lower-frequency tone for channel balancing. Then the narrator, Luke Hammond, keeps talking as he moves around from far right to far left and back to center, as a means of illustrating stereo directionality as well as of checking its effectiveness in your particular setup. And the last couple of minutes (or roughly one third) of this tape are devoted to a rousing pops performance by the Chicago Symphonic Band. Thus, the reel as a whole seems not only essential for



its particular Steradapter-check purposes, but compares very favorably with the Stereophony T 50 tape (reviewed here last November) as a general stereo test tool.

More Outstanding DDT's

The latest system showoff (display and demonstration, if not actually test) recordings on hand are notable not only for their expected sheer sonic effectiveness, but also for uncommonly attractive — and unusual — musical materials. It would be a great pity if *Music for Trumpet and Orchestra* (Unicorn UNLP 1054) were to be relished only by hi-fi connoisseurs in general and brass specialists in particular, for although the recording is one of Peter Bartók's very best (which is saying all that need be said!) and the playing of Roger Voisin and Armando Ghitalla, with Daniel Pinkham as organist and a small orchestra under Harry Ellis Dickson's direction, is magnificent, it is the music itself, as richly satisfying as it is vibrantly exhilarating, which provides the most substantial rewards.

After hearing Voisin do bits of the famous Haydn E-flat Concerto for "clarino" and the Clarke (ex-Purcell) Voluntary for the Vox *Spotlight on Brass* album, I have been waiting impatiently for the complete works from him — and they prove to be every bit as dazzling as I had expected. Moreover, he also does an early, authentically Purcell Sonata for Trumpet and Strings in D, a more dubiously Purcellian but very dramatic *Tune* and hauntingly lyrical *Air*, also in D; plus, paired with Ghitalla, another Voluntary (this time in C) attributed to Purcell, and a wondrously invigorating Concerto for Two Trumpets in C by Vivaldi. Dickson's orchestra is perhaps a bit small for the full effectiveness of the Clarke Voluntary, but everything else (including the quite reverberant Jordan Hall, Boston, acoustics) is sheer delight — not least the pealing tones of the long "herald" trumpet used in the Clarke work and Pinkham's superb organ collaboration, with exceptionally solid yet attractive low pedal tones, in the *Tune* and *Air*. I can't wait to hear the promised stereo version, but even in single-channel sound this program is by far the finest of its kind yet to appear.

There are more extraordinarily searing brass sonorities and an ultrabrilliant (if less reverberant) recording of distinctively different kinds in *American Military Marches* (Audio Fidelity AFLP 1836), in which Genaro Nunez's Banda Taurina, usually heard in traditional bull-ring music, ranges far outside its accustomed repertory to play eleven familiar marches by Sousa and other *norteamericanos*. The Plaza Mexico band's virtuosity is as striking as ever, its sizzling cymbals and floor-shaking bass drum were never more impressively recorded, and its slight idiomatic accent gives the more hackneyed materials here fresh piquancy. But the unflagging energy tends to become a bit wearisome, and I wish a few of the less inspired Northern items had been dropped to make room for more of such deliciously sprightly south-of-the-border novelties as Codina'a *March of the Zacatecas*. Here again a stereo version (AFST 1836) is announced as pending and should be well worth waiting for by any audiophile with two-channel facilities.

Solo guitar timbres by their very nature never can be as dramatically impressive as the thunders of a full military band or even the clarion blasts of a solo trumpet, but they can provide a rigorous test of both recording and reproducing systems' transient-response capabilities. Moreover, when they are colored with the delicacy and polychromatism of a supreme tone painter, and are captured with translucent tonal purity, they can sharpen discriminating listeners' ears to sonic beauties which are as admirable in their own way as overpoweringly big sonorities are in theirs. *Segovia and the Guitar* (Decca DL 9931) strikes me as easily the best LP yet in the Spanish virtuoso's extensive repertory, both for its flawless technological qualities and the musical interest of its uncommonly well-planned and varied program, which ranges from a batch of delectable short pieces by the Scarlattis, Dowland, and Luys de Narváez of olden times to a long rhapsodic Fantasia-Sonata by the contemporary composer Joan Manén — one of the most imaginative evocations of the guitar's expressive and atmospheric potentialities I've ever heard.

The sensational novelty, however, is Ralph Burns's *The Masters Revisited* (Decca DL 8555), a quite indescribable combination of experiment and *jeu d'esprit* in which Mussorgsky's *Pictures at An Exhibition* and Lecuona's *Suite Espagnole* are audaciously, if not blasphemously, rescored for a dance-band ensemble comprising nine reeds, seven brasses, and six percussion and keyboard instruments. These are no conventional dabblings in "jazzing the classics" or extra-fancy "arrangements"; they are quite serious attempts to metamorphose the original works into completely new sonic terms. I won't claim they're largely successful, even in the more malleable Lecuona Suite, for there are plenty of moments which seem unduly forced or even unintentionally comic. But at their most daring (as in the Latin-American translations of the "Old Castle" and what is now the "Little Chicken Conga"), they are an odd-sounds-fancier's field day, with none of the scoring ingenuities lost in penetratingly brilliant, if ultradry, recording. A shocking record in many ways, this is at worst an electrifyingly startling one, and at best no less electrifyingly provocative.

Segovia — the artist and his instrument.

Standard (Mostly So-So) Classics

After these perhaps excruciating but always sensational aural titillations, I'm definitely spoiled for more orthodox fare, such as Karl Böhm's perhaps unduly brooding Brahms Second Symphony (Decca DL 9933); the Boyd Neel Orchestra's certainly unduly matter-of-fact *Eine kleine Nachtmusik, Serenata Notturna*, and *Divertimento* No. 11 by Mozart (Unicorn UNLP 1042); and Felix Slatkin's high-powered but rather pretentious *Overture* program (Capitol P 8380). These are all reasonably well recorded, but have been performed much more effectively by others. In a lighter vein, Paulik's *Gold and Silver* old-world-waltz program (Vanguard VRS 1002) and Aliberti's coupling of Lehár's *Gold and Silver* with Waldteufel's *Skaters'* Waltzes (Sonotape stereo SWB 7003; no LP as yet) are more successful, both sonically and interpretatively. Among the works of greater substance, I admired most Fritz Lehmann's restrained yet songfully expressive performance of the complete Schubert *Rosamunde* music, plus two short choral pieces (Decca DXB 144, two LP's) and Fischer-Dieskau's eloquent singing of the Op. 35 Kerner cycle and other *Lieder* by Schumann (Decca DL 9935). But I must admit that these are more likely to appeal to romantic listeners than to those who crave excitement, and although they are beautifully recorded (by Deutsche Grammophon), they display only the quieter virtues of high fidelity and none of its galvanizing sensationalism.

Odd-Ball Jazz and Pops

For the real McCoy in sonic Benzedrine and high-proof alcoholic jolts, I com-

Continued on page 39

The University KEN-15 Enclosure Kit

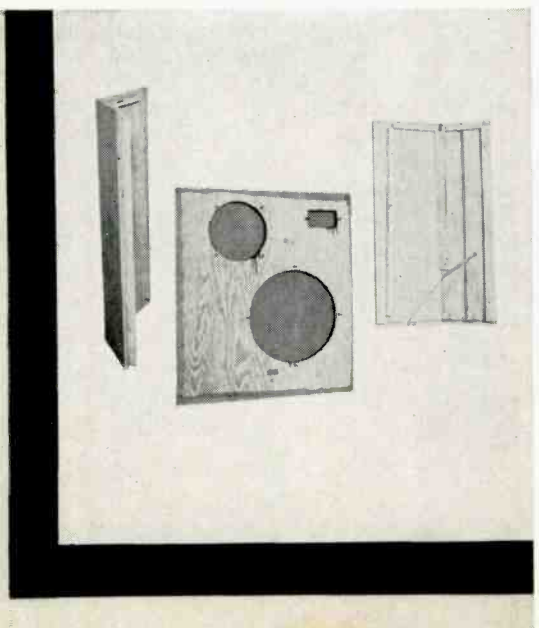
An **audiocraft** *kit report*

Here's an enclosure which can be placed anywhere in your listening room. It sounds great along a wall or in a corner, and looks as fine as it sounds.

RECOGNIZING that many hi-fiers are capable of using a screw driver and finishing materials, and are willing to do so in order to save an appreciable sum of money, to obtain a custom finish, or both, University has made available complete kits of parts for home assembly of its EN-15 and EN-12 loudspeaker enclosures. These are identified (logically enough) as the KEN-15 and KEN-12 KwiKits.

Both enclosures are of folded-horn design incorporating both direct radiation and rear horn loading. Although they will fit comfortably in a room corner, they do not require the corner for completion of the horn flare. Accordingly they can be used anywhere in the listening room, with no more reduction in bass response than is obtained when a simple bass-reflex or totally enclosed system is moved out of a corner. This makes them far more flexible in application than most rear-loading corner horns.

Fig. 1. Completed subassemblies. These pieces form sides and front of enclosure.



Adding to their flexibility still further is the great variety of drivers each will accommodate. The KEN-12 speaker-mounting board has holes cut for a 12-inch cone speaker and any combination of middle-range and high-frequency reproducers, with adapter plates and cover plates for the latter two. You can start right out with a two-way or three-way system, or begin with a wide-range or coaxial 12-incher and expand later. There are even holes on the back panel drilled for two speaker level controls. The KEN-12 is 15½ in. deep by 21½ wide by 29½ high. Its price is $44.75, which should be compared with $76.00 (mahogany), $79.50 (blond), and $83.50 (walnut) for factory-built and -finished models.

The KEN-15, when completed, is 18½ in. deep, 29 wide, and 35¼ high. Its price is $59.50; equivalent factory-made versions, with special tapered and coved moldings, are $125.00 (mahogany), $135.00 (blond), and $139.50 (walnut). Speaker-mounting provisions are basically the same as for the KEN-12 except that the 12-inch cutout is replaced by a 15-inch one. For $1.50 extra, however, you can get a 12-inch speaker adapter board. Note: the KEN-15 will also take an eight-inch cone speaker for the middle range in addition to horns.

Principal exterior parts of both KwiKits are of ¾-inch lumber-core Korina veneer, smoothly sanded and practically ready for finishing. All wood parts are drilled and cut to exact size; you don't need to do any woodworking. Necessary hardware, glue, acoustical padding, and grille cloth are supplied — even a tube of plastic wood is thrown in for repairing any damage you might do if your screw driver slips! The instructions are clear and well illustrated. You can hardly go wrong, as the following comments and photographs show.

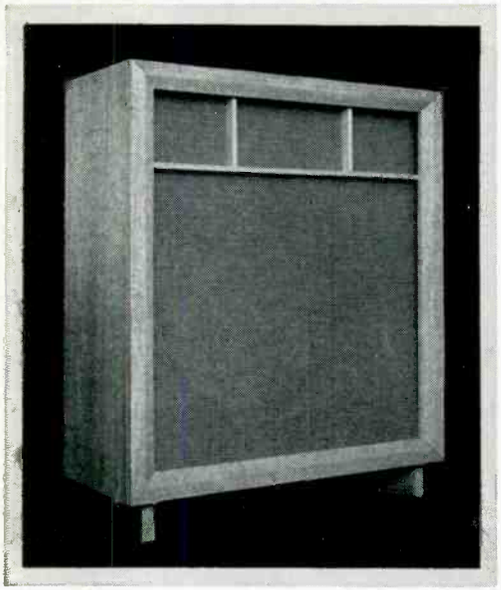
Construction Notes

Of the two University kits described above, we will be concerned specifically with the construction of the KEN-15 only. Comments will apply to the KEN-12 also, since assembly procedure for the two models is exactly the same. The manufacturer has gone to great lengths to make construction as simple as possible and yet give the builder the feeling of having added his own personal touch to the finished product.

We found that reading over the instructions once or twice before starting was well worth the few extra minutes it took to become thoroughly familiar with each step of the process. The manufacturer suggests that as the kit is unpacked you mark each part as identified in the parts list with a pencil, making sure that nothing is missing. Fig. 1A on pages 4 and 5 of the instruction manual diagrams each part for easy recognition. As you check the hardware, separate the different types into envelopes or boxes by themselves, as we did; there are three sizes of flathead screws which, when mixed together, can easily be confused.

When you are ready to begin construction of the kit, putting the components together first without glue (a dry run, so to speak) will give you a chance to see that all pieces fit properly and will also familiarize you with the assembly procedure. When this is done you can begin final construction knowing that you can solve any fitting and alignment problems.

To prevent scratching the wood, we did as much of the assembling as possible on an old blanket. The first step is to attach the cleats to the side and back panels. Cleaning the grooves and careful joining will insure an airtight fit between the parts. If you do encounter trouble



in aligning any of the cleats, which may be warped, an extra screw driver used as a wedge between the groove and the cleat will remedy it. If an overflow of glue appears on the cleats or panels be sure to wipe or scrape it off; otherwise, improper contact and/or damaged finish might result. Make sure all screws are tight, but don't overtighten to the point of stripping the holes. Fig. 1 shows completed subassemblies.

With these joined, we were ready to attach the top section E. Steps 8 through 12A (construction of the cabinet frame) should be done as rapidly as possible. The glue sets in approximately one hour, and all adjustments and corrections should be made within this time.

At this point we ran into trouble. But we were able to correct the difficulty with little effort because of our dry run before final construction. When subassemblies A-B and C-D are joined, the angle made at the intersection of the two parts is too sharp to accommodate the angle rabbeted out on panel E. We fixed this by loosening the four screws which go through cleat B3 on subassembly A-B and cleat D3 on subassembly C-D; this enabled us to widen the angle, permitting the parts to fit properly. Once panels A-B and C-D were secured to top panel E the screws were retightened. Fig. 2 shows subassemblies with the top joined.

To continue the operation, inner-back panel F and lower-back panel G were installed. These were glued but not screwed into place until base H had been put in place permanently. Fig. 3 shows the base and back panels in position. This completed the inner part of the horn, and the sound path from the speaker could now be seen.

On the outer surface of the base panel there is a penciled outline for the purpose of aligning the three legs on the cabinet. The legs, besides functioning as a base on which the enclosure stands, also form the mouth of the folded horn. It is from this port in the base of the cabinet that the lower frequencies emanate.

Fig. 4 illustrates the inside walls of the horn and the mouth in the base. Fig. 5 is a view from the rear, with the back removed. Make sure that back leg 2 is flush with the horn opening and that side legs 3 and 4 run parallel to the sides of the horn opening. From this point on all work proceeded with the cabinet right side up, except for attaching the bottom molding strip in step 18.

The next step was to install the sound-absorbing material on the inner surfaces of the cabinet (Fig. 6). At this time we did not put the panels of material in place, in order to show the structural details in our pictures. But the panels were installed later and we found that they fit quite well. Only a few tacks or a little glue is needed to hold them in place. Our only suggestion here is that, when the first strip of Tuflex is affixed along the front part of the base, you make sure that the narrow slot appearing there (Fig. 6) is completely covered.

Next we prepared the baffle board for

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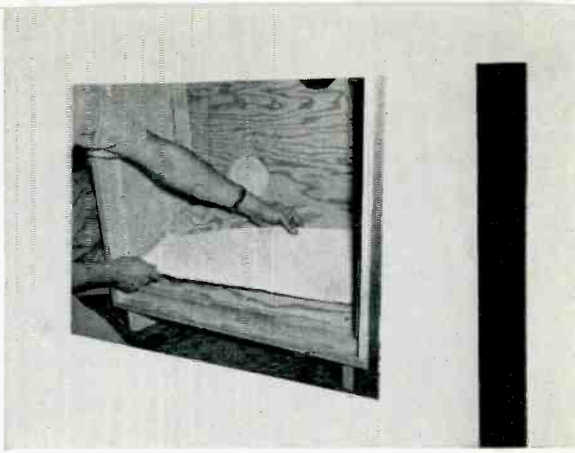


Fig. 6. Sound-absorbing material is placed on inner surfaces of enclosure.

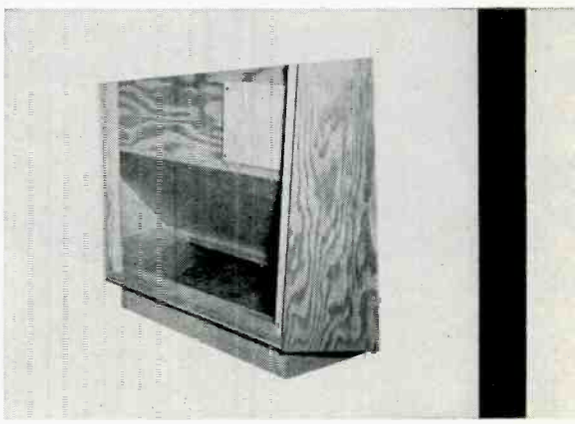


Fig. 5. With back removed, opening in base and inner construction are visible.

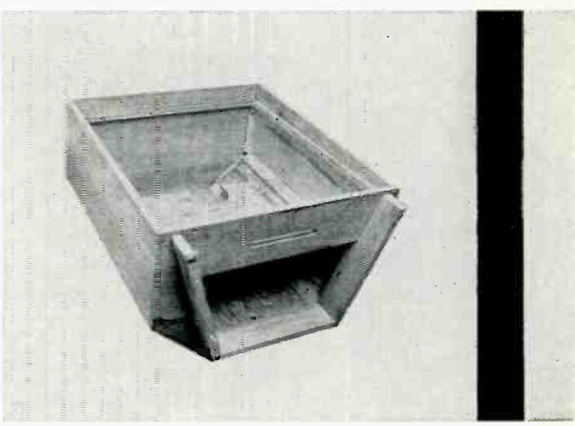


Fig. 4. Tipping enclosure on side shows how opening in base appears from below.

Fig. 2. Subassemblies (shown detached in Fig. 1) have been joined to top panel. Assembly is pictured resting on its top.

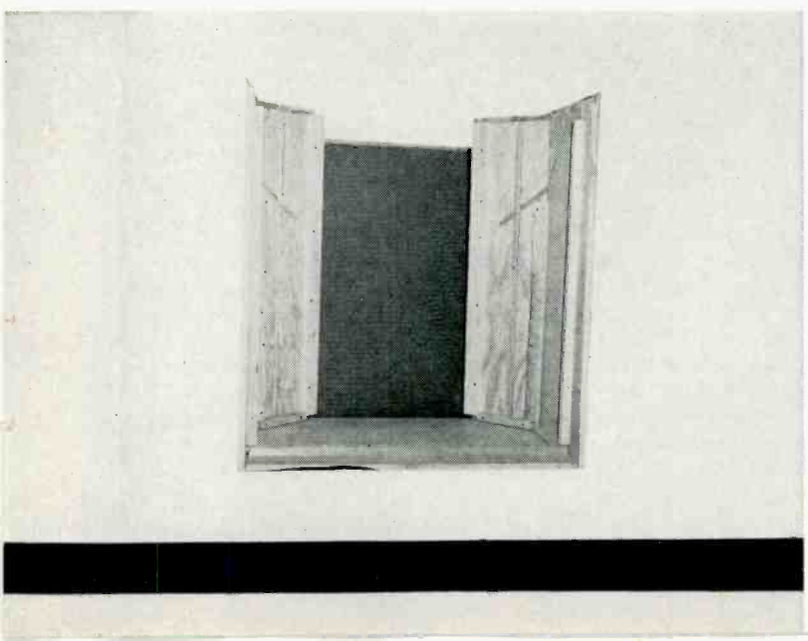
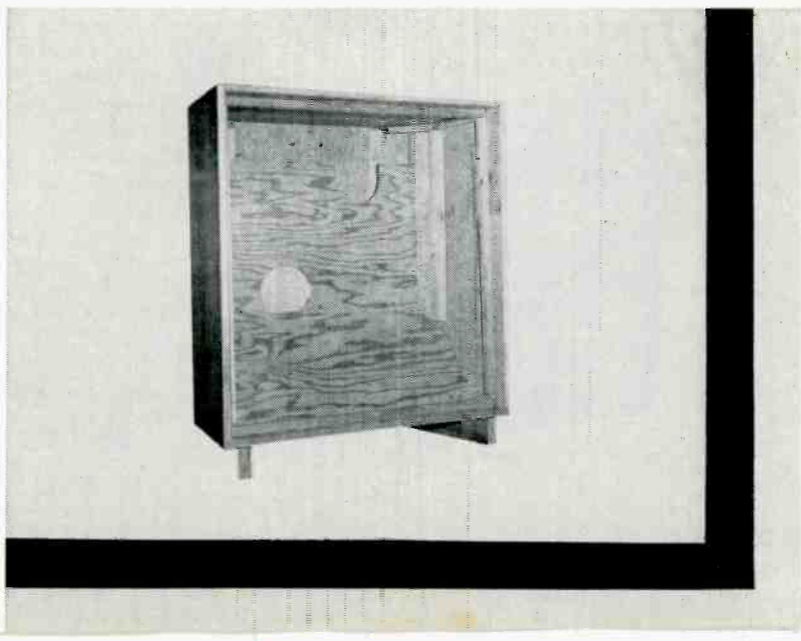


Fig. 3. Base and back panels have been added to side and top pieces, and assembly begins to assume final appearance.



by J. GORDON HOLT

Audio input mixers are versatile tools for the professional recordist. Here's how to use them.

LAST month's "Tape News & Views" was launched with a couple of hypothetical recording projects which were about as different as one could hope for without being unreasonable about it, yet which had something (actually, two things) in common. The first and most obvious meeting ground was that each involved tape recording; the second was the fact that each required the use of an input mixer.

As a matter of fact, any recording venture that can be facilitated by the ability to mix together and control independently two or more input sources calls for a mixer. Just what *kind* of mixer it calls for depends on the problem at hand. So let's tackle a few and see how we might solve them with this or that input mixer.

We have several types of mixers to choose from, and, while these were discussed in some detail last month, a short recap of them won't do any harm. There are dry mixers, wet mixers, and high- and low-level mixers. All of them have separate input connections for two or more sources; all have separate and independent volume controls for each source or channel; and all have some means for combining the separate channels into a single output channel. If a mixer has each of its volume controls feeding a separate tube input, and mixes the channels together at a point *following* the tubes, it is referred to as a *wet* mixer. If the mixing takes place between the individual volume controls and the following tube stage, then the mixer is referred to as being *dry*. I am confident that there is an excellent reason for this hygrometric terminology, but I'm sure I don't know what it is. High-level and low-level should be self-explanatory: they refer simply to the voltage of the input sources being fed to the mixer. A wet mixer is shown in Fig. 1, and a very simple dry mixer in Fig. 2.

Fig. 1. Professional mixer and preamp.

Generally speaking, wet and dry mixers can be used interchangeably for any application. The only practical difference between them is their potential quality; wet mixers usually have superior high-frequency response and are free from control interaction, whereas dry mixers (having no tubes) have no distortion, but suffer from a certain amount of control interaction. Take your pick.

The mixer characteristics that are important to the practicing recordist are those which pertain to input levels, input impedance, and output impedance. The simplest mixer circuits are those designed to accept two or more sources having the same level and the same impedance — two low-impedance microphones or two tuners, for instance. Low-impedance microphones are quite commonly used by home recordists, but low-impedance high-level sources are not likely to be found outside of radio stations or professional recording studios. So we can pretty well assume that any high-level mixer we encounter will be equipped with high-impedance inputs. Low-Z microphones are another matter; we'll take them up later.

Exclusively high-level mixers are most commonly used for dubbing 78-rpm records onto tape, for purposes of eternal preservation of the family's musical archives. Apart from the immortality that taping bestows upon a 78-rpm disc, the most attractive feature of disc dubbing is the ability to edit out the pauses between the short 78-rpm record sides, to give to the music the continuity that it lacked before LP's came along. With some practice, the magnetographer can learn to join taped copies of consecutive sides so well that only a trained ear will detect the splices, but there are many records which cannot be edited perfectly in this way. The reason is that in ye days of olde, the conductor would often stop the music at the end of each disc side, and would await the flash of the recording light before resuming for the next side. As a result, side 1 of the record might end with a resounding chord, followed by about three seconds of fading echo, while side 2 might then take up with a quiet, pastoral passage. The catch is that the opening note of side 2 *should* come in about half a second after the last chord on side 1. Try to edit the tape that way and see what happens: either the side-1 reverberation will cut off abruptly as the

side-2 note comes in, or there will be a three-second pause between sides while the echo dies out.

Let's see how we might resolve this dilemma by using a two-channel high-level mixer and some borrowed equipment, a second pickup (preferably identical to the first), a second preamplifier-control unit, and an SPDT switch. Connect the pickups to the preamps, set the equalization controls properly, and connect the tape outputs from the preamps into the mixer, as in Fig. 3. The mixer output, of course, goes to the tape recorder. The switch connects between both of the main outputs from the preamps, and goes to the main system's power amplifier, to serve as a cuing channel. Now put a record on one turntable, set the cue switch to that preamplifier, and adjust the preamp's volume control for comfortable listening level. Do the same thing with the other channel, and then play through some of the loudest passages on the discs, using these to adjust the mixer-channel level controls and the recorder's volume control for proper record level. Note the mixer control settings and then turn both all the way off.

Put disc side 1 on one turntable, side 2 on the other, and set the cue switch to the channel carrying side 1. Start the tape recorder, put the pickup stylus in the lead-in groove, and then quickly bring up the mixer control for that channel to its predetermined setting.

While side 1 is playing, flip the cue switch to the side-2 channel, put the pickup on, and let it run until it hits the opening note of that side. Shut that turntable off, turn the disc backward by hand until it is a half a revolution or so *ahead* of the opening note, and wait until side 1 is almost completed. A fraction of a second before side 2 is to commence, start that turntable running. Gradually (but not *too* gradually) advance its mixer control to its predetermined position, and, if you've timed things right, the opening bars of side 2 will be heard through the sudsiding echo at the end of side 1. Finally, fade out side 1's mixer control so the tape won't have an abrupt change in the surface noise between sides.

There are undoubtedly other applications for exclusively high-level mixers, which will present themselves to the user as the occasion arises, but the foregoing example will serve to illustrate one of the uses for such a device.

Of much wider application, however, is the combined high-level and low-level mixer (Fig. 3) which enables a microphone to be blended with a phonograph, tuner, or another tape recorder. This will facilitate combining narration and musical effects on home-taped movie sound tracks, adding identifying notes or commentary to tapes of recorded music, or simply impressing tape correspondents with your dexterity in combining appropriate background music or sound effects with the week's reel news.

These are just a few of the things that can be done with a simple two-channel high-level/low-level mixer, although the addition of a second high-level channel will give greatly increased versatility, and will permit fading from one high-level source to another without interrupting the all-important commentary.

Low-level mixers are of value primarily to those "live" magnetographers whose ambition it is to get the best possible

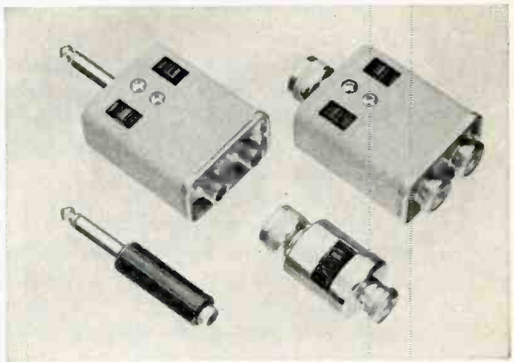


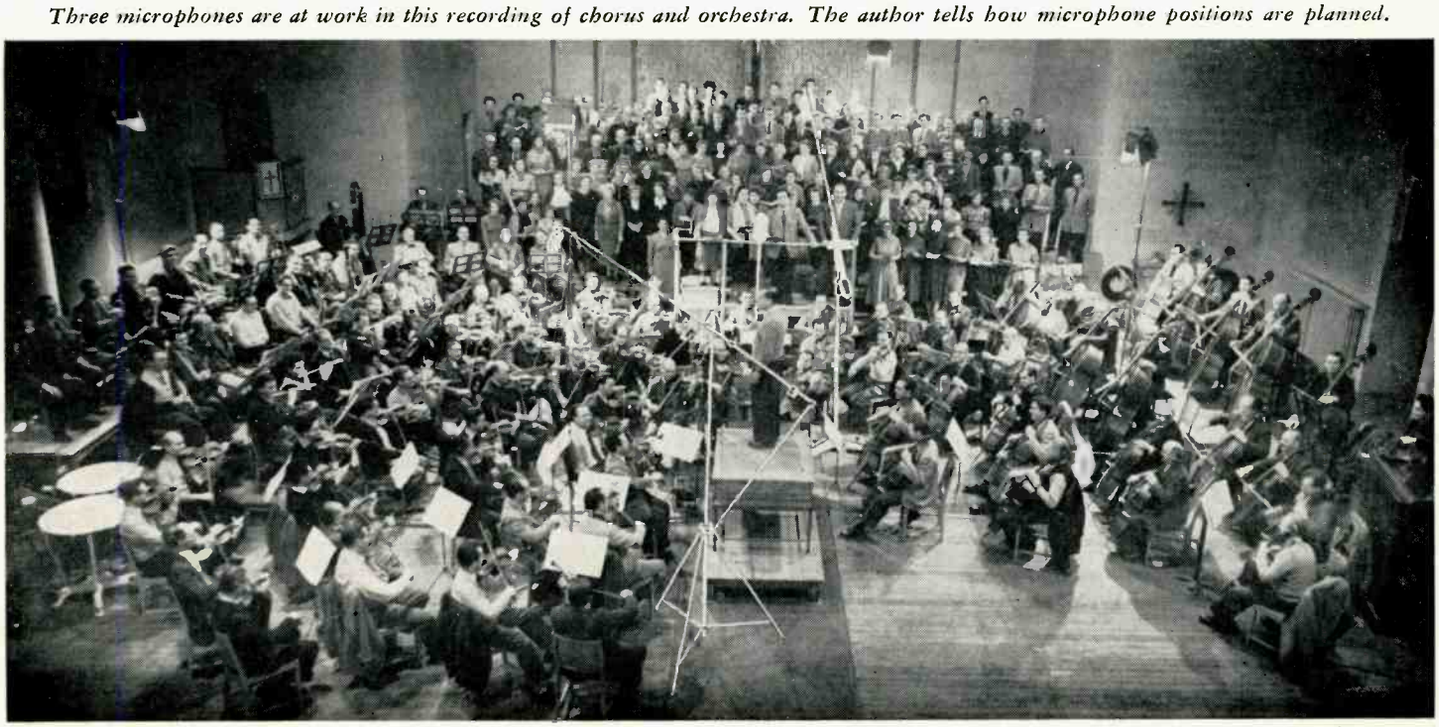
Fig. 2. Small, inexpensive dry mixers.

recordings of musical performances "in the flesh." If live recordings are the exception rather than the rule in the year's activities, then a single microphone will suffice for most applications. Where more professional results are desired, then multiple miking is usually the way to obtain them, and this is where one needs a low-level mixer.

Additional microphones may be used to advantage when recording almost any large musical group, and the larger and more varied the group, the more microphones that are likely to be needed. For instance, to get back to last month's hypothetical problem, consider the case of a large chorus, an orchestra, a narrator with a weak voice, and three soloists who stand in the same spot on stage but whose voices have widely differing carrying powers. A single microphone, high in the air and aimed at the entire group, would pick up all of these just as they are: the soloists would be unbalanced, the narrator would be barely audible, and to attempt to remedy one shortcoming would aggravate another.

We add a second microphone, preferably a unidirectional one, several feet in

Three microphones are at work in this recording of chorus and orchestra. The author tells how microphone positions are planned.



front of the narrator, placed approximately at his waist level and aimed upward toward his face, in order to pick up as little as possible of the orchestra behind him.

Next we go over to the other side of the stage, where the soloists will be standing, and add another microphone. This time it should be a bidirectional (figure-8) unit, and oriented so as to discriminate between the strongest voices and favor the weakest ones.

We check the results at a rehearsal, and if we are losing any part of the orchestra or the chorus, a directional mike 10 or 15 ft. away from the weak section and aimed directly at it will help to bring that into balance.

Then we find that we need some more echo — the recording is too dead. If blending between the over-all group is not adequate, we may improve both by moving our general pickup microphone further away. But if the blending is perfect and we still need more echo, it can be added by placing a unidirectional microphone at the front of the stage and aiming it out into the auditorium, where it will pick up whatever echo is bouncing back from the loges.

This has given us a grand total of five microphones, which of course will call for a five-channel mixer. Admittedly, I've gone a little overboard with this whole thing, but it should be clear by now that a two- or three-channel microphone mixer can help to solve some rather knotty recording problems. Additional channels will be of help on occasion, but two or three will cover most exigencies.

There are several things to watch out for when using microphone mixers; it is easy to get a worse recording with two or more microphones than could ever be obtained with one. The first and possibly most important requirement is that all the microphones used be in phase with each other. If they are not, any given low-frequency rarefaction or compression in the air will create a positive impulse from one microphone and a negative impulse from the other, and the signals will cancel each other leaving little but distortion and frequency-response peaks.

Phasing may be checked as follows: place a pair of mikes side by side on stands about 6 ft. from the main speaker system and aimed at a point 3 ft. to one side of the tweeter. Turn the mixer's channel-level controls all the way off, connect the mikes to the mixer, and connect the mixer's output to the main reproducing system. Turn everything on, and when it has warmed up, slowly advance one channel control until feedback between the speaker and the microphone is audible. Make a note of the control setting, back off the control until it is just below the feedback point, and slowly advance the other control until its microphone begins to produce feedback. Drop this channel to just below the feedback point, and then turn the other control all the way off. If the microphones are in phase, all traces of feedback will disappear when the first control is turned off. If not, turning off the first mike will cause feedback through the second, as the signal cancellation between them ceases.

If there are more than two microphones, try them in various pairings to find which ones are in phase with which, and choose the largest number of mikes which "agree" as your standard for correct phasing.

Pressure-sensitive microphones such as dynamics, condenser types, and most crystals, will produce the same output polarity regardless of which way they are facing, but velocity microphones (which respond to the movement of air through an aperture) will reverse their phasing when turned around 180°. If there is any question about a particular velocity mike, establish (by test or otherwise) which side, if either, gives the better-sounding reproduction, mark this side with a piece of cellulose tape, and aim it at the test speaker or at the performers.

There is an important distinction that should be made at this point. High-impedance microphones generally operate through single-wire shielded cable, with the inner lead "hot" and the outer shield grounded. Consequently, the signal polarity *must* remain unchanged between the microphone and the preamplifier; if the leads are reversed anywhere along the line, the mike will hum like mad. This is not the case with low-impedance microphones, however. These almost invariably have a two-conductor shielded cable, with the shield grounded and both inner conductors "hot" and above ground. If the inner conductors are reversed, the mike will still operate normally, but the polarity of the voltages passing through the cable will be reversed. So if low-impedance microphones are used, the *first* thing to do when checking their phasing is to see that all extension cables run straight through, without any lead reversals. This can be checked visually, by making sure that a conductor of a certain color connects from pin 2 in one cable connector to pin 2 in the other connector, and so on.

Now, if a low-impedance microphone is found to be out of phase with the "standard" ones, it can be switched simply by reversing the hot leads going to whichever connector is attached as an integral part of it. If a high-impedance microphone is out of phase with its mates, it should be opened up and the leads coming from its element — the diaphragm or crystal — should be reversed. High-impedance condenser microphones may not provide any means of phase reversal at all, so if one of these is involved, it's usually easier to reverse all the other mikes to conform to it.

The mixer itself can sometimes reverse the phasing of a low-impedance microphone, if care has not been taken to follow through uniformly on its transformer and plug connections. To check the mixer, connect it to a sensitive AC voltmeter; then tie two input connectors in parallel, strapping together the same-numbered pins on each plug. Feed a 1,000-cps tone into the mixer, and bring one level control up until it gives a half-scale meter reading. Then slowly bring up the second level control, and note whether there is a point at which the meter reading *decreases*. If there is, reverse the phasing at any convenient spot in either channel or (if there are three or more channels) in that channel which disagrees with the rest. Repeat this test on all inputs, until no combination of inputs or control settings produces cancellation of the input signal.

The second thing to watch out for when using two or more mikes is overzealousness. Remember that, when microphones are being mixed, the slightest change in the level of one channel will be audible in the recording, unless the change is made when no signal is coming over that channel. If balance adjustments must be made while recording,

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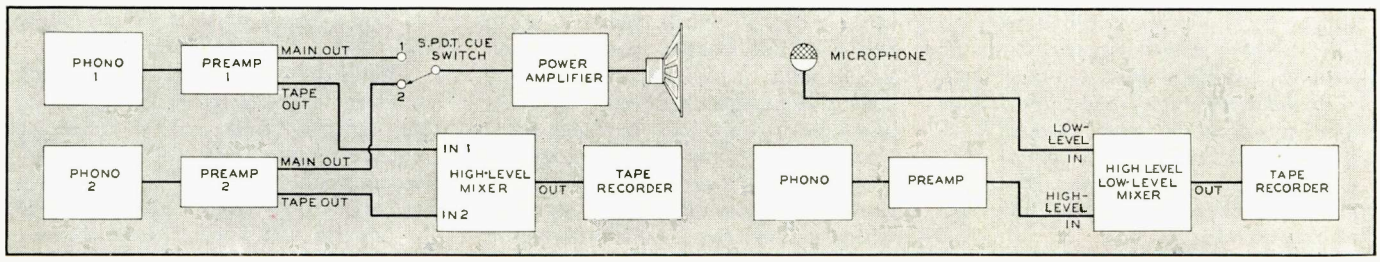

Fig. 3. Arrangement at left may be used to dub consecutive 78-rpm discs on tape. Add commentary with units shown at right.

HOUSEBOAT HI-FI

by SANDRA KEYES

A FLOATING high-fidelity set might sound like a fishy tale to some people, but to Jean Loba of San Diego, California, it's a reality. This young man has built a houseboat around his hi-fi set.

The hi-fi-houseboat idea was born about two years ago when Jean had a very small ocean-view apartment and an extremely large, loud high-fidelity set. He liked loud music, his landlord didn't; and it wasn't long before Jean found himself apartmentless.

Mr. Loba wanted living quarters that had a somewhat Bohemian atmosphere and cheap rent, where he could play his hi-fi as long and as loudly as he wished. One of his friends told him about an old Navy landing craft that was rotting in San Diego Bay. Jean bought the craft for $130 and hauled it to its present dock position on Shelter Island, among the commercial fishing boats and yachts. From the decks there is a picturesque view of the bay and sky line of the city of San Diego.

Bohemian decor features plenty of sound.

The landing craft was filled with dirt, grime, and grease, and had to be cleaned out before any building could be done. Jean scraped it clean and filled three large trash cans with dirt and grease. Then he filled the bottom of the craft with a ton of rocks to prevent its tipping over.

He installed the speakers in the boat (twenty-four of them, mounted on a board 5 by 6 ft.), and then started building around them. With scrap lumber and windows, acquired from torn-down war housing units, he built the first floor to fit the height of the 6-foot speaker board. The first floor holds the kitchen, bath, and living room.

After the first floor was completed, Jean added the second floor, consisting of a combination sunroom, study, and bedroom. The second floor is accessible by a ladder which, incidentally, is the only nautical appliance on the boat. From the second floor, you can step out onto the newest addition to Jean's houseboat — a railed sun deck.

The houseboat is painted blue and orange and is furnished with a war-surplus refrigerator, sink, stove, and shower. The other furniture, such as tables and chairs, was made by Mr. Loba.

The hi-fi speaker board holds twenty 12-inch electromagnetic speakers and four 5-inch PM tweeters. Power supplies for the speakers are four in number, and are built in one chassis. He bought most of his equipment from do-it-yourself hi-fi retailers and the rest he made from war-surplus goods. He has a Dynakit 50-watt amplifier, and a Heathkit preamplifier and FM tuner.

When the hi-fi is cranked up high, it carries across one end of the bay (about 800 yards) on a clear day and "is more powerful than the fog horn on the Queen Mary," according to Jean. Cost of the entire system was less than $235.

Wiring one speaker in an array of 24.

But his hi-fi installation has been valued at $1,000 — by the tax assessor.

Living, however, is cheap in San Diego Bay. Eighteen dollars a month pays for dock rental, water, and lights; $7 buys butane gas every three to four months for cooking; and once a year $35 is spent to scrape and paint the bottom of the houseboat, protecting it against barnacles.

To make the houseboat a bit more Bohemian Mr. Loba has added a 9-foot

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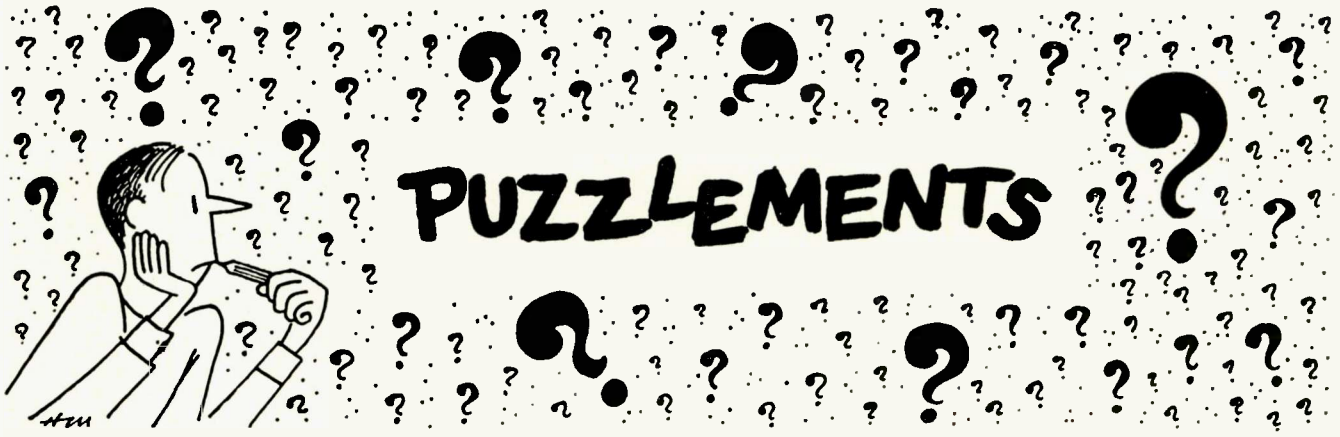
Records and gear are easily accessible.

Have you ever wondered why some amplifiers do not sound as good as their specifications would indicate? Here's why.



by NORMAN H. CROWHURST

THIS puzzlement was brought to my attention by a man who makes amplifiers for musical instruments (guitars, basses, accordions, etc.). The subject is baffling but not exactly unfamiliar. In his line of amplifiers he has a 25-watt model and a 50-watt model. When I dropped in he had just finished demonstrating both models to a prospective customer.

He explained to me that customers often preferred the 25-watt model, quite apart from its lower cost. They said that the 25-watt model "seems to have more punch" and similar comments. His usual practice had been to give a completely separate demonstration of each model so that the customer did not get a direct A-B comparison, but heard each only after an appropriate setup time. He had always regarded this preference as being due to some psychological factor that he could not explain.

But this particular morning a customer had insisted on having the two demonstrated side by side, so that a quick change-over could be made from one model to the other. Then it became definitely apparent that the 25-watt model gave more output before distortion became objectionable than did the 50-watt model.

Before I appeared on the scene he had taken the two amplifiers and checked their power performance, finding that the 25-watt model began to clip not very much above 25 watts, while the 50-watt model delivered a full 50 watts. He checked both of them into a resistance load and also into the loudspeaker with which they are used, and found results compatible with his measurements. Why, then, should the 25-watt model be capable of an apparently bigger output than the 50-watt model when music is played through it?

My first question concerned the circuits he was using. "They are both modified Williamsons," came the answer. Further questioning revealed that the only resemblance to the Williamson amplifier was the front end. The power tubes were operating under conditions the original Williamson amplifier would not recognize! The 25-watt model had a couple of pentode tubes in push-pull, with cathode bias. The 50-watt model had the same pair of pentodes, with a higher plate voltage and fixed bias to achieve Class-AB operation.

These, with a different size of output transformer, were the only differences between the two amplifiers. Was it the different output transformers, operation in Class AB instead of Class A, or the use of fixed bias instead of cathode bias, that made the difference in apparent available output?

Because similar experiences had been reported previously with other combinations of amplifiers using output transformers quite different from these, the possibility of the output transformers being the critical factor was eliminated. Confirming this, my friend told me he had tried output transformers of different manufacture in each amplifier with not very noticeable differences in results either measured or observed. But why should fixed bias or Class-AB operation, while giving greater output under measurement conditions, seem to give less output under practical program conditions?

It all proves to be a question of what happens in the amplifier when clipping occurs. *Any* modern feedback amplifier, with some 20 db of over-all feedback, runs into the clipping power level quite suddenly. This is because the feedback tends to maintain the purity of the wave form as long as the tubes can deliver the required power at all. But, as soon as that part of the output-tube characteristic is reached where no further output is possible, the feedback is no longer able to "push" the wave form any further, and clipping occurs quite abruptly.

"But these guitar amplifiers *use* only between 2 and 5 watts," came the next question, "how can we possibly be going into clipping?" This is explainable by the particular way in which the guitar is played: by plucking. True, the *average* power delivered by a loudspeaker amplifying a guitar is probably not more than between 2 and 5 watts (and this is true of other types of program material as well) but the "pluck" tone may well represent a peak power in excess of the 50-watt peak available from a 25-watt amplifier, or the 100-watt peak available from the 50-watt amplifier. What the standard methods in testing do not discover is what happens if this peak tends to drive the amplifier up to a much

higher power level for this very brief instant.

In both amplifiers the output-tube grids are driven from the plate circuit of the drive stage by resistance/capacitance coupling. This means that when the output-tube grid is driven positive and grid current flows, a negative charge is left on the grid side of this coupling capacitor. This causes the output tubes to become overbiased until the charge leaks away through the grid return resistor.

Now we have two matters to consider. First is the fact that one amplifier is working in Class A, while the other is biased back further to begin with; consequently, a temporary overbias may drive it from Class AB to Class B, or even into Class C, resulting in serious wave-form distortion more quickly than would occur when overbias changed the operation from Class A to Class AB momentarily.

The second factor is the effect on the existing bias supply. In the case of cathode bias, when the grid reaches the positive region the cathode current will be very high to provide an offsetting positive voltage at the cathode. Consequently a given amount of positive overdrive on the grid will produce a smaller amount of negative bias in the grid circuit than it will if the grid-to-cathode voltage is fixed by a separate supply unit. In the case of a fixed bias supply, the positive voltage on the cathode is not increased by this positive swing at the grid. It follows that the grid produces a bigger negative charge and temporary bias on the output side of the coupling capacitor than it does when cathode bias is used.

The over-all effect is that an overdrive peak caused by plucking the instrument merely produces clipping in the 25-watt amplifier. This clipping is not noticeable apart from the normal pluck sound of the guitar. As soon as the pluck sound has passed, the reproduction of the musical tone from the instrument remains undistorted at a level that may be from 2 to 5 watts. The volume control can even be turned up so as to achieve an average level for the musical tone of the instrument of 10 watts or so, without noticing any appreciable distortion on the pluck sound.

On the other hand, with the 50-watt amplifier, operating at 2 to 5 watts may be permissible, with perhaps a little distortion from the pluck sound. But an endeavor to work as high as 10 watts will cause the pluck component to overbias the output tubes, leaving a form of crossover distortion that is quite severe for the initial part of the musical tone that follows.

Consequently, the 25-watt amplifier may appear to give a 10-watt average output quite comfortably, while the 50-watt amplifier will appear to go into very severe distortion when registering around

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Tips and short cuts from our readers

Clean Heads

I have found that it is almost impossible to reach the recording and erase heads of my tape recorder with the eye droppers usually supplied with bottles of cleaning and lubricating fluids. Most of the liquids are wasted.

Ordinary Q-Tips, available at any drug store, make the job much easier. Q-Tips are the small, round sticks with cotton swabs at each end. Use one end to apply the cleaner and the other for the lubricant. Since Q-Tips are very inexpensive (about ½¢ apiece), they can be thrown away after use.

Harry Collins
San Fernando, Calif.

Trouble Light

A convenient, small trouble light for hi-fi equipment repair work can be made from an extension cord with a cube tap, and a plug-in night light. The night light is just plugged into the cube tap.

This light does not give off much heat, and, due to its small size, it gets ample illumination into close quarters.

W. C. Sannes
Broadview, Ill.

Modified Alligator Clips

With round-nosed pliers, open up the ends of the jaws of an ordinary small-sized alligator clip. Then take two pieces of No. 10 copper wire about 1 in. long and, with a file, flatten one side of each about ⅓ of the diameter. With the two flat sides together, shove the two pieces of wire into the jaws of the clip and solder them in place. A piece of wood placed between the pieces of wire to hold the jaws of the clip open will help make the job easier.

These clips come in handy in close soldering in critical places, up close to resistors, capacitors, transistors, and the like. The heavy copper conducts away the heat rapidly to protect delicate parts against burning. The clips are also very useful in holding small parts in place temporarily during assembly and repair.

I carry about a half dozen of these in my tool kit. Some I leave as described here; to others I have added handles, both straight and right-angle, and one has a big paper clip attached for use as an anchor in holding small parts in place.

Michael L. Byrd
Inglewood, Calif.

Speaker Switching

With binaural FM-AM and FM-FM radio broadcasts a reality for limited periods of time in some localities, many individuals have purchased the necessary equipment to receive this type of broadcast.

At such times as only monaural broadcasts are offered, it is possible to utilize both speaker systems as shown in the two drawings below.

If 16-ohm speakers are used, they are thrown in parallel across the 8-ohm tap; two 8-ohm speakers are thrown in series across the 16-ohm tap. A proper impedance match is thus maintained.

Mel Moon
Chicago, Ill.

Fig. 1. Four-pole, three-position shorting-type switch. Pos. 1: A drives S; A_1 drives S_1 (stereo). Pos. 2: A drives S and S_1. Pos. 3: A_1 drives S and S_1.

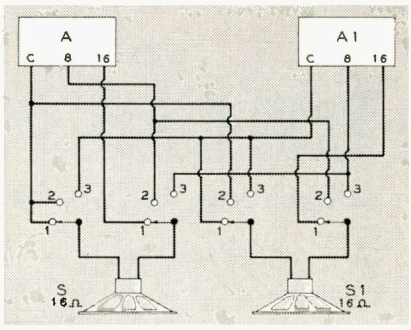
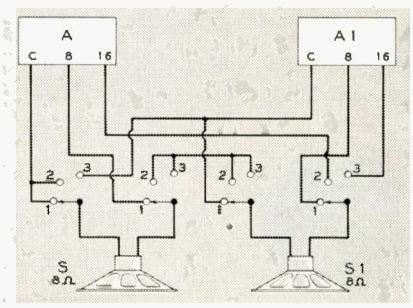


Fig. 2. Four-pole, three-position, shorting-type switch. Pos. 1: A drives S; A_1 drives S_1 (stereo). Pos. 2: A drives S and S_1. Pos. 3: A_1 drives S and S_1.



Reactive Feet

The black, synthetic-rubber feet found on many pieces of audio equipment for the protection of fine finishes often defeat their intended purpose. It seems that the chemicals used in compounding the rubber react unfavorably with the varnishes and laquers used on the woodwork.

These feet, when in direct contact with the finish, will sometimes cause depressions in less than a month. If the feet are first covered with patches cut from self-adhering cellophane tape, this trouble will be eliminated.

Henry F. Robbins
New York, N.Y.

Soldering-Gun Modification

Frequently, one has to make emergency repairs on equipment at points which are virtually inaccessible even to the slender tip of a soldering gun. Or, it may be necessary to do some fine soldering on the voice coil of a speaker or a printed circuit. A conventional soldering gun or iron provides neither a small enough tip nor sufficiently low heat for these applications. Of course, a special iron is the best answer, but if the home hobbyist does not feel that the additional investment in soldering equipment is justified, he may find the following alternative helpful.

Cut off a piece of solid hookup wire 3 or 4 in. long and strip off the insulation. Then twist the wire securely around the tip of the soldering gun (or iron) so that about 1½ in. of it extend beyond the end. Now heat the iron or gun, tin the wire extension, and you're ready to do some fine soldering. It is true that the wire will not carry enough heat to solder heavy connections, but it works well on joints involving No. 40 wire or smaller.

John E. Turner
Boise, Idaho

Pickup-Arm Handle

An ordinary 1-inch rubber band cemented vertically against the center of the front of a pickup shell can be used as a handle for the pickup. Use of this rubber-band pickup-arm handle will reduce the danger of scratching records,

and it will simplify placing the needle in any specific groove.

The cement used is the ordinary dime-store variety. It should not be permitted to drip onto the needle or record surface. Allow the cement to harden for 24 hours before using the handle.

L. M. Garrett, M.D.
Corpus Christi, Tex.

Storing Parts

The problem of storing the many small parts used in radio and high-fidelity work has long been met by the home experimenter by placing everything in one large box, commonly known as the junk box. While this method is obviously inefficient, the parts bins offered for sale tend to be quite expensive.

There is now on the market a soft-plastic ice-cube tray which I have found to be well suited to storing parts. The trays I use contain 16 small compartments; they are available at supermarkets and hardware stores at the low price of 29¢ each. A rack for storing the trays can be made from plywood or light sheet metal, if desired.

Harold J. Wagner
East Syracuse, N.Y.

Record-Storage Cabinet

After reading Mr. Williams's article on the construction of a record-storage cabinet (AUDIOCRAFT, Feb. 1956, p. 29), I decided I would try his idea of using ⅛-inch brass rods as separators for the records in my previously built record cabinet. I went to a local hardware and plumbing store which carries a large stock, and found they had no such rods.

As a substitute, I purchased several lengths of ¼-inch wooden dowel which is available almost anywhere. The same installation procedure is followed, allowing approximately ⅜ in. more than the height of the cabinet and then snapping the dowel into the ¼-inch holes. An advantage is that the wooden rods can be stained or painted to match the decor of any cabinet or room.

George H. Covey III
Katonah, N.Y.

Reducing Tape Wow

Owners of many of the lower-priced tape-playback units experience tape slowdown and wow toward the last half inch or so of the supply reel.

The quality of tape playback can be improved by wrapping about an inch of electrical tape around the reel spokes, next to the hub, thereby increasing the effective radius of the hub. This is, admittedly, an unlovely and temporary arrangement, but even the longest tapes will still fit comfortably on the modified reel.

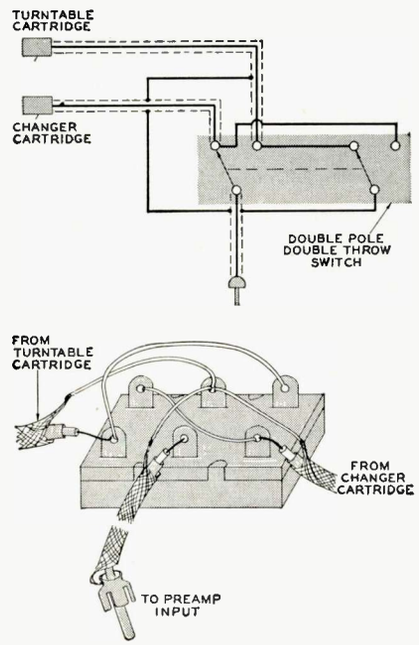
Ted Mead
Port Chester, N.Y.

Turntable Switching

When the shiny new turntable and tone arm wormed their way into the family budget, the good wife wouldn't hear of removing the changer. "It's too handy for putting on a stack of records while I'm doing the housework," she said.

The problem was that the preamp had only one magnetic phono input, and I didn't want to replace the magnetic cartridge on the changer with a crystal.

The problem was finally solved by mounting both the changer and the



turntable on one wide mounting board with a selector switch between them, and only one lead running from the switch to the phono input jack. Here's the circuit [diagrammed above].

L. E. Johnston
Madison, Wis.

Improving Bass Response

The new, high-quality ceramic phono pickups give best response working into a 2- or 3-megohm load, but the impedance of most radio and TV phono-input jacks is ½ megohm.

Bass response can be improved by connecting a ¼-watt, 2 megohm resistor in series with the connecting cable. The resistor can be spliced into the inner conductor of the cable.

To do this, double back the leads of the resistor over the resistor's body and solder the inner conductor of the cable to the leads, close to the body of the resistor. Insulate the resistor by wrapping it with a layer of electrical tape. Next, solder together the unbraided ends of the cable's shield and wrap the entire splice with aluminum foil. Tape the joint with electrical tape beyond both ends of the foil.

This arrangement will reduce gain somewhat, but most radio and TV amplifiers will give sufficient volume to permit the loss.

William A. Banton
Salinas, Calif.

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Antistatic Meters

Substantial errors in reading meters used in audio measurements may result from static charges on the glass or transparent plastic covers. The charges are caused by friction in cleaning or handling meters, particularly in the dry air of the winter heating season. The error is apparent if the charge displaces the pointer from its zero position, but usually escapes notice if it occurs only in deflected positions.

The time-honored remedy is to breathe on the cover and wait for the charge to dissipate through the reduced insulation of the moisture path. A more dependable method is to coat the glass or plastic with one of the antistatic liquids or sprays made for records, such as Stati-Clean. For added effectiveness, it may be applied also to the inside surface, in case there is occasion to remove the meter cover.

O. A. Friend
Carmel, N.Y.

Equipment Accessibility

This suggestion is intended for those audio enthusiasts who have mounted their equipment in cabinets, bookcases, or shelves where it cannot be reached easily. I mounted my own equipment in a set of specially constructed shelves, and, since the controls are on the preamp, I located the amplifier in a cubicle at the bottom. Occasionally, however, I wish to gain access to the amplifier to change tubes, check the balance of the outputs tubes, and so on. The amplifier weighs about 30 pounds and is equipped with a covering cage, so it is difficult to remove it from the small compartment.

This problem was solved by mounting the amplifier on ball-bearing, 16-gauge steel drawer slides. These slides are the ones intended for mounting record changers. They come in several lengths and are available from almost any radio or audio supply house. With the slides screwed securely to the bottom of the compartment it is a simple matter to slide the amplifier out to make the adjustments.

Robert D. Hoffsommer, Jr.
Metuchen, N.J.

GROUNDED EAR

Continued from page 5

0.1% at 1,000 cps, of which more than half is noise.

Perhaps my ears are showing the erosion of age, but at any level any of us could tolerate in my living room I could not distinguish this amplifier from the two 50-watt amplifiers on my shelves. It has the same clean and well-defined response at the low and high ends delivered by the best big amplifiers; and the definition is equally outstanding. This would not be true with low-efficiency speakers, of course.

There is a slight ripple on a 20,000-cps square wave, as indicated on the tracing. However, it is no worse with no load or with a speaker load, even with 15 ft. of speaker cable; and no capacitance up to 0.1 μfd makes it look disturbing. The 20-cps square wave has a tilt of less than 20°. Despite the 27 db of feedback and the bump at 8 cps, the amplifier is stable at both ends. Even when the preamp obtains its voltages from the amplifier, it is possible to induce low-frequency instability only by adding almost the full bass boost to the very large bass boost provided by a loudness control — a condition which could not possibly be used for listening to modern records.

There is only one difficulty. If all the parts are purchased, the cost will run between $50 and $55, depending on whether the Dynakit PC board is used or not. An additional $15 would buy the Dynakit 50-watt Mark II or the EICO HF-60, with far higher margin of reserve power and even better distortion figures above 2 or 3 watts. It is, therefore, not inexpensive. However, if you already have power-supply components or an old 6V6 amplifier, the cost can be reduced greatly.

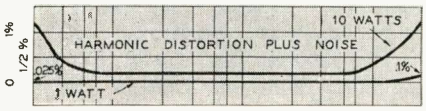

Fig. 4. Harmonic distortion and noise.

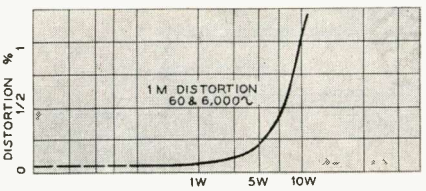

Fig. 5. Graph showing IM distortion.

Low-Distortion Audio Generator

Incidentally, readers who note the extremely low harmonic-distortion figures in these curves may wonder what kind of sine-wave generator I am using or whether I subtract generator distortion to arrive at these figures. Answering that question may also solve a problem for those who require a generator of extremely low distortion. The generator used is a Heathkit AG-9A. Heath claims a distortion of 0.1%, but it is actually only .025 in mine. I do not subtract this residual generator distortion except when the reading approaches 0.1%. This is not an isolated instance of a specimen with uncommonly low distortion; similarly low or lower figures have been obtained by several other users I am acquainted with. This generator has found use in extremely critical laboratory applications because of its phenomenally low distortion.

Another fine feature is the good attenuator network which provides a signal as low as 100 microvolts. The instrument can be used to run distortion or frequency tests through microphone, phonograph and instrument preamps, without danger of overloading. It is also the fastest generator to use for repeated frequency or distortion runs in decades. And although the advertised range is from 10 to 100,000 cps, it will go down to 1 cps with decreased meter accuracy below 10 cps.

TAPE NEWS AND VIEWS

Continued from page 30

make them gradually so that the changes won't stand out like mourners at the Mardi Gras. Also, when mixing a soloist with a large performing group, don't make the mistake that some professional engineers still make: to override the ensemble with the soloist. It is disconcertingly unreal to hear the sound of a contralto overpowering a full symphony orchestra with organ and chorus. Use solo mikes to *spot* soloists — to give them a little additional detail and intimacy — but don't make them relatively louder than they actually are. It isn't necessary, and it will detract from the effectiveness of the recording.

Speaking from painful experience, I should admonish anyone who is recording a soloist with accompaniment either to make some test recordings beforehand (making notes of mike placement and control settings) and then audition these on the home system, or to get a good pair of headphones (such as the Brush 205A-1) and to record in a sonically isolated room some distance from the performing location. The ability to hear the performers *directly* as well as through the monitoring phones can completely ruin one's capacity to judge what is and is not properly balanced, and is likely to result in a recording that bears practically no relationship to what was heard through the headphones.

A final word: many of the tapes you make will probably be of performing groups whose musical competence ranges from moderate to practically nil, and the sound of your recordings is going to have a good deal to do with the sound of the group itself. The best recordings can't make good music out of a bad performance, so don't blame all of your less impressive efforts on your recording technique alone. Spare the sackcloth and ashes until you've had a chance to try your tape technique on some good performing groups.

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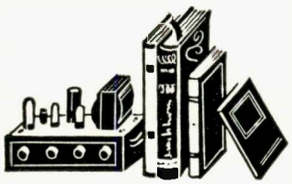

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READER'S FORUM

Continued from page 15

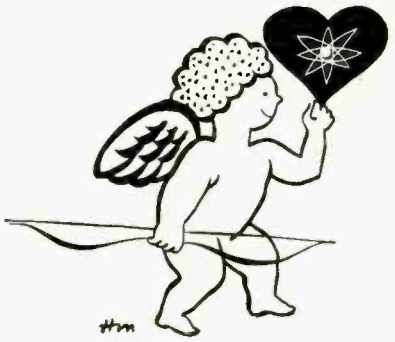
would appreciate information on how to construct a miniature good-quality power supply with a plug-in to the Dynakit preamp. According to the literature, the power requirements are: "200 to 400 volts DC at 3 to 4 ma, 6 volts AC at 0.75 amps."

Perhaps other readers would profit by this information which would add flexibility and attractiveness to the unit. Where could I get the detailed information (including a pictorial) which a nontechnical reader such as myself could use to build this power supply?

Charles W. Pachner
Scarsdale, N.Y.

The Dynakit preamplifier requires so little power that any power supply built specifically for it would be readily usable with no other unit. For that reason, a construction article on such a device would be of limited value to readers.

There is one marked advantage of the preamp's small and flexible power requirement, though: just about any amplifier can furnish the requisite power without any strain. Because of this, you can simply connect directly into the amplifier's filament supply and B+ circuit without danger of upsetting anything.
— ED.



Gentlemen:
Can you recommend a high-fidelity handbook laying particular emphasis on the correct installation and maintenance of turntables, cartridges, and arms necessary for optimum performance from home music systems? I need to know not only the proper measurements and adjustments to make, but also the proper tools necessary to make them with.

H. K. Darby
St. John's, Nfld.

Perhaps the best book for your purposes is Maintaining Hi-Fi Equipment *by Joseph Marshall. This is available through our book department at a cost of $5.00 (cloth-bound) or $2.90 (paper-bound).*
— ED.

Gentlemen:

May I rush to Mr. Wright's defense ["Rumble Seat," December AUDIOCRAFT]. Mr. Dorf seems to take violent exception to the statement that electronic organs employing frequency dividers cannot produce good ensemble. I think you will find that most organists will agree with Mr. Wright — at least this one does.

I haven't played the Schober organ that Mr. Dorf manufactures, but as a professional organist I have often played the three commercial organs that employ this principle and have found them all notably weak in this respect. I don't think there is any satisfactory substitute for individual oscillators yet.

Richard Van Sciver
Charlotte, N.C.

SOUND-FANCIERS' GUIDE

Continued from page 25

mend extraverted, sensation-craving listeners to some of the beyond-jazz and exotic pops available in profusion this month. The stereo medium is so ideal for such materials that ordinarily I would unhesitatingly give first place to such striking tapes as the extraordinary and often enigmatic *Monk's Music* (Riverside, via Livingston, RT 7-20 BN) and the infectiously rhapsodic jazz fiddling of *Stuff Smith* (Verve VST 10005-6; also in the Verve LP 8206), which are trailed by the less original (except for its haunting *Song for Tuba*) but still mightily exhilarating *Brass in Hi-Fi* by Pete Rugulo's Orchestra (Mercury MDS 2-11; also in a less impressive LP, MG 20261).

Yet there are several LP's "only" this month which unexpectedly transcend the usual limitations of their single-channel medium in various ways, all calculated to tickle the most demanding sound-fancier's ears as well as toes. The *Music for Brass* by the Jazz and Classical Music Society (Columbia CL 941) is mostly rather pretentious after-jazz-what stuff, except for its more jauntily lyrical *Three Little Feelings* by John Lewis, yet it does contain some fascinating sonority manipulations as well as thrilling recording. The Chico Hamilton Quintet's jazz themes and "concerto" from the *Sweet Smell of Success* film (Decca DL 8614) strain less hard for modernism, but are more effectively original, and at their best (as in *Cheek to Chico* and *Jonalah*) are infectiously vivacious. The *Jazzpickers* program (EmArcy MG 36111) also demonstrates exceptional ingenuity and sparkle in *I'll Remember April, Yardbird* Suite, *Rap-Scallion*, and *Clap Hands*, although its novel timbre effects tend to get a bit monotonous elsewhere.

Continued on next page

SOUND-FANCIERS' GUIDE

Continued from preceding page

And the Max Roach Quintet makes a valiant attempt in *Jazz in ¾ Time* (EmArcy MG 36108) at jazzical animations of waltz materials. The results here are dubiously successful (except perhaps in *Little Folks*), but they never lack tonal piquancy and interest — evaluations even more applicable to Art Blakey's *Orgy in Rhythm*, Vol. 1 (Blue Note BLP 1554) and *The New York Jazz Quartet Goes Native* (Elektra stereo, via Livington, EL 7-7 BN; also in the Elektra LP, 118). The former is particularly fascinating for its inclusion of exotic African and Latin-American instruments as well as idioms; the latter for its less strenuous lilting flute playing (by Herbie Mann) and bongo-drumming (by Manuel Ramos and Teiji Ito).

For less distinctively novel, more obviously exotic (yet not less brilliantly recorded) dance music, don't overlook Pedro Garcia's *Cha Cha Cha* Vol. 3 and *Tango* collections (Audio Fidelity AFLP 1837 and 1838 respectively, which also include jacket diagrams and instructions for the steps themselves). And when you finally weary — if you ever do — of all such adventures into exotica and want to step out to more familiar tunes and orthodoxly catchy rhythms, you can't do better nowadays than pick the immodestly but (for once) by no means inaccurately titled *America's Most Danceable Music* by the Griff Williams Orchestra. *I Could Write a Book* is perhaps the most irresistibly buoyant, but all these pieces are a dancer's delight in the LP version (Mercury MG 20288) and in addition, a stereophile's dream in the MDS 2-7 taping!

HOUSEBOAT HI-FI

Continued from page 31

totem-pole mast (carved from an old telephone pole), burlap drapes, and a 5-by-5-foot abstract painting of an amoeba. His sun deck and second-story window boxes feature green plants — each one different.

But besides the Bohemian atmosphere and cheap rent, there are other reasons why Jean likes his houseboat. He couldn't have as large or as noisy a hi-fi set anywhere else, unless he lived out in the middle of a desert. He doesn't have to worry about landlords or policemen yelling for quiet — just neighbors, and there are only about 12 houseboats in the bay.

Jean has been warned by several fishermen not to leave the dock. "They're afraid I'll sink," he said. But his boat will never leave the harbor. It doesn't have a motor.

ATTENUATOR SET

Continued from page 21

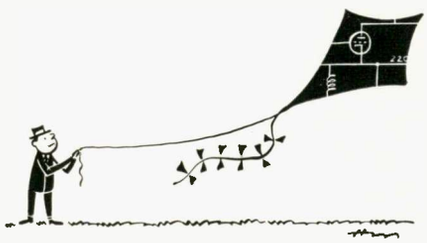
to handle more power, larger resistor values may be used.

Calibration

When the unit was finished, no step of the 10-db attenuator was off more than 0.2 db; the greatest deviation of any step of the 100-db section was 0.5 db. Since some resistor values were on the high side, and some on the low side of their rated values, the over-all attenuator accuracy came within 1%.

The only instruments needed to calibrate the attenuator are an audio oscillator and AC vacuum-tube voltmeter. These are usually included in the audio hobbyist's collection of test equipment.

The three sections of the instrument are calibrated separately, since calibration of the complete set would result in extremely low output voltages not readable with an ordinary AC volt-



meter. The input and output of each attenuator section must be terminated in its characteristic impedance; in this case, 600 ohms. The oscillator output is applied in turn to the 10-db attenuator and then to each 50-db attenuator section. In each case, the oscillator output is adjusted for 1 volt as measured by the AC voltmeter. The voltage readings obtained at the output of each attenuator, for a given attenuation or switch position, should then be close to the values given in Table 3.

Applications

Since the attenuator set is variable in 1-db steps up to 110 db attenuation, it is useful in many applications. It can be employed to attenuate accurately the output of audio oscillators; measure transmission loss through an audio system; measure gain and frequency response of amplifiers; check attenuation characteristics of fixed resistive networks; etc. The impedance of the instrument may be matched to any device or load by means of fixed T pads or terminating resistors, as required. Three examples of the many arrangements possible are given in Fig. 5. Several practical applications will be outlined in the following paragraphs.

When measuring noise and distortion in an amplifier, it is desirable to provide an audio signal to the input of the circuit that is equivalent to the signal normally provided by the microphone, phono cartridge, or other signal source. This input voltage, as available from some transducers, is too minute to be measured easily. With the decibel attenuator set, these small signal voltages can be applied to the input of the amplifier with the comfortable assurance that they are accurate. Depending on impedances involved, a test circuit similar to those shown in Fig. 5 may be used. Some convenient output from the oscillator, as read on a VTVM, is fed to the attenuator set. Suppose this is 1 volt. The signal level, then, from the output of the attenuator may be any desired value from 1 volt down. As an example, if the attenuator is set for 20-db attenuation, the signal level would be 0.1 volt. At 40 db the output would be .01 volt. 60-db attenuation would give .001 volt output and so on.

It is also desirable to measure distortion at a level at least 10 db above rated output of the transducer to allow for peaks of complex voice and music signals. It is, therefore, only necessary after a test is made at rated output of the transducer to reduce the attenuator setting by 10 db and make the distortion measurement.

When measuring response of amplifiers incorporating equalizer networks providing a rising characteristic over a

Continued on next page

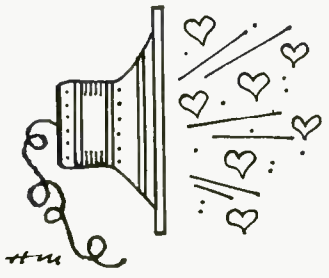
ATTENUATOR SET

Continued from preceding page

certain portion of the audio band, overloading may occur at these boost frequencies. This can be overcome by using the attenuator set between the oscillator and amplifier input and an audio voltmeter at the amplifier output. Then, for each test frequency, the reading on the output meter is held constant by varying the input to the amplifier by means of the attenuator knobs. A response curve can then be drawn directly from the db variations as recorded from the settings of the attenuator controls; it will be accurate within a fraction of a db.

In measuring over-all voltage gain of an amplifier or complete audio system, the input signal should be low enough to prevent overloading of any part of the system. The attenuator set will prevent this. As an example, suppose the input to the attenuator is 1 volt as read with a VTVM. If the attenuator set is adjusted for 40 db attenuation, the input to the amplifier will be 10 mv. The output voltage of the amplifier, as read by the VTVM, divided by 10 mv will give the voltage gain of the system.

The attenuator set will quickly measure feedback voltage of the amplifier, supplying the answer directly in decibels. The attenuator is connected between an oscillator and the amplifier input. An AC voltmeter is placed across the amplifier output and, with the feedback circuit in the amplifier opened, a signal is fed to the amplifier input to obtain some convenient reading on the output meter.



The attenuator controls should be set somewhere near their middle range. The feedback circuit in the amplifier is then restored to normal, and the attenuation of the attenuator set gradually reduced until the output meter again indicates the same value as it did when the feedback loop was open. The feedback in decibels of the amplifier is then equal to the number of db the attenuator was reduced as indicated by the attenuator controls.

These suggested applications of the attenuator set are but a few of the many that are possible. The audio experimenter will discover others as he becomes accustomed to using the device.

STEREO DISCS

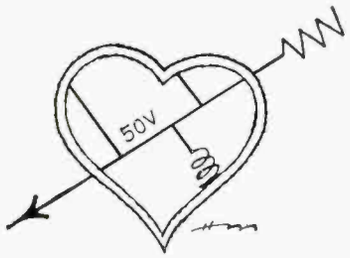
Continued from page 19

system is quite high, but this is only a makeshift device to determine if the cutter is getting sound onto the disc. It was, however, the cartridge system used to demonstrate the Westrex system before the AES. Commercial cartridges will be far more elegantly designed.

Unlike any of the others mentioned up to now (except the EMI signal/data method), the Westrex system is fully compatible. That is, a Westrex disc can be played by a conventional cartridge and a conventional disc can be played by a Westrex cartridge. In the former case this is true because the modulation of the Westrex disc is both lateral and vertical in both channels. Thus, with a conventional cartridge we get the lateral modulations of both channels combined by the cartridge and we hear the resultant. In the case of a Westrex cartridge playing a conventional disc, since the channels are sensitive to both lateral and vertical movement of the reproducer stylus, we get output proportionate to the lateral movement of the stylus. Accordingly, we get equal monophonic output from both speakers.

Stereo Tape vs. Stereo Discs

You might ask here, just why all this fuss over stereo discs? Isn't stereo on tape good enough? Of course it is. Tape is probably the most flexible medium we have. It can be recorded in the home; it can be erased and reused; it never wears out, and is as tough as anything has the right to be. Then why all the excitement over stereo discs? Let me ask a few other questions, which



should answer the first. Is there a tape changer as we have record changers? Is it as easy to find a specific passage on a tape as it is on a record? Do you have to rewind a record? Is it as easy to duplicate a tape as it is to press a record? Is raw tape as inexpensive as raw vinyl? In the minds of the general public, is a tape recorder as easy to use as a record changer (or player)? On the last, forget your opinion. You know something about products. Think of the last person or so who visited you, who knew nothing about high fidelity, and his reaction to your system. Now, which stereo system do you think the general public will more quickly accept — tape or disc?

Continued on next page

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STEREO DISCS

Continued from preceding page

The trouble is, the public has never fully accepted tape because it has never been fully educated to it; tape has not been around long enough. There you have your answer in a nutshell.

On the other hand, the tape market will not die. Anyone interested in true hi fi quickly appreciates the value of tape. For sonic potential and quality longevity, tape has the edge. Monophonic recorded tapes were around before stereo tapes, and they still are. Stereo tapes did not kill them.

Of course, there will probably be more emphasis on stereo *recorders* rather than players, especially since more good-music stations will start broadcasting stereo discs by AM-FM or FM multiplex. We are certain to get FM multiplexing once there is a plentiful supply of stereo to broadcast.

It is apparent that the rapid growth of stereo tape sales must slow down. Presently, to have stereo, you must have tape. In a while, a very short while, this will not be true. But, as people get more deeply involved in high fidelity they will want tape; so tape sales will not only continue but they will continue to grow, if at a slower rate. In the past, people would buy "a Hi Fi" and rapidly become dissatisfied as they heard more and more genuine high fidelity. They soon turned to true high fidelity. I expect the new stereo disc will accelerate this trend.

Which System and When?

Now, just how close is this monogroove stereo disc? A lot closer than you think! For the past few months, RCA Victor, Capitol, Decca, and Columbia have been experimenting with the Westrex cutter. According to rumor, one of these firms is no longer cutting new masters of conventional records. In addition, it is reliably reported to have the intention of releasing Westrex discs very soon, and discontinuing conventional disc releases sometime next summer. This company has been recording everything in stereo (as have all the major recording companies) for better than a year now, and will have no trouble in changing over since only the cutters and amplifiers will be involved. Thus, stereo discs will be produced in quantity and should be selling at prices close to or equal to those for conventional records. We can, therefore, talk of next fall as the latest date for the arrival of monogroove stereo discs.

How about cartridges to play back these discs? All manufacturers are probably working on them now. My firm, Fen-Tone Corporation, certainly is (at the B&O factory in Denmark). Fairchild certainly is; this company even had a V/L cartridge on display at the 1957 New York Audio Show. According to Mr. Fairchild and Ruben Carlson (Director of Engineering at Fairchild), they are now working, and are almost ready with, a vector-system cartridge. Ronette supposedly has a new V/L crystal and an even newer V/L ceramic, and claim to have both types of vector cartridge. There can be but little doubt that other manufacturers such as GE, ESL (Danish Ortofon), and Electro-Voice are now working on reproducers. We will have cartridges aplenty, little enough worry about that.

One of the world's largest manufacturers of record changers is working on a model that will use a Westrex system cartridge. A manufacturer of phonographs (both "Hi-Fi" and high fidelity types), is now preparing a new series to use stereo cartridges and to use stereo as a major selling feature, with a building-block type of unit for future additions. There can be no question about our having the records and the playback equipment. And the public will buy — they'll have little enough choice. Still, the public will be happy and so will the manufacturers. It makes good sense to make only one kind of record, a fully compatible one.

Yet, is the Westrex system fully compatible. Yes and no! Since there is a good deal of vertical output from both channels, only a cartridge with high ver-

tical compliance can be used. Assuming you do not have a Westrex system cartridge, there is the possibility that the cartridge you now have will not track a Westrex system disc. Many high-fidelity cartridges have high vertical compliance, but many others do not. Still, the Westrex system is probably too close for anything else to be considered seriously, and it is safe to say that only a monogroove system is acceptable.

Jerry Minter, past president of the Audio Engineering Society and now president of Components Corporation (makers of turntables and test records) prefers a frequency-modulation record system, and is now working on one, along with John McConnell, Chief of Engineering at ESL. This involves a highly modified cutting system and added playback equipment. To be sure, it may well be better, since it has none of the Westrex shortcomings (such as the need for high-vertical-compliance pickups for compatibility). Will the public and the manufacturers accept such a design and the need for additional equipment and controls? We don't know. This will probably become a case for the RIAA, in order to prevent a repetition of the confusion we had with the 33- and 45-rpm records. There may not be much the RIAA can do now but accept the Westrex system. We'll just have to wait and see.

Let us now compare the various methods and their faults. Each method has at least one fault which might have to be overcome prior to its release. We went into the matter of the improbability of low-frequency response in the vertical channel of any V/L system, a major shortcoming since the ideal system calls for two identical channels. In addition, there is the problem of scratch, hiss, pop, crackle, and other such sounds. These sounds are predominant in vertical-channel reproduction. Lateral-channel pinch effect also appears in the output of the vertical channel. Finally, there is the problem of record wear due to the heavy stylus force required in a V/L system. London claims no need for great tracking force, and so does Sugden; yet light stylus force would further limit low-frequency reproduction in the vertical channel.

The EMI data/signal system is fine, but I seriously doubt the acceptance of any pseudostereo system.

The Westrex system is not free from faults either. Since there are vertical components in both channels of the Westrex system, the reproducing cartridge must have vertical sensitivity. This means sensitivity to scratch and all the other sounds mentioned in connection with V/L systems. In addition, since there are vertical components in both channels, the same troubles, outlined in the earlier parts of this article in connection with low-frequency response in V/L systems, are still present. None of these is present to as great a degree in the Westrex system, since it is only half-vertical and half-lateral for each channel, yet the problems do exist. Tracking force is not as great a problem with the Westrex system. A tracking force of only 4 grams is probably sufficient with a high-quality arm and a 1-mil stylus diameter.

The Components Corporation system will require special techniques and equipment in both recording and playback. Aside from that, little is known; it is still very much an experimental system.

Any dual-groove system suffers from synchronization difficulties and a parallel-groove system might suffer from pre- or post-echo from adjoining grooves. Then there is the problem of separation. Sugden claims 25 db separation, London/Decca 45 db, and Westrex 35 db. No claims have been made for other systems. We do know that 35 db is a minimum, from past experience with stereo.

What does all this mean to you? If you have been reluctant to go over to stereo, you no longer need be. All the records you'll be buying soon will be stereo, so why not take full advantage of them? It means another amplifier and another speaker as well as a new cartridge (and possibly a new arm and turntable), but the results will be worth it. We'll soon be getting lots of stereo broadcasting, and you'll need the basic stereo equipment for that too.

What about those who have tape machines now? It should not affect you, because stereo tapes will continue to be available. In addition, with a slight modification of your recorder, you'll be able to tape stereo programs off the air. You'll be able to save your valuable stereo discs as many now save their monophonic discs by recording them, storing the discs, and playing the tapes. So don't plan to retire your tape machine, or don't let the advent of stereo discs dissuade you from getting a tape recorder. Stereo discs will make it more useful than ever.

PUZZLEMENTS

Continued from page 33

10 watts average output. So the impression is obtained that the 50-watt amplifier gives less distortion-free output than the 25-watt model.

What a customer described as "punch" is the ability of the amplifier to take those intense transients that the instrument delivers when high degrees of expression are put into the playing, without producing distortion of the following tones.

We have always believed that fixed bias, with a degree of Class-AB operation, is capable of delivering a bigger power output than Class-A operation with cathode bias. Isn't this true, then?

Using conventional circuits, such as those just described, this is true only on the test bench, when operating with sine-wave signals that can be increased gradually to the maximum output point without any overdrive in the process. As musical material does not consist of this kind of signal, the results achieved are often quite different when listening to them as high-fidelity amplifiers.

But if the aftereffects of grid current could only be eliminated from the fixed bias combination, the greater power could be realized in practice as well as under test-bench conditions. This is achieved in fact with quite a few commercial amplifiers. The simplest method of achieving it is to drive the output stage with a direct-coupled cathode follower.

The cathode of the cathode follower is direct-coupled to the grid of the output stage and the bias of the output stage is then controlled by the grid potential of this cathode follower. If necessary, to protect the grids of the output stage from overheating on temporary positive drive, the resistance of the drive source can be increased by inserting a resistance between the cathode of the cathode follower and the output-tube grid. But this still maintains the direct coupling.

When the grid of the cathode follower is driven more positive than the output-stage cathode potential, the output stage will draw grid current but the cathode follower driving it will not. So resistance/capacitance coupling can be used here without any risk of negative bias hangover, because the grid current drawn by the output stage does not get reflected back to this capacitance. This means that, as soon as the wave form goes back to the potential of the output-stage cathode, the clipping terminates and the following audio wave form continues to be amplified undistorted.

This cathode follower does not have to be a power tube. A number of amplifiers use a 12AX7 tube, with one triode for driving each of the output tubes. This takes very little extra power from the power supply and is a relatively inexpensive addition to an amplifier in which the designer has already gone to the expense of adding a separate fixed-bias supply and other refinements to get a larger power from the available tubes.

PROFESSIONAL DIRECTORY

UNIVERSITY KIT

Continued from page 27

receiving the grille cloth. This panel has three speaker cutouts for accommodating a three-way speaker system; cover plates are provided for the less ambitious. First, drive all the speaker mounting bolts from the front side of the baffle board through the holes previously marked by the manufacturer, regardless of the number of speakers you intend to use. The same bolts are used for the speakers and the cover plates, whichever you intend to use.

It is necessary to paint the front side of the baffle board a flat black to prevent the light wood from showing through the grille cloth. After the paint is dry, position the grille cloth over the baffle board and wrap the cloth around the board edges, fastening it with staples or tacks; the corners should be done last. You can install your speakers now and then complete the final construction, or finish it and install the speakers later. Now add the decorative lattice work and picture-frame molding. Be sure that these parts are not glued in place, since they will have to be removed each time you want to gain access to the speakers. Putting back panel L in place completed the construction of the enclosure.

The cabinet is of Korina veneer and may be finished in any way you choose. The manufacturer does not supply a finishing kit, but does suggest several suitable finishes that can be applied.

The kit, minus time for finishing, took about four hours and fifteen minutes to complete. If it were not for the dry run, it would probably have taken a little longer.

AUDIOCRAFT Test Results

Although these enclosures are intended for use with any standard speakers or combinations of speakers, it seems like good sense to evaluate them with the speakers that are most likely to be used in them: those made by University. For the KEN-12 we obtained a C12W woofer, a 4409 middle-range horn and driver, an HF-206 high-frequency horn and driver, and the N-3 three-way crossover network. The same components were used in the KEN-15, except that a C15W woofer was substituted for the C12W. Crossover frequencies in both systems were 700 and 5,000 cps.

Since there are level controls for both the middle-range and high-frequency drivers in these systems, balance was adjustable over very wide ranges — wide enough, in fact, to meet every conceivable environmental requirement. In our test room (about 14 by 16 ft. and quite bright) we found that balance to suit our ears occurred when the KEN-15's PRES-

Continued on next page

UNIVERSITY KIT

Continued from preceding page

ENCE (middle-range) level control was set at 1:30 o'clock and the BRILLIANCE (high-frequency) level control at 10:30. The over-all sound was then crisp, with very good detail; high frequencies were reproduced clearly but smoothly, as evidenced by low needle-scratch audibility. A slight middle-range coloration would have been cleared up by substitution of University's new H-600/T30 assembly for the 4409 (and we understand that the new assembly is standard now). Bass was robust and also smoothly extended. In our room a strong fundamental was maintained down to 36 cps, and was still audible below 30. This is exceptionally good. In fact, the KEN-15 with its standard University three-way speaker complement — at a total cost of $253.50 — is one of the better speaker systems available, in our opinion.

Either because the C12W is lower in efficiency than the C15W, or because it is an 8-ohm unit and the C15W is operated with a 4-ohm voice-coil connection, we found it necessary to use lower settings of the level controls in order to obtain audibly equivalent balance in our KEN-12 system. The settings we found most listenable were 11:30 to 12:00 o'clock for the PRESENCE control and 9:30 o'clock for the BRILLIANCE control. When these adjustments were made the middle- and upper-frequency ranges were, of course, identical to those of the KEN-15 (since the same components were used). Low-frequency response began dropping sharply below 41 cps, however, and at 33 cps was inaudible. The entire low-frequency end was less robust than that of the KEN-15 system. Fortunately, there was very little harmonic generation at normal levels, so that bass boost can be employed to good effect in the preamp. We found that with about 5 db boost at 50 cps, the excellent balance of the larger system could be almost perfectly duplicated — except for an occasional subterranean note which we became accustomed to hearing with the KEN-15, and is missed with the smaller system. After all, the KEN-15 is twice the size of the KEN-12, and has a larger and much more expensive woofer; its bass response *should* be better. Good response to 40 cps, with reasonably high efficiency, is doing very well indeed for a system of moderate size.

In sum, these KwiKits are easy to build, inexpensive, and versatile in placement. They offer good performance and make it easy for you to start with a modest speaker complement and expand it as your budget permits.

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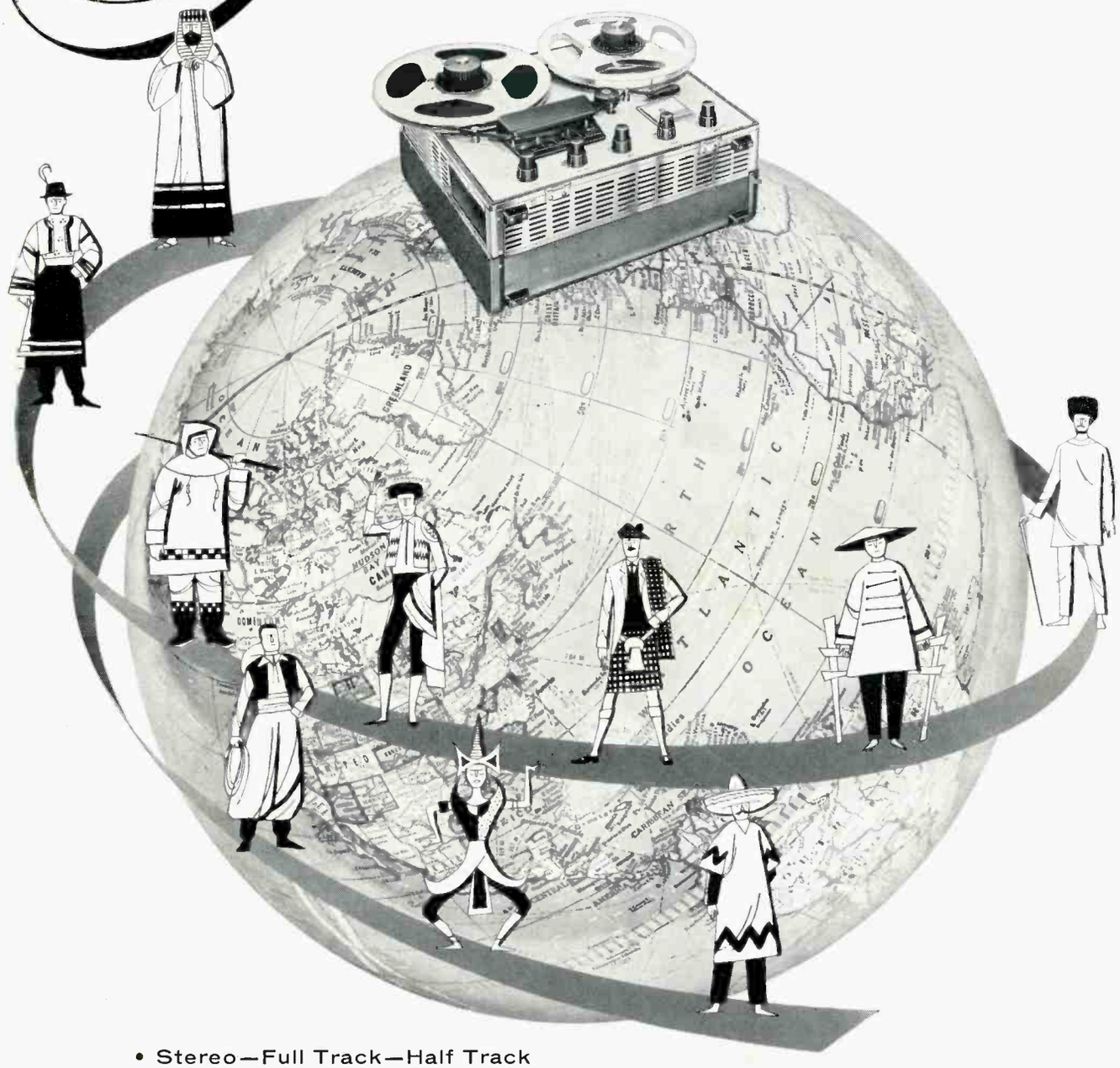

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