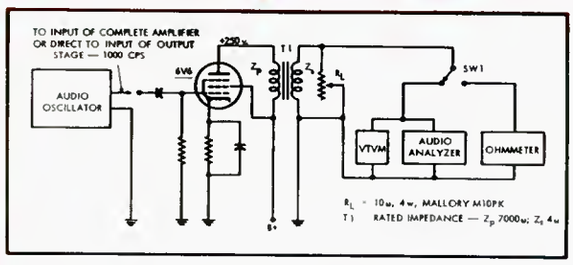
AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

JUNE, 1957

50¢



Using this test set-up, you can determine for yourself the optimum transformer ratio for a given tube-to-load circuit. The author presents thoroughly detailed data. See page 24.

Leopold Stokowski at the controls of one of the amplifiers used in the 1933 stereophonic test described in this first of the Bell Laboratories' reprints. See page 17.

REPRODUCTION OF ORCHESTRAL MUSIC IN AUDITORY PERSPECTIVE

A reprint of the original Bell Laboratories paper — first of a series

TRANSFORMER IMPEDANCE TRANSFORMATION

HUM SPECIFICATION MEASUREMENTS

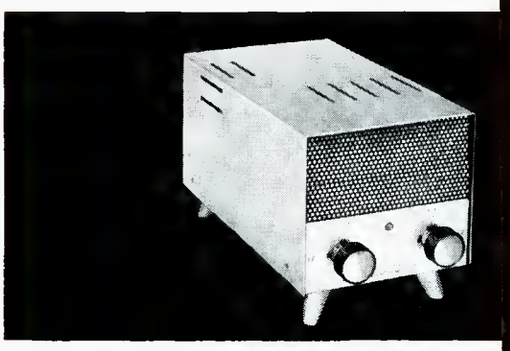
STERE

STEREOPHONIC TAPE PLAYBACK is now within the
budget—thanks to the mighty BOGEN ST10 Stere
fier and 2-Channel Preamp. Until now, using a s
meant buying a separate preamp for your secon
an additional amplifier as well . . . and a lot of
two sets of controls.

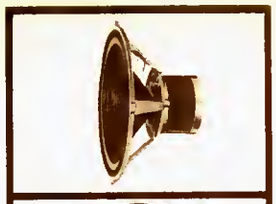
But not any more . . . because Bogen has devel
It saves you trouble—and a lot of money. Here's

First, the ST10 preamplifies both of your stereo
(the gain control acts on both channels simulta
matically assuring balanced stereophonic playb
preamplifier feeds your present hi-fi system, w
preamp feeds the ST10's built-in 10-watt amp
second speaker. This one amazing wonder-unit
all for the incredibly low price of $52.50 in ch
$59.50 for the ST10G with cage and legs, as illust

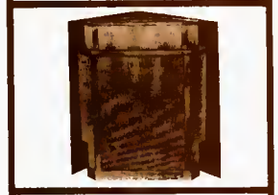
Write for ST10 literature (include a quarter and we
our 56-page *Understanding High Fidelity*) or bett
hi-fi specialist. Dept. AR, David Bogen Co., Inc.,
500, Paramus, New Jersey.



The Standing Board

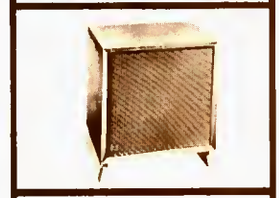


■ **WHARFEDALE**
Loudspeakers
Built under the personal supervision of world-famous engineer, G. A. Briggs. Unique soft suspension of cone.



■ **BRIGGS ENCLOSURE**
Exclusive sand-filled non-resonant corner enclosure for 3-way speaker system.

■ **BOOKS BY G. A. BRIGGS**
"Loudspeakers," "Sound Reproduction," "Pianos, Pianists and Sonics," and new book "High Fidelity, the Why and How for Amateurs."



■ **R-J ENCLOSURES**
(Floor Model)
The original small space loudspeaker enclosures. Patented R-J design principles. Full smooth bass; unobstructed highs.

■ **R-J ENCLOSURES**
(Single & Double Shelf Models)
"Maximum Bass, Minimum Space." Thrilling performance from any loudspeaker because of patented design.

■ **R-J WHARFEDALE**
First and only complete R-J system . . . includes special Briggs designed Wharfedale Speaker.

■ **RIVER EDGE**
"Customized" Cabinets
Equipment and loudspeaker cabinets with panels cut to fit components of all manufacturers.

■ **RIVER EDGE**
"100"
"Do-It-Yourself"
Kits, and assembled, but not painted units. Birch hardwood, takes fine furniture finish.

■ **S. G. BROWN**
High Fidelity Headphones
Internationally famous for precision, sensitivity, fine workmanship and ruggedness.

■ **ERSIN 5-CORE MULTICORE SOLDER**
World's finest core solder, made with exclusive Ersin Flux . . . non-corrosive, extra active

All B.I.C. components are illustrated and fully described in the BIC High Fidelity Plan Book, a useful guide in planning any hi-fi system.

Mail coupon for your free copy.

British Industries Corporation
Port Washington, N. Y. Dept. AF
Please send B I C High Fidelity Plan Boo

Name .....

Address .....

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

JUNE, 1957 VOL. 41, No. 6
Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

AUDIO (title registered U. S. Pat. Off.) is published monthly by Radio Magazines, Inc., Henry A. Schober, President; C. G. McProud, Secretary. Executive and Editorial Offices, 204 Front St., Mineola, N. Y. Subscription rates—U. S., Possessions, Canada and Mexico, $4.00 for one year, $7.00 for two years, all other countries, $5.00 per year. Single copies 50¢. Printed in U. S. A. at Lancaster, Pa. Entered as Second Class Matter February 9, 1950 at the Post Office, Lancaster, Pa. under the Act of March 3, 1879

RADIO MAGAZINES, INC., P. O. Box 629, MINEOLA, N. Y.

AUDIOCLINIC??

JOSEPH GIOVANELLI*

Test Equipment

Q. *I am planning to obtain test equipment so that I can keep a check on my system from time to time. What do I actually need? I do not want the equipment to be too elaborate because I am not particularly skilled. Norman Giust, Canton, Ohio.*

A. It is difficult to tell you just what test equipment you should have. If all you intend doing is performing routine maintenance on your equipment, all you would really need is a voltmeter with a sensitivity of at least 20,000 ohms per volt, and, possibly, an ohmmeter whose highest range is in the vicinity of ten megohms, full scale. It might be convenient, although certainly not necessary, for you to have a capacitance checker. An audio oscillator can be useful since it can be placed at the input of each stage for signal substitution work. Unless you plan to build a great deal of equipment, a good oscillator is not necessary. A relaxation oscillator or a transistorized code practice oscillator might be just what you need. Of course, such a device is capable of only a limited range of frequencies, a range totally inadequate for one who wants to do very much experimenting and testing. However, where a program source is needed merely to feed a signal into a circuit for tracing purposes, a wide-range unit is not needed. Since you would have only a few tubes to test, it is likely that a tube checker would be a waste of money, as would be a scope. Again, if you were planning to service huge quantities of equipment, and build even more, certainly these last-named pieces of equipment would be real necessities, as would be an a.c. vacuum-tube voltmeter and a distortion analyzer.

Transient Response

Q. *What is meant by transient response of an amplifier? Denis Reilly, Ft. Lauderdale, Fla.*

A. Transient response is a measure of the ability of an amplifier to reproduce the start of a sound. It is linked with frequency response. It has been found that in order to reproduce the beginnings of such sounds as drums, maracas, and many other musical instruments, the amplifier should be capable of passing frequencies in excess of ten times that of the highest audio frequency to be reproduced. Were it not for the ability of an amplifier to follow these exceedingly rapid attacks produced by various instruments, much of that intangible thing called "presence" would be lost. It is this difference in rise times for various musical instruments which helps to distinguish one from another.

Tracing Distortion

Q. *In discussions of pickup performance the term* tracing distortion *is often encountered. What does it mean? N. Mulle, White Plains, N. Y.*

A. Tracing distortion refers to the ability of a given pickup to follow the deviations in the grooves of phonograph records, regardless of their amplitude or velocity. When you stop and consider it, we are asking a lot of a pickup. Assume that we are to play back a tone whose frequency is 10,000 cps. When the pickup stylus is placed in the groove, it must accelerate to a maximum velocity, decelerate, come to rest, and then proceed in the opposite direction. Thus, in order to reproduce this note accurately, the stylus must stop and start 20,000 times during one second. It is almost impossible to imagine. Naturally, if the moving parts are too heavy, or the damping is too stiff, the needle will tend to follow a straight line, *striking* the groove undulations rather than *tracing* them. If this happens, the output can hardly be said to represent a true picture of the original recording. Not only will this happen, but the disc will be physically damaged, because the needle will knock off rather than trace, the fine wiggles which the pickup could not follow.

Hum and Distortion

Q. *I have an amplifier and a tape recorder. All inputs to the amplifier work normally, but when I feed in the recorder there is hum and distortion. I have tried reversing the wall plugs, but that did not help. I notice that when I bunch up the line cord and place it near the machine the hum is reduced somewhat. I notice, too, that this distortion and hum condition varies in relation to the time of day, becoming worse as evening approaches. The equipment itself seems all right, for, when I take it to another location, it works properly. C. J. Grant, St. Paul, Minn.*

A. As I see it, the hum can be caused by several things: first, make sure that all shields are properly bonded and returned to ground. Where possible, use two-wire shielded cable, wiring it in such a manner that the shielding does not form part of the signal path return. One of the conductors should serve this purpose. Second, perhaps your building has fuses in the ground side of the line, as well as in the hot side. If this ground fuse were blown, the chances are that you would still have current, although the voltage regulation would be poor, and the ground would have a high order of resistance. This might conceivably cause induced voltage in the room. Thus, when the line cord is bunched near the grill work of your cabinet, voltages may be induced out of phase with the hum voltage, causing a reduction of said hum. In this same connection, perhaps the wiring conduit is not properly grounded, causing a lack of its shielding characteristics. All this might be overcome by connecting a line from the tape recorder chassis to a ground, such as a radiator or water pipe.

In connection with the blown ground return fuse, sometimes referred to as a neutral fuse, mentioned earlier, this would also cause a voltage drop, robbing your equipment of necessary voltage. Since in the evening this drop would be greater because of the increased current demands throughout the house, distortion would mount. Even if your fuses are intact, it might be well for you to investigate the possibility of low line voltage.

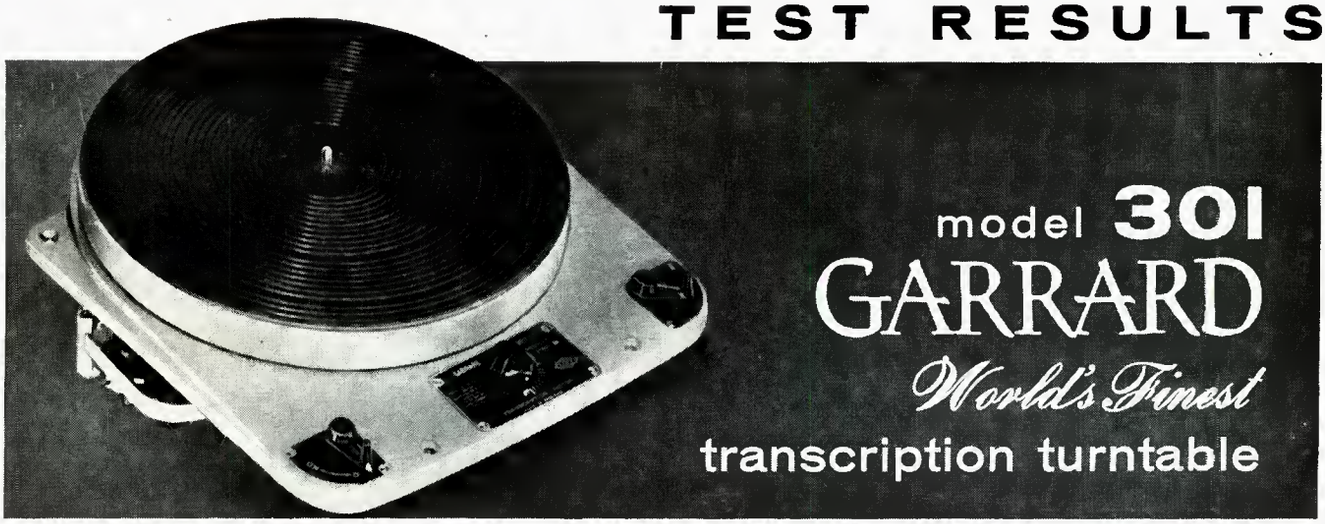
Gain Controls

Q. *Is it better to run the gain of the preamplifier low and the gain of the power amplifier high, or vice versa? S. F. Saiya, Brooklyn, N. Y.*

A. I recommend the following procedure: First, turn both controls down to zero. Next, gradually advance the ampli-

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

TEST RESULTS



TESTED: for performance by Audio Instrument Company, Inc., an independent laboratory.

RESULTS: Garrard Model 301 tested even better than most professional disc recording turntables...sets a new standard for transcription machines!

Read Mr. LeBel's report below

3 Stock machines selected at random!

Gentlemen:

We have tested the three Garrard Model 301 Turntables which the undersigned selected at random from sealed unopened cartons in your warehouse stock. These three bore the following serial numbers: 867, 937, 3019. We used a standard Model WB-301 mounting base without modification, a Leak tone arm fitted with their LP cartridge, and a complete Leak preamplifier and power amplifier, model TL/10.

Pickup and amplifier system conformed in response to the RIAA-new AES-new NARTB curve within ± 1 db.

Standards referred to below are sections of the latest edition, National Association of Radio & Television Broadcasters Recording and Reproducing Standards. Our conclusions are as follows:

Turntable easily adjusted to exact speed!

Measurements were made in accordance with NARTB specification 1.05.01, using a stroboscope disc. In every case, speed could be adjusted to be in compliance with section 1.05, i.e. within 0.3%. In fact, it could easily be adjusted to be exactly correct.

WOW less than NARTB specifications!

Measurements were made at 33⅓ rpm in accordance with NARTB specification 1.11, which calls for not over 0.20% deviation. These values substantially agreed with those given on Garrard's individual test sheets which are included with each motor.

Garrard Serial No.	%
867	.17
937	.13
3019	.12

Rumble less than most professional recording turntables!

Measurements were made in accordance with sections 1.12 and 1.12.01, using a 10 to 250 cps band pass filter, and a VU meter for indication. Attenuation was the specified 12 db per octave above 500 cps and 6 db per octave below 10 cps. Speed was 33⅓ rpm.

Signal to Rumble Ratio Using Reference Velocity of 7 cm/sec at 500 cps

This reference velocity corresponds to the NARTB value of 1.4 cm/sec at 100 cps.

Rumble: checked by official NARTB standard method (—35 db. min.) —52 db.!

Garrard Serial No.	DB
867	52
937	49
3019	49

The results shown are all better than the 35 db broadcast reproducing turntable minimum set by NARTB section 1.12. In fact they are better than most professional disc recording turntables.

Signal to Rumble Ratio Using Reference Velocity of 20 cm/sec at 500 cps

Rumble: checked by Manufacturer A's methods —61 db.!

Garrard Serial No.	DB
867	61
937	58
3019	58

We include this second table to facilitate comparison because some turntable manufacturers have used their own non-standard reference velocity of 20 cm/sec, at an unstated frequency. If this 20 cm/sec were taken at 100 cps instead, we would add an additional 23.1 db to the figures just above. This would then show serial number 867 to be 84.1 db.

Rumble: checked by Manufacturer B's methods —84.1 db.!

Of greatest importance! Always consider these vital factors to evaluate any manufacturer's claim.

It will be seen from the above that no rumble figures are meaningful unless related to the reference velocity and the reference frequency. Furthermore, as stated in NARTB specification 1.12.01, results depend on the equalizer and pickup characteristics, as well as on the turntable itself. Thus, it is further necessary to indicate, as we have done, the components used in making the test. For example, a preamplifier with extremely poor low frequency response would appear to wipe out all rumble and lead to the erroneous conclusion that the turntable is better than it actually is. One other factor to consider is the method by which the turntable is mounted when the test is made. That is why our tests were made on an ordinary mounting base available to the consumer.

Very truly yours,

C. J. LeBel

AUDIO INSTRUMENT COMPANY, INC.

C. J. LeBel

fier's gain control until the hum and/or hiss level begins to be audible from the speaker. This is the point at which the amplifier gain control should be set. Under this condition, most preamplifiers should be able to deliver satisfactory output. In other words, the amplifier gain should be the minimum possible, although this can be carried too far. It is possible to set this gain control down so low that the preamplifier would be driven to distortion before giving enough output. This same approach should be given to tape recorders, meaning that the gain control of the input to the preamplifier should be down as low as possible, with the tape machine's gain control used for actual level adjustments.

Radio Tuner

Q. *I have an a.c.-d.c. AM-FM radio. I have been advised not to use it as a tuner. Also, this receiver seems to have more than an ordinary amount of hum content. Any help you can give on these problems would be appreciated. B. Kalan, Albany, Calif.*

A. Since a receiver such as yours is equipped with a half-wave rectifier, the normal hum level is likely to be higher than that of a straight a.c. receiver. If the hum is at a level higher than that normally encountered with your type of receiver, check the filter capacitors and check the tubes. When checking tubes, the most important consideration is the heater-cathode leakage. The reason you have been advised against taking output from the detector is that the a.c. line is connected directly to the ground of the set, so that if the amplifier is grounded to the radiator, or if its line bypass has shorted, there is danger of blowing the house fuse or of damaging equipment. The simplest thing to do is to acquire an isolation transformer of appropriate wattage rating, which would be in the order of fifty watts. Of course, you should *check this before ordering the transformer.* Such a unit has a ratio of one to one, and is used to keep the line from being directly involved in the circuit into which it is incorporated.

Resistors

Q. *Some amplifiers specifically call for wire-wound resistors. What is the advantage of this type of resistor over the carbon kind? David Roth, Chattanooga, Tenn.*

A. Wire-wound resistors, in general, develop less noise than do carbon resistors in high-gain circuits. This is because the carbon resistor is composed of fused carbon granules having relatively poor electrical contact from granule to granule. It can be said that any one contact between any two granules is constantly intermittent. While there are many paths from granule to granule from one end of the resistor to the other, because of these poor and intermittent contacts, the over-all resistance is constantly changing by a small amount. Therefore, since there is a current flowing through the resistance, there is a constantly varying potential drop across the resistor which will be impressed upon succeeding circuits as a constant hiss similar to that produced by a carbon microphone. Wire-wound resistors, on the other hand, do not have these intermittent and poor contacts and therefore are relatively noise free. Because of the uniformity of area and length of wire, it is possible to manufacture resistors of high precision. In some cases, a special form of winding is used which produces a non-inductive resistor. Carbon resistors are inherently non-inductive, which is an advantage they have over wire-wound resistors. Also, the cost of carbon resistors is always less for a given wattage and resistance rating.

NOW!

from **KAY ELECTRIC**

TRANSISTORIZED AUDIO INSTRUMENTS

KAY *Audiolator*

All-Transistorized Beat-Frequency Audio Oscillator

FEATURES

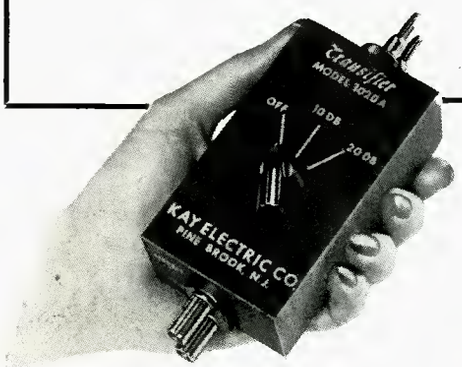
- **Constant Output, No Line Voltage Influences**
- **Built-In Stability By Means Of Feedback**
- **Output Constant with Frequency: 1 db over range**
- **No Hum**
- **Battery Power Supply — Long Life**
- **No Grounds Needed — Place Across Any Transmission System**
- **Excellent for Field Service, Military, Commercial and Domestic Hi-Fi, Industrial Applications**

The new Kay *Audiolator* is a fully transistorized, beat-frequency audio oscillator powered by mercury or penlight cell batteries. A single rotation of the dial covers the audio range of 50 cycles to 15 KC. A △f dial is provided for zero beat adjust and fine frequency control over the entire range.

SPECIFICATIONS

Frequency Range: 50 cycles to 15 KC
Output Voltage: 1 Volt at 600 ohms
Output Impedance: 600 ohms
Output Flatness: 1 db over entire range
Attenuator: 0 to maximum, continuously variable
△f Dial: 0 adjust—fine frequency control. Constant frequency shift over entire range
Power Supply: Mercury or penlight cells—400 hrs. life
Dimensions: 6" x 2" x 3¾"
Weight: 2 lbs.
PRICE: $149.50 FOB Pine Brook, N. J.

Quality Performance IN A MINIATURE SELF-POWERED UNIT



KAY *Transifier* MODEL 1020A

Miniature, Plug-In, Wide-Band Transistorized Video Amplifier

FEATURES

- **Broad-Band Response to 15 mc**
- **Completely Transistorized — Small, Self-Contained, Compact Portable Unit**
- **Signal Gain Controlled By Overall FeedBack —Built-In Stabilization**
- **No Hum**
- **Long Stable Life—Powered By Two Penlight or Mercury Cells**
- **Units May Be Cascaded to Provide Additional Gain**

The Kay *Transifier* is a true modular plug-in unit fully transistorized with feedback circuit built-in for stabilized signal gain.

The tubeless unit offers all advantages provided by use of transistors—small size—light weight—long life—rugged operation —low power consumption—high conversion efficiency.

The *Transifier* is completely self-contained in a cast-aluminum housing with standard banana plug input and output. Long life battery power is obtained by using low drain, low voltage transistors.

SPECIFICATIONS

Frequency Response: 10 db position: 3 db down at 20 cycles and 15 mc; 20 db position: 3 db down at 20 cycles and 10 mc
Gain: 10 db and 20 db switchable
Input Impedance: Capacitance 15 mmf—Resistive Component—20,000 ohms at 1 mc to 15,000 ohms at 10 mc
Output Impedance: 100 ohms, approximately
Maximum Output Voltage: 0.15 volts 10 db position; 0.30 volts 20 db position
Price: $85.00 FOB Pine Brook, N. J.

For Literature On The Complete Line of Kay Transistorized Instruments Write:

KAY ELECTRIC COMPANY

Dept. A-6, 14 Maple Avenue, Pine Brook, N. J., CAldwell 6-4000

LETTERS

Clarification

SIR:

An edited version of a letter I wrote you in July, 1955, was printed in the May, 1957, issue. The purpose of that letter was to take issue with an editorial of yours which appeared in the June, 1955, issue. That purpose was obliterated by the delay and by the exercise of your editorial license. The last sentence in the first paragraph originally read, "For this reason I feel that a footnote to the June Æ editorial, 'Judge for Yourself', is in order."

You have no obligation, of course, to print material unacceptable to you or in disagreement with your policies. It is quite another matter, however, to manipulate an expression of opinion to suit your own ends while still quoting its author.

LEON D. HARMON,
Old Stirling Road, RD-2,
Plainfield, N. J.

(We stand corrected, even though we can't see that our correspondent differed appreciably from our policy. ED.)

Why do we Face Sound Sources?

SIR:

Quoting from the Hume article (March, 1957, page 28, first column), "It is obvious that the reason creatures turn their heads to face a sound source is two-fold; first, to obtain maximum intelligibility (highest readability of the message); and second, to obtain maximum accuracy of orientation (maximum stereo sensitivity)."

This statement of a concept within a concept may sound very scientific, but it is far from "obvious" and I doubt if it is true.

My observation leads me to believe that a creature of the forest orients a sound instantly and wheels about to face the source *with his eyes.* This is true of the hunter, also.

In many instances, the alerted animal doesn't even try to obtain "maximum stereo sensitivity." Sound and scent have told him all he needs to know and his reflexes have given him a head start in the opposite direction.

Furthermore, I have observed with pity that a sightless person moves his head very little. I have sat beside blind children who faced straight ahead while we talked.

In our present concern with stereophonic sound we are losing sight of one basic fact relating to concert-hall listening. This may be a cryptic statement in which the import is not obvious, but is most certainly true.

NICHOLAS B. COOK,
72 Garfield Place, Totowa Boro,
Paterson 2, N. J.

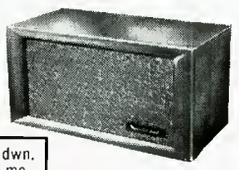
"We're building a HEATHKIT.®..

BECAUSE IT'S SUCH GREAT FUN . . . AND BECAUSE WE GET SO MUCH MORE FOR OUR MONEY!"

Every day more and more people (just like you) are finding out why it's smart to "do-it-yourself" and save by building HEATHKIT high fidelity components. These people have discovered that they get high-quality electronic equipment at approximately one-half the usual cost by dealing directly with the manufacturer, and by doing their own assembly work. It's real fun—and it's real easy too! You don't need a fancy work shop, special tools or special knowledge to put a Heathkit together. You just assemble the individual parts according to complete step-by-step instructions and large picture-diagrams. Anyone can do it!

Heathkit Model SS-1 Speaker System Kit

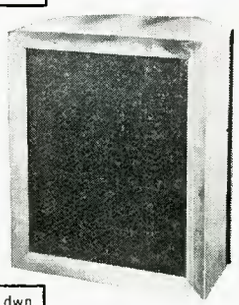
This high fidelity speaker system is designed to operate by itself, or with the range extending unit listed below. It covers the frequency range of 50 to 12,000 CPS within ± 5 db. Two high-quality Jensen speakers are employed. Impedance is 16 ohms, and power rating is 25 watts. Can be built in just one evening. Shpg. Wt. 30 lbs. **$39.95**



$4.00 dwn.
$3.36 mo.

Heathkit Model SS-1B Speaker System Kit

This high fidelity speaker system kit extends the range of the model SS-1 described above. It employs a 15" woofer and a super-tweeter to provide additional bass and treble response. Combined frequency response of both speaker systems is ± 5 db from 35 to 16,000 CPS. Impedance is 16 ohms, and power is 35 watts. Attractive styling matches SS-1. Shpg. Wt. 80 lbs. **$99.95**



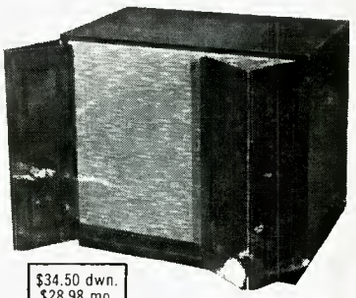
$10.00 dwn.
$8.40 mo.

HEATHKIT
"LEGATO" SPEAKER SYSTEM KIT

Months of painstaking engineering by Heath and Altec-Lansing engineers has culminated in the design of the Legato, featuring "CP" (critical phasing) and "LB" (level balance). The result is a *new kind* of high fidelity sound, to satisfy even the most critical audio requirements. Two high-quality 15" theater-type speakers and a high-frequency driver with sectoral horn combine to cover 25 to 20,000 cycles without peaks or valleys. "CP" and "LB" assure you of the smooth, flat audio response so essential to faithful reproduction. Choice of two beautiful cabinet styles below.

"Legato" Traditional Model HH-1-T

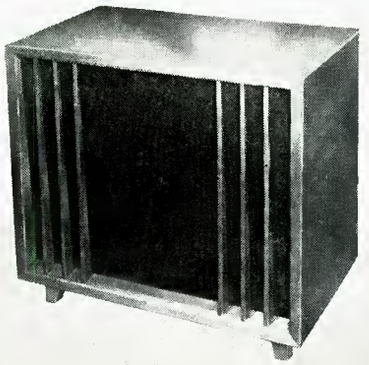
Styled in classic lines to blend with period furniture of all types. Doors attractively paneled. African mahogany for dark finishes unless you specify imported white birch for light finishes. Shpg. Wt. 246 lbs. **$345.00**



$34.50 dwn.
$28.98 mo.

"Legato" Contemporary Model HH-1-C

This fine cabinet features straightforward design to blend with your modern furnishings. Slim, tapered struts run vertically across the grille cloth to produce a strikingly attractive shadowline. Wood parts are precut and predrilled for simple assembly. Supplied in African mahogany for dark finishes unless you specify imported white birch for light finishes. Shpg. Wt. 231 lbs. **$325.00**



$32.50 dwn.
$27.30 mo.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 25, MICHIGAN

Make yours a HEATHKIT®

It's Easy (and fun) to Plan Your Own Hi-Fi Installation
By Choosing the Heathkit Components
That Best Suit Your Particular Needs.

As the world's largest manufacturer of electronic equipment in kit form, Heath Company can provide you with a maximum variety of units from which to choose. You can select just the amplifier you need from five different models, ranging in power from 7 watts to 25 watts, some with preamplifiers, and some requiring a separate preamplifier. You can pick your speaker system from four outstanding high fidelity units ranging in price from only $39.95 to $345.00. You can even select a fine Heathkit FM or AM Tuner! Should there be a question in your mind about the requirements of an audio system, or about planning your particular hi-fi installation, don't hesitate to contact us. We will be pleased to assist you.

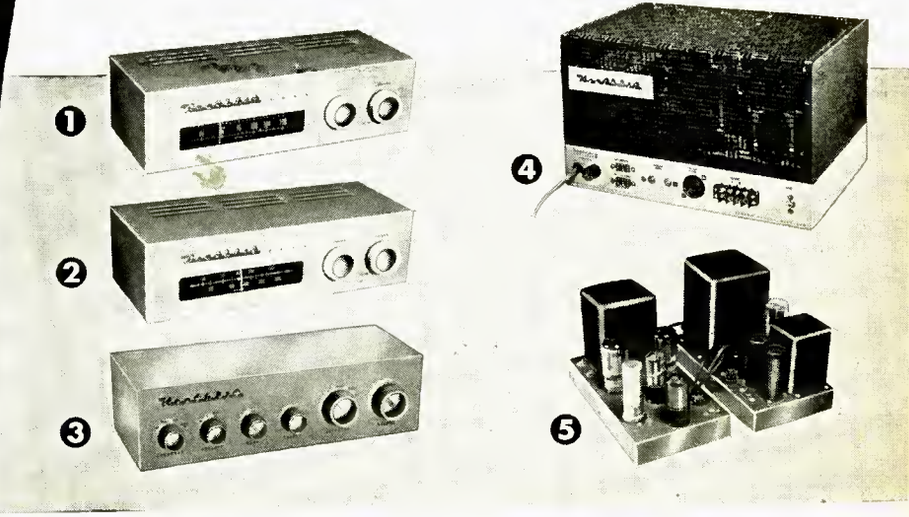
MATCHING CABINETS . . .
The Heath AM Tuner, FM Tuner and Preamplifier are housed in matching satin-gold finished cabinets to blend with any room decorating scheme. Can be stacked one over the other to create a central control unit for the complete high fidelity system.

MODEL FM-3A MODEL BC-1 MODEL WA-P2

PRE-ALIGNED TUNERS . . .
A unique feature of the Heathkit AM and FM Tuners is the fact that both units are prealigned. A signal generator is not necessary! IF and ratio transformers are pretuned at the factory, and some front-end components are preassembled and pretuned. Another "extra" to assure you of easy kit assembly.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 25, MICHIGAN

EASY TIME PAYMENTS . . . We invite you to take advantage of the Heath Time Payment Plan on any order amounting to $90.00 or more. Just 10% down and the balance in twelve monthly payments. WRITE FOR COMPLETE DETAILS.



HIGH FIDELITY SYSTEM

1 HEATHKIT HIGH FIDELITY FM TUNER KIT Features AGC and stabilized, temperature-compensated oscillator. Sensitivity is 10 microvolts for 20 db of quieting. Modern circuit covers standard FM band from 88 to 108 mc. Employs ratio detector for efficient hi-fi performance. Power supply is built in. Illuminated slide rule dial for easy tuning. Housed in compact satin-gold enamel cabinet. Features prealigned transformers and front end tuning unit. Shpg. Wt. 7 lbs.

MODEL FM-3A Incl. Excise Tax (with cab.) **$25.95**

$2.60 dwn., $2.18 mo.

2 HEATHKIT BROADBAND AM TUNER KIT This fine AM Tuner was designed especially for use in high fidelity applications, and features broad bandwidth, high sensitivity and good selectivity. Employs special detector circuit using crystal diodes for minimum signal distortion, even at high levels. Covers 550 to 1600 kc. RF and IF coils are prealigned. Power supply is built in. Housed in attractive satin-gold enamel cabinet. Shpg. Wt. 8 lbs.

MODEL BC-1 Incl. Excise Tax (with cab.) **$25.95**

$2.60 dwn., $2.18 mo.

3 HEATHKIT HIGH FIDELITY PREAMPLIFIER KIT This preamplifier meets or exceeds specifications for even the most rigorous high fidelity applications. It provides a total of 5 inputs, each with individual level controls. Hum and noise are extremely low, with special balance control for absolute minimum hum level. Tone controls provide 18 db boost and 12 db cut at 50 cps, and 15 db boost and 20 db cut at 15,000 cps. Four-position turnover and four-position rolloff controls for "LP", "RIAA", "AES", and "early 78" equalization. Derives power from main amplifier, requiring only 6.3 VAC at 1A and 300 VDC at 10MA. Beautiful satin-gold enamel finish. Shpg. Wt. 7 lbs.

MODEL WA-P2 (with cab.) **$19.75**

$1.98 dwn., $1.66 mo.

4 HEATHKIT ADVANCED-DESIGN HI-FI AMPLIFIER KIT This fine 25-watt high fidelity amplifier employs KT66 output tubes by Genalex and a Peerless output transformer for top performance. Frequency response ± 1 db from 5 to 160,000 cps at 1 watt. Harmonic distortion less than 1% at 25 watts, an IM distortion less than 1% at 20 watts. Hum and noise are 99 db below 25 watts. Output impedance is 4, 8 or 16 ohms. Extremely stable circuit with "extra" features.

MODEL W-5: Consists of W-5M *plus* WA-P2 Preamplifier

Shpg. Wt. 38 lbs. Express only **$79.50** $7.95 dwn. $6.68 mo.

MODEL W-5M

$59.75 $5.98 dwn. $5.02 mo.

Shpg. Wt. 31 lbs. Express only

5 HEATHKIT DUAL-CHASSIS HI-FI AMPLIFIER KIT This 20-watt Williamson-type amplifier employs the famous Acrosound model TO-300 output transformer, and uses 5881 tubes. Frequency response is ± 1 db from 6 cps to 150 kc at 1 watt. Harmonic distortion less than 1% at 21 watts, and IM distortion less than 1.3% at 20 watts. Output impedance is 4, 8 or 16 ohms. Hum and noise are 88 db below 20 watts.

MODEL W-3: Consists of W-3M *plus* WA-P2 Preamplifier

Shpg. Wt. 37 lbs. Express only **$69.50** $6.95 dwn. $5.84 mo.

MODEL W-3M

$49.75 $4.98 dwn. $4.18 mo.

Shpg. Wt. 29 lbs. Express only

6 HEATHKIT SINGLE-CHASSIS HI-FI AMPLIFIER KIT This 20-watt Williamson-type amplifier combines high performance with economy. Employs Chicago-Standard output transformer and 5881 tubes. Frequency response ± 1 db from 10 cps to 100 kc at 1 watt. Harmonic distortion less than 1.5% and IM distortion less than 2.7% at full output. Output 4, 8 or 16 ohms. Hum and noise—95 db below 20 watts.

MODEL W-4A: Consists of W-4AM *plus* WA-P2 Preamplifier

Shpg. Wt. 35 lbs. Express only **$59.50** $5.95 dwn. $5.00 mo.

MODEL W-4AM

$39.75 $3.98 dwn. $3.34 mo.

Shpg. Wt. 28 lbs. Express only

7 HEATHKIT 20-WATT HIGH FIDELITY AMPLIFIER KIT Features full 20 watt output using push-pull 6L6 tubes. Built-in preamplifier provides four separate inputs. Separate bass and treble controls. Output transformer tapped at 4, 8, 16 and 500 ohms. Designed for home use, but also fine for public address work. Response is ± 1 db from 20 to 20,000 cps. Harmonic distortion less than 1% at 3 db below rated output. Shpg. Wt. 23 lbs.

MODEL A-9B **$35.50**

$3.55 dwn., $2.98 mo.

8 HEATHKIT ELECTRONIC CROSS-OVER KIT This device separates high and low frequencies electronically, so they may be fed through two separate amplifiers driving separate speakers. Eliminates the need for conventional cross-over. Selectable cross-over frequencies are 100, 200, 400, 700, 1200, 2000 and 3500 cps. Separate level controls for high and low frequency channels. Attenuation 12 db per octave. Shpg. Wt. 6 lbs.

MODEL XO-1 **$18.95** $1.90 dwn., $1.59 mo.

9 HEATHKIT 7-WATT ECONOMY AMPLIFIER KIT Qualifies for high fidelity even though more limited in power than other Heathkit models. Frequency response is ± 1½ db from 20 to 20,000 cps. Push-pull output and separate bass and treble tone controls. Good high fidelity at minimum cost. Uses special tapped-screen output transformer.

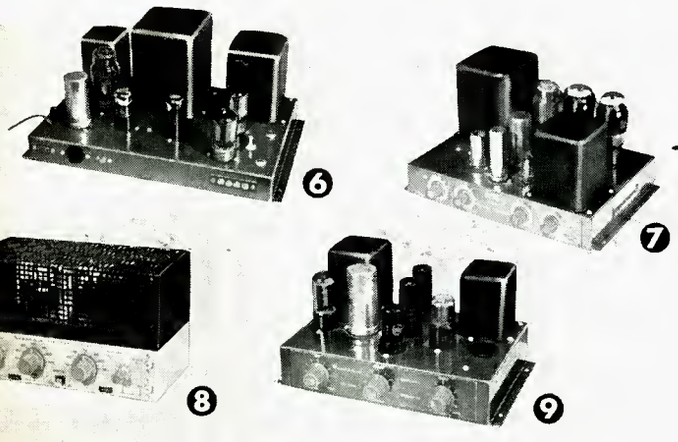
MODEL A-7E: Same as A-7D except one more tube added for extra preamplification. Two inputs, RIAA compensation and extra gain.

Shpg. Wt. 10 lbs. Incl. Excise Tax **$19.95** $2.00 dwn. $1.68 mo.

MODEL A-7D

$17.95 $1.80 dwn. $1.51 mo.

Incl. Excise Tax
Shpg. Wt. 10 lbs.



Write for Free Catalog

HOW TO ORDER

Just identify kit by model number and send order to address below. Write for further details if you wish to budget your purchase on the HEATH TIME PAYMENT PLAN.

HEATH COMPANY
A Subsidiary of Daystrom, Inc.
BENTON HARBOR 25, MICHIGAN
Please send Free HEATHKIT catalog.

Name_____

Address_____

City & Zone_____ State_____

London Letter

RICHARD ARBIB*

THE RADIO COMPONENT SHOW at Grosvenor House and Park Lane House, London, was followed immediately by the second London "Audio Fair" which this year was enlarged and took place at the Waldorf Hotel which, whilst of somewhat more modest proportions than the hotel of the same name in New York, was not sufficiently large to cope with the crowds.

Whilst the first Audio Show held last year was a huge success at the smaller Washington Hotel, the move to the larger Waldorf did not provide sufficient space for the crowds of enthusiastic high fidelity devotees who crammed the Exhibition Hall and individual demonstration rooms throughout the four days the Fair was open.

The same procedure was followed as last year of allowing each manufacturer to have static exhibits of his products in the Central Exhibition Hall so that visitors could compare immediately the appearance of the different brands of apparatus on view. Individual demonstrations could then be heard in the converted bedrooms upstairs.

Twelve manufacturers exhibited both at the Radio Components Show and Audio Fair. British manufacturers, well-known in the U. S. A., included Collaro, Cosmocord, Garrard, Goldring, Goodmans, Plessey, Rola Celestion, Vitavox, Whiteley, and Wright & Weaire.

As there were no practical demonstrations at Grosvenor House or Park Lane House, your correspondent will deal with the new equipment seen and heard at the Audio Fair.

Although some of the finest stereophonic tapes have been produced in England; notably those under the H. M. V. and Columbia Trade Marks, the sale of stereophonic equipment here has up to the present been negligible. Although it is still difficult to buy stereophonic equipment in stores in this country, some manufacturers of amplifiers and loudspeakers used stereophonic tapes for demonstrating their wares at the Fair. Apart from the actual manufacturers of stereophonic tape recorders, G.E.C. and Wharfedale used stereophonic tapes for demonstration purposes.

Output Transformerless Amplifier

Among the new products seen at the Fair was the range of High Fidelity equipment now being marketed by the London Philips Organization, under the Trade Mark "Hi-Z." Although this equipment may be designed in Holland, much of it is made in one of the Philips factories in England. Philips are, of course, probably the largest organization in Europe making electronic equipment of all kinds. This new amplifier has no output transformer, which is claimed by Philips to have always been the weak link in the chain.

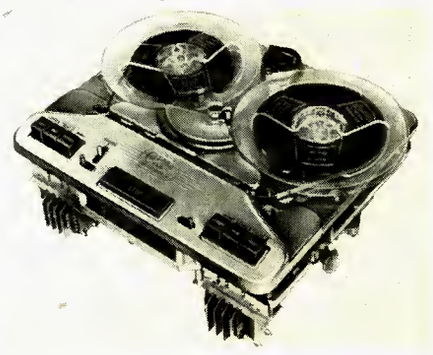
The "Hi-Z" 12 watt Amplifier Type NG 5200 employs in its output stage four power pentodes in a series-parallel arrangement to produce the required output power and to bring down the output impedance to a usable value. A triode driver stage applies voltages of opposite phase to the two halves of the output stage, the output to a loudspeaker being taken from the cathodes of two of the valves via a blocking capacitor. A pentode is used as a voltage amplifier, and heavy negative feedback is applied over the entire circuit.

It is claimed that this amplifier has a 12 watt output with a frequency response of 5–100,000 cycles, substantially flat. 10–20,000 cycles ±0.2dB. The distortion is less than 0.1 percent at 12 watts and less than 0.3 percent at 25 percent overload. The negative feedback is 36dB; damping factor 60; output impedance 400 ohms for Philips "Hi-Z" loudspeakers.

Two matching "Hi-Z" Loudspeakers are available for use with the new amplifier. They are both of the dual-cone type, 9710 BM (8 inch) and 9762 BM (12 inch) and have specially wound 400 ohm speech coils. They are similar in specification—apart from their impedance—to the well-known Philips dual-cone speakers designed for conventional amplifiers.

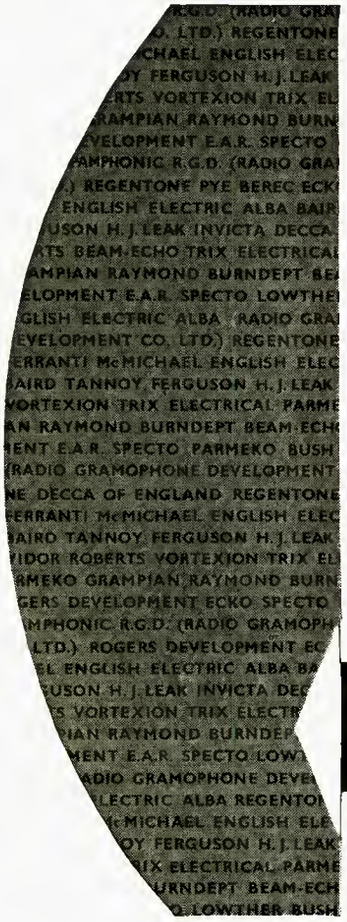
New Tape Recorders

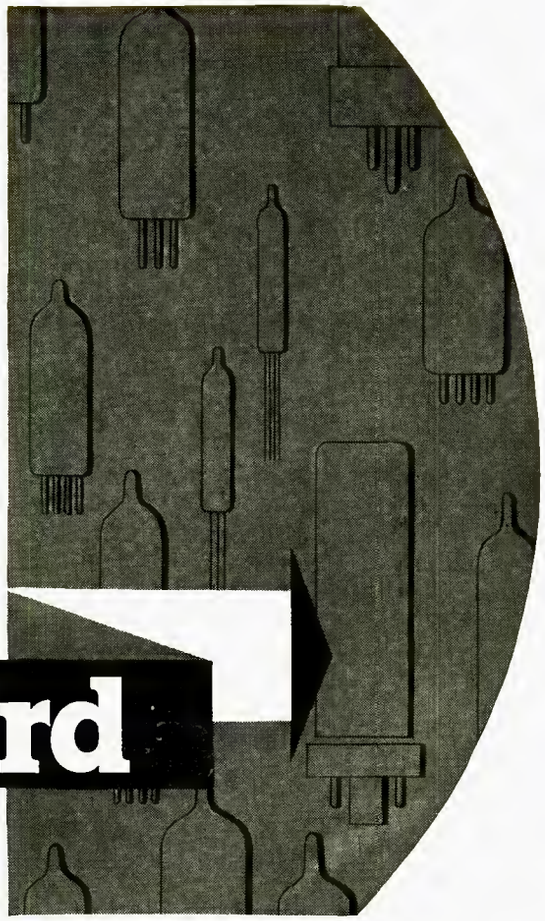
Among the most interesting developments in tape recording and reproducing were exhibits of Collaro, Ferrograph, Grundig, Truvox, and Vortexion. Collaro are now in full production with their Mark III Tape Transcriptor. This is a comparatively inexpensive four-head twin-track tape deck which runs at 3¾, 7½, and 15 ips. Operation and braking are mechanical, performed without rubber belts or solenoids; control buttons are foolproof, as after the depression of any control all



* *Multicore Solders, Ltd., Hemel Hempstead, Herts., England.*

The Greatest Names in British Electronics use Mullard Tubes





British equipment manufacturers are making a vital contribution to the development of electronics in all fields of application.

Their products are being exported to every corner of the world, earning a universal reputation for advanced techniques and excellent performance.

The majority of these electronic equipment manufacturers consistently use Mullard tubes. This choice is decided upon because they prefer the greater assurance of efficiency and dependability, and because the vast manufacturing resources of the Mullard organisation guarantee ready availability of Mullard tubes wherever they are needed.

Supplies of Mullard tubes for replacement in British equipments are available from the companies mentioned below:—

In the U.S.A.

International Electronics Corporation,
Department A6,
81, Spring Street, N.Y. 12.
New York, U.S.A.

In Canada

Rogers Majestic Electronics Limited,
Department HF,
11-9 Brentcliffe Road,
Toronto 17, Ontario, Canada

Mullard

Electronic Tubes — used throughout the world

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

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

MEV 45

others are interlocked. An interesting feature of this deck is that the reels of tape do not have to be turned over in order to record or reproduce a second track. Extra heads provide for the second track recording and reproduction. This unit will no doubt form a part of many British-made tape recorders.

The Ferrograph people, whose tape recorders are already well-known in the U.S.A., introduced stereophonic recorders at the Show. The main characteristics of the Ferrograph machines are their high degree of reliability and the soundness of design. This has been proved by the fact that they have been little changed during the past seven years.

Ferrograph were showing a new counter mechanism which they are marketing in kit form. This can be fitted to any Wearite tape deck manufactured during the past six years. It is in the form of a clock face and is scaled from 0–10 in tenths by a pair of hands so that a total count of 1000 is available for a single reel of tape. These counters are fitted to the new Stereo models.

The Ferrograph Stereo 77 and Stereo 88 have the same physical appearance as the portable monaural model, already well-known in the U.S.A. The Stereo 77 provides monaural recording and playback with stereophonic playback. It has speeds of 3¾ and 7½ ips. The Stereo 88 provides for monaural and stereophonic recording and playback at speeds of 7½ and 15 ips. Both models are fitted with in-line heads and as they are intended for use with high fidelity amplifiers, they incorporate preamplifiers and the playback channels providing 2 milliwatts across 600 ohms. The reels allow 68 minutes playing time of long play tape on one track. All Ferrograph decks are now drilled to receive "Bib" splicers.

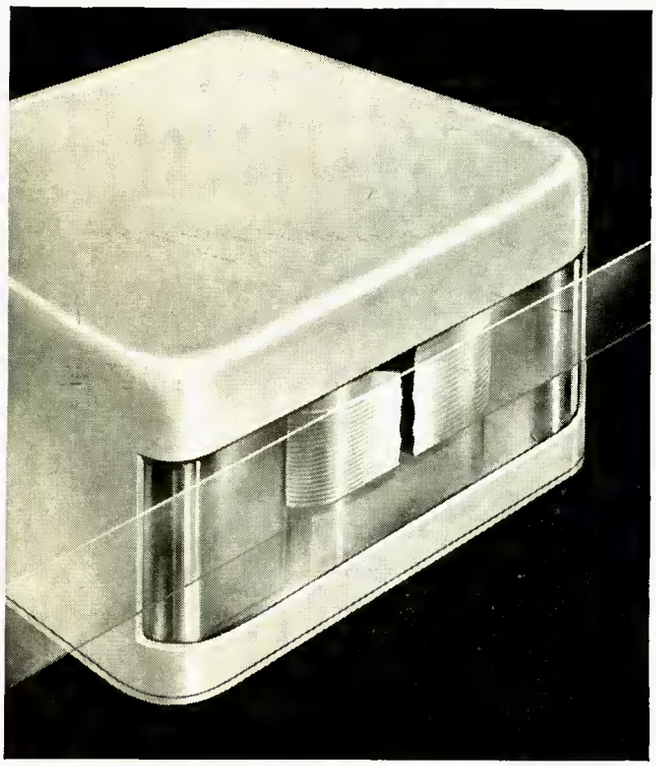
Disc recorders were shown by the two companies who were making them long before tape recorders were invented and, despite the interest in tape, visitors could not conceal their admiration for the fine engineering of the Sugden and the M.S.S. disc cutting machines.

Truvox, who are one of England's oldest tape recorder manufacturers and who have produced many decks at modest prices, were showing their R1 Model which provides for the reproduction of stereophonic tapes. The stereophonic head, whilst being designed primarily for fitting to the various Truvox tape decks which have been produced during recent years, is also suitable for fitting to many other makes of

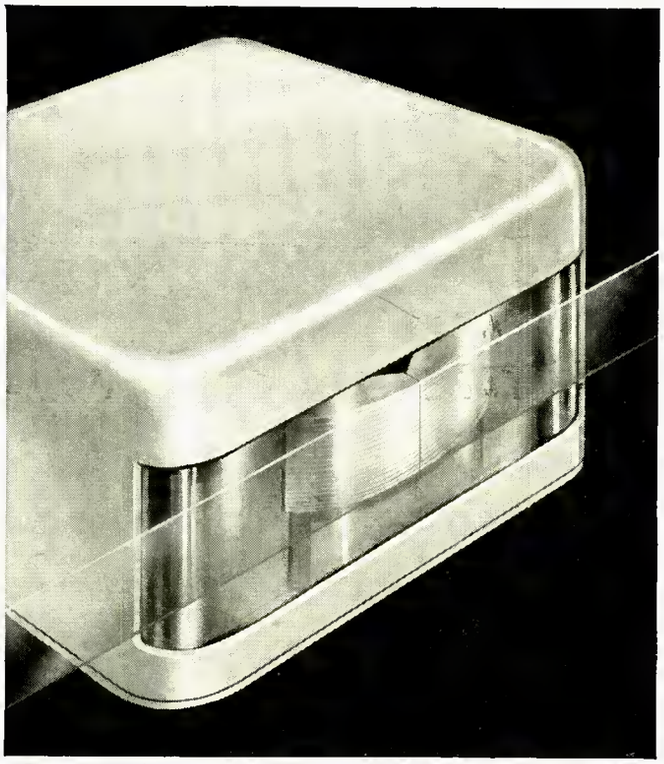
tape recorders. It is claimed that this head —Model TR 2049—has an output voltage of 1–3 MV with an impedance of 50,000 ohms measured at 10,000 cps. The frequency response is claimed with specific amplifiers to be from 50 to 15,000 cps. Besides complete recorders Truvox also supply decks and separate amplifiers. Their

(*Continued on page 40*)

COMPARE!



Picture of a recorder head's contact surface, with critical center gap eroded and enlarged by the wearing action of conventional magnetic tape.



Same type head, same period of use. But see how silicone lubricated "Scotch" Brand Magnetic Tape has saved the head from wear—assuring perfect response!

Read how "Scotch" Brand's built-in dry lubrication reduces recorder abrasion

Know what's the most vulnerable part of your recorder? It's the sensitive magnetic head—the tiny, precision-made part where lack of proper lubrication can cause annoying wow, flutter and harmful friction.

Compare the two magnetic heads magnified above. See for yourself what lack of proper lubrication can do. Like the heads in your recorder, each head is made with an almost invisible quarter mil gap over which tape passes. At left, abrasive action by conventional tape has worn down the head .0025 of an inch. (Small, yes, but enough to cause a frequency drop of a full octave!) Now, look how "Scotch" Brand Magnetic Tape has saved the head on the right. No wear. . . so no loss of sound.

Only "Scotch" Brand Magnetic Tapes perform this critical lubricating job for you. Exclusive silicone lubrication process (dry lubrication) lets tape glide smoothly, safely over the magnetic heads. And this famous safety feature lasts the life of the tape. Treat your machine to a reel soon.

Free Tape Tips—write Dept. AH-67.

ONLY "SCOTCH" BRAND HAS SILICONE LUBRICATION

Extra playing time | Extra strength | Higher output | True economy

SCOTCH BRAND Magnetic Tapes

Your guarantee of quality

EDITOR'S REPORT

LONDON AUDIO FAIR

Although a detailed description of the 1957 London Audio Fair appears in Richard Arbib's LONDON LETTER which commences on page 10 of this issue, it seems that there is some difference of opinion as to the merits of the London show format. Some who attended thought it was an improvement over shows that have been held here, while others took the opposite viewpoint. This observer was one of the latter.

Before making any actual comments on the show as presented, it must be remembered that audio shows are rapidly approaching the saturation point. Only so many people can pass through an exhibit room in a given time—when more attempt to do so, there is hopeless confusion and no one gets a really good demonstration. On the other hand, exhibit facilities have not yet been found which would accommodate all the people who want to attend, although the garden apartment arrangement of the Ambassador Hotel in Los Angeles came closest.

An ideal arrangement would consist of a two-room suite—a smaller room adjacent to the corridor and used only for seeing the equipment, and a larger one isolated from the corridor by the first and used for continuous demonstrations. The outer room should have two doors to the corridor, and there should be two doors between the rooms to provide for a continuous flow of traffic. But no one has yet come up with facilities of this sort.

Admittedly, the London format tried to isolate the *seeing* and *hearing* functions of the show. The people walked through a silent exhibit hall and looked at and asked questions about the equipment. To hear it they went up to the two floors where demonstrations were being held. Unfortunately, they had to queue up in the halls while a specific demonstration program was in progress, with the result that there were numerous queues all over the demonstration area. The main disadvantage of this arrangement seems to be that for a complete tour of the show—including both the exhibit hall and the demonstration rooms—the people were immobilized for about half their time. As to the exhibit room itself, it was too small and there was not enough space for either exhibits or aisles, so it was well jammed up.

We must give the committee a big "E" for effort, and we must credit them with ingenuity in devising the format of the show, but we couldn't help but deplore the time wasted by those who had to stand in the halls waiting to get into the demonstration rooms.

Maybe someone will come up with an answer to the problem of staging an audio show. For the present, however, we can only make do with the facilities which are available.

One immediate advantage of our visit was to obtain the answer to a question we have been asked hundreds of times, "How good is the 'full-range' electrostatic speaker?" We can only repeat what we said to the makers of such speakers, which was, in essence, that there was not enough bass for the U.S. market. As everyone knows, that could be solved by making the speakers large enough, but it is doubtful if one sufficiently large for good bass would be accepted by the public. When we are able to build such a speaker in the wall between two rooms, for example, then it is quite probable that there would be sufficient bass for anyone. Reproduction was remarkably clean on the models we heard—as would be expected from our experience with the domestic models—but we did feel that the low-end response was not up to standard.

Second immediate advantage was the opportunity of hearing a stereo disc. We have known of the development work on this product for some time, but one has to hear to be convinced. We do not wish to give the impression that this product is ready for the market—far from it. We would be inclined to think that it would be at least two years before we have stereo discs of quality comparable to our present stereo tapes. But it is something to look forward to. Consider the simplicity from the manufacturers' standpoint—all records could be made from a single master which was stereo-cut. If you were set up for playing stereo—that is, with the special type of pickup required and with the usual two amplifiers and speakers—you would have stereo reproduction; if not, you simply played your record with a monaural pickup in the usual manner. We doubt the early appearance of the stereo record because it was perfectly obvious that the quality (of either channel) did not compare with that of a modern LP record. We believe that much work will have to be done to achieve sufficient perfection to permit introducing stereo records. However, we now know that the system works, and we assume it can be perfected.

REPORTS

The continuing build-up of onus on the word "reports" when it refers to discussions of performance of equipment has culminated in our own decision to eliminate EQUIPMENT REPORTS from our usual line-up of editorial features. In the future, our own presentations of descriptive material about new equipment will be under the heading EQUIPMENT REVIEW just to make sure it is not confused with any other type of "report."

Bell Laboratories researchers Henry S. McDonald, Dr. Eng. from Johns Hopkins, and Max V. Mathews, Sc.D. from M.I.T., examine magnetic tape used in new research technique. Voice waves are converted into sequences of numbers by periodic sampling of amplitudes, 8000 samples per second. General purpose electronic computers act on these numbers as a proposed transmitting device might.

They send real voices on imaginary journeys

In their quest for better telephone service, Bell Laboratories researchers must explore many new devices proposed for the transmission of speech signals. For example, apparatus can be made to transmit speech in the form of pulses. But researchers must always answer the crucial question: how would a voice sent through a proposed device sound to the listener?

In the past it often has been necessary to construct costly apparatus to find out. Now the researchers have devised a way to make a high-speed electronic computer perfectly imitate the behavior of the device, no matter how complicated it may be. The answer is obtained without building any apparatus at all.

The researchers set up a "program" to be followed by the computer. Actual voice waves are converted into a sequence of numbers by sampling the waves 8000 times per second. Numbers and program are then fed into the computer which performs the calculations and "writes out" a new sequence of numbers. This new sequence is converted back into real speech. Listeners hear exactly how well the non-existent device could transmit a real voice.

With this novel technique, new transmission ideas are screened in only a fraction of the time formerly required. Thus valuable time and scientific manpower are saved in Bell Laboratories' constant search to provide still better service for telephone customers.

BELL TELEPHONE LABORATORIES

World center of communications research and development

From the Archives of Bell Telephone Laboratories

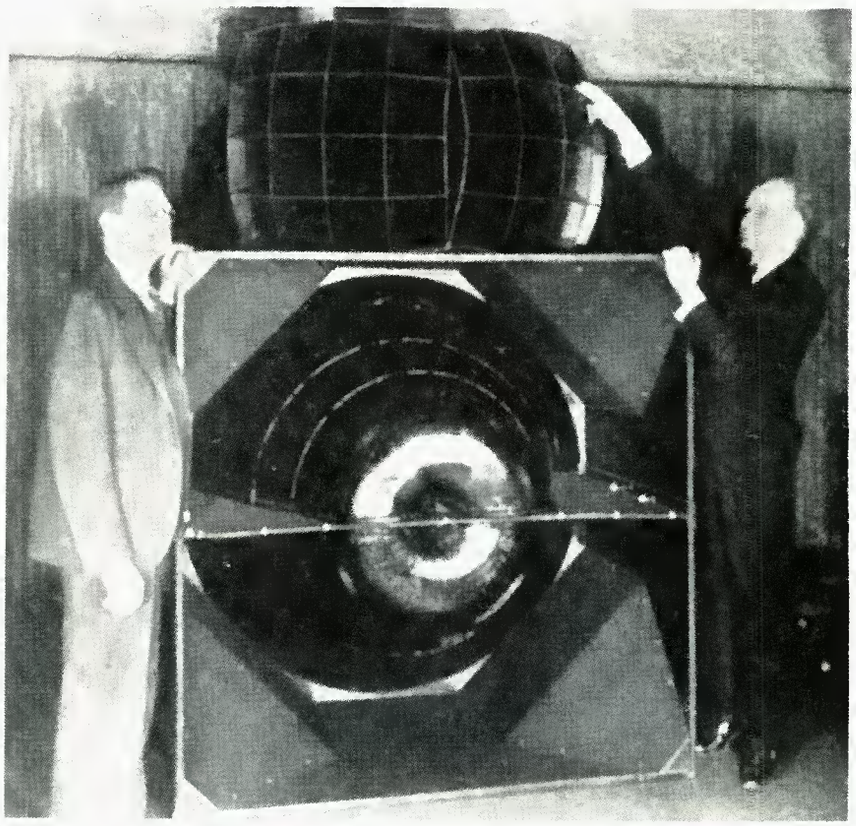
The Reproduction of Orchestral Music in Auditory Perspective

Although the experiment described herein was conducted almost 25 years ago, it is classic in the sense that it proved the feasibility of stereo sound as we recognize it today.

IN THIS ELECTRICAL ERA it does not seem very remarkable that music, even from a large symphony orchestra, should be picked up by microphones, transmitted over telephone wires, and reproduced at a distant point. Most of us probably hear it accomplished every day by means of the radio, and radio transmission and reproduction would, in general, be called good. Between good reproduction and perfect, however, there is a very wide gap, and the difficulties of crossing it are probably not realized by those not technically familiar with the subject. Perfect reproduction, of a symphony concert for example, would make it impossible for one listening with his eyes blindfolded to know that the actual orchestra was not on a stage before him. Not only would every tone and over-tone be present in its correct relative volume, but there would be a depth and color which is not ordinarily obtained when electrical apparatus intervenes between the orchestra and the audience.

Three classes of requirements must be met if the reproduced sound is to be indistinguishable from the original. Two of them, that both the complete frequency and complete volume ranges be transmitted, have been generally recognized for some time. The third, that the sounds must be reproduced with the correct auditory perspective, has been fully appreciated only by those most closely associated with the science of sound reproduction.

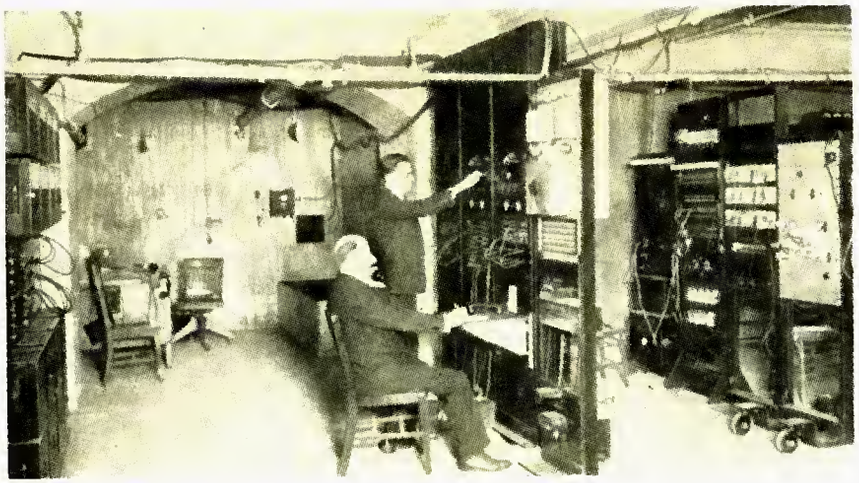
Sounds in general are composed of a group of tones and over-tones ranging from the deep bass of the lowest organ notes, or those of a bass drum, to the shrillest tones the ear can hear. Each note of a musical instrument has a fundamental tone and a group of harmonics. The fundamental tone sets the pitch, and the harmonics give the note its quality. It is the harmonics that make it possible to distinguish a note on a violin from one on a trumpet or from any other of the same pitch. It is in the harmonics that reside the richness of music and the wealth of sensuous appeal. These tones and over-tones are known and recognized by their frequency, or vibratory rate; and the range of frequencies to which the ear responds runs from about 16 cycles per second to 16,000, or even 20,000 cycles for some ears. The sensitivity of the ear falls off rapidly at the higher frequencies, however, so that the effect of frequencies above 15,000 cycles is negligible for the most part. The highest note on the piano has a fundamental frequency of only about 4,000 cycles, and few of the musical instruments exceed this pitch, but the accompanying harmonics or over-tones, which are of still higher frequencies, are very necessary to the proper quality and richness of the notes.



Two Bell Laboratories staff members with one of the speaker systems used at Washington.

Of no less importance, if the full aesthetic effect of music is to be obtained, is the range in volume. The ear has a recognizable range of volume as it has of frequency. This extends from sounds so low that the ear cannot hear them, to sounds so great that the sensation is one of pain rather than of hearing. For convenience in scientific study, the power of sounds is graded in units known as decibels (abbreviated db). The threshold of hearing is taken as a reference base, and the ordinary audible range runs from the volume of sound one would hear in a quiet garden, or that of an average whisper at a distance of four feet, which are at a level of 20 db, to that of a pneumatic riveter, at

Reprinted from Bell Laboratories Record, June, 1933, Vol. 11, No. 10.



Control room in the basement of the Academy of Music in Philadelphia. W. A. Munson of the Laboratories is standing at the voltage amplifiers

a level of 100 db—a total range of about 80 db. The range of a large symphony orchestra is about 70 db, so if the music of such an orchestra is to be faithfully transmitted electrically, a volume range of the order of 70 db must be transmitted: a range of power of ten million to one.

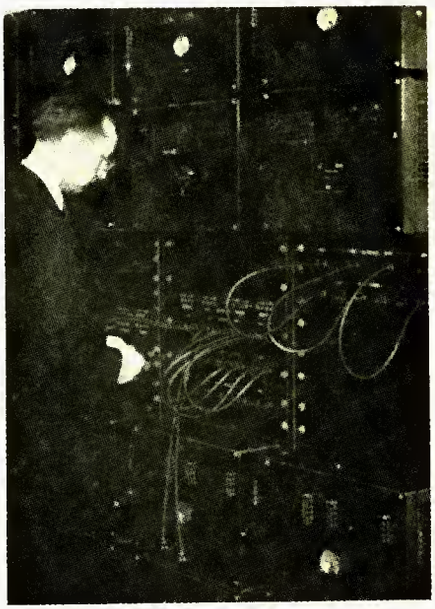
The third requirement becomes of particular importance when the sound to be transmitted and reproduced is that from a large and relatively widely spaced group of instruments, such as a complete symphony orchestra. When one sits in an auditorium and listens to a symphony concert he experiences something that is over and above the effect produced by the actual frequency and volume range given out by the orchestra. This additional appeal is difficult to describe, and almost impossible to measure. It is partly due to a spreading of the sound in all directions so that it fills the entire volume of the auditorium and thus reaches one's ears by various paths. It is partly due to other factors; but whatever its cause it results in a richness and texture of tone that no ordinary electrical reproduction can provide. For lack of a better term, the effect may be called auditory perspective. Without it the music would be one dimensional and not expanded into its true spatial relationship. The difference may be compared to that between the appearance of a photograph of a scene and the same scene when viewed through a stereoscope.

How to obtain this auditory perspective in music transmitted and reproduced electrically was discovered by the scientists of Bell Telephone Laboratories as a result of their fundamental investigations in acoustics and telephonic transmission. During the course of those investigations they had developed telephonic systems of high quality, but for their further researches they needed opportunity to utilize music in its most perfect forms. Now it happened that Dr. Leopold Stokowski, Director of the Philadelphia Orchestra, was interested in the possibilities of electrical systems for the production of exceptional orchestral effects. Through his voluntary cooperation, therefore, the Laboratories' scientists were able to make quantitative physical studies of music as rendered by his orchestra, and so to perfect their designs; and with the completion of the new equipment some of the possibilities which Dr. Stokowski had hoped for became practicable. An extended series of tests was then carried on in Philadelphia in which the Laboratories' scientists were generously assisted by Dr. Stokowski. As a result of these studies, it was found that by employing two microphones, one properly located on each side of the stage, and by transmitting over two separate circuits to two of the newly developed loud speakers, similarly placed, the effect of the actual presence of the orchestra was successfully obtained.

Even with the discovery of a comparatively simple means of obtaining true auditory perspective, the problem was not completely solved. Never before had either the complete frequency, or the complete volume range, of a symphony orchestra been commercially transmitted and reproduced. No complete chain of apparatus, from microphone to loud speaker, was available that would faithfully transmit the entire range of frequency and volume. Microphones perhaps offered the fewest difficulties. Bell Laboratories had already designed sensitive microphones that would transmit practically the entire range required, and only minor modifications were needed to make them entirely suitable.

This was not true of the amplifiers. There had to be developed amplifiers which would faithfully transmit all frequencies from 35 to 16,000 cycles at levels from the barely audible pianissimo effects to the resounding orchestral crashes of ten million times greater power; and all the pieces of apparatus had to be so designed that even during intervals of complete silence not the slightest noise would be introduced to suggest the presence of electrical apparatus. No underlying hum or noise, such as is commonly present in radio or other systems of reproduction, could be tolerated with the new apparatus. In the intervals of silence there must be real silence: a dead auditory void in which the fall of the lightest pin could be heard. This has actually been accomplished to a degree heretofore unknown. Probably the most quiet electrical reproduction up to the present is that obtained with high-grade sound picture apparatus; but such apparatus at its most quiet moments gives off 300 times more sound than the new apparatus when the musicians are silent.

Of even greater difficulty possibly was the design of suitable loud speakers. It is not practicable to obtain the entire frequency range with a single unit, and so two types of loud speakers are used. One, somewhat resembling the horns used for sound pictures, is employed for the frequencies from 35 to 300 cycles; and another type, for the range from 300 to 16,000 cycles. These loud speakers are different from anything previously produced commercially. Never before have these elements fulfilled such difficult requirements of frequency range and volume. The best sound picture systems record and reproduce approximately half the range of frequencies handled by the new loud speakers, and the best radio systems even less. In volume range the comparison is equally remarkable. Although sound picture systems under the most favorable conditions may provide a volume range of 40 or 45 db, radio systems rarely exceed 30, while the range provided by the new apparatus is well above 80. Whereas the power range of radio is of the order of 1000 to 1, the new equipment is capable



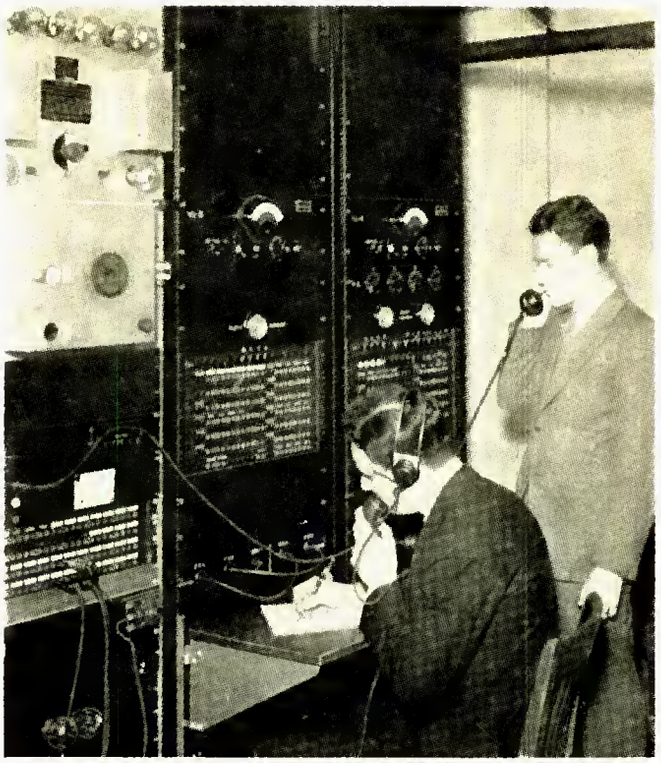
D. T. Bell of the Laboratories at the power amplifier panels in Washington

of yielding a range of 100,000,000 to 1.

The new loud speakers and their associated equipment of amplifiers and microphones are, therefore, fully capable of handling the entire volume range of a symphony orchestra. When one speaks of range of loudness which can be handled by an electrical system for reproduction, one is concerned with the differences between the loudest and faintest passages of the music which it can reproduce. There is in addition the problem of handling the peaks of maximum loudness. These peaks in the case of music from a symphony orchestra are beyond the possibilities of the ordinary loud speaker to reproduce without distortions which seriously affect the musical sonority. The low frequency sounds make the largest contribution to the peaks of sound power which must be handled to meet these conditions. The diaphragm of the low frequency element in the new loud speaker has been made nearly seven times larger than that of the elements used ordinarily for sound picture reproduction. By these diaphragms a large column of air is set into motion.

The ordinary loud speaker also becomes directional in its characteristics at the higher frequencies. Low frequency sounds spread in all directions from the mouth of the horn, but the higher frequencies tend to concentrate into a beam projected directly ahead of the horn; and the width of the beam becomes narrower and narrower as the frequency increases. Because of this fact, the audience, in a large hall equipped with the ordinary loud speakers, never hear quite the proper blending of frequencies. Those directly in front of the horn receive too great a proportion of the higher frequencies, while those on the sides receive too much of the low frequencies. To avoid this effect, the horn of each high-frequency element is divided into 16 diverging rectangular sections which spread the sound over an arc of 60 degrees vertically and one of 60 degrees horizontally. Two of these units placed side by side thus spread the sound over a horizontal angle of 120 degrees—a far wider coverage than has been obtained before and one which distributes the sound throughout the auditorium with a faithful blending of the frequencies.

Besides providing for the full volume range of the orchestra, the amplifiers have an additional amplification of at least 10 db, so that, if desired, the volume of loud passages may be made ten times as great as the actual output of the orchestra. Technically described, the maximum sound power of a symphony orchestra integrated over an interval of two-tenths of a second is less than 20 watts, whereas that possible from the loud speakers of the new apparatus is more than 200 watts. This additional gain allows effects to be obtained which have been impossible before. Besides the effects of range and quality of tone, the total aesthetic appeal of an orchestra is due in no small degree to the range in volume. The number of musicians one can place on a stage is limited. To put ten times as many as contained in a modern symphony orchestra is impossible in any existing hall. The control of volume given by the new apparatus enables the director to secure at will the equivalent of an orchestra of nearly a thousand musicians.



R. F. Tillman of A. T. & T. (left), and A. R. Soffel of the Laboratories at the voltage amplifiers in Constitution Hall, Washington

The advantage of this control of volume does not end here, however. Its presence makes it possible to reproduce operatic music, where a soloist is accompanied by an orchestra, without allowing the voice of the singer to be drowned out by the louder passages. For this purpose a third channel, including its separate microphone, transmission line, and loud speaker, has been provided in the new system primarily for the singer. The volume of output of this channel is controllable independently of the other two. In this way the loudness of the voice may always be kept just above that of the orchestra and the desired musical effect be obtained. There thus reside in the new apparatus possibilities heretofore unattainable; and telephonic research has laid a foundation for what may be one of the greatest advances in musical aesthetics of the present scientific era.

The first public demonstration of the new apparatus was given in Washington on the evening of April 27 under the auspices of the National Academy of Sciences. At that time Dr. Stokowski, Director of the Philadelphia Orchestra, manipulated the controls from a box in the rear of Constitution Hall, while the Philadelphia Orchestra, led by Associate Conductor Alexander Smallens, played in the Academy of Music at Philadelphia. Between Philadelphia and Washington, the music was transmitted over telephone cable circuits. The program consisted of the Toccata and Fugue in D Minor, of Bach; Beethoven's Symphony No. 5 in C Minor; L'après-midi d'un Faune, of Debussy; and the Finale of Götterdämmerung. A visual accompaniment was provided for the music by Electrical Research Products, Incorporated. Its stage direction—through the courtesy of the Yale School of Drama—was by S. R. McCandless, and the designs were by Eugene Savage and George Davidson.

During the intermission Dr. W. W. Campbell, President of the National Academy of Sciences, introduced Dr. Harvey Fletcher, Director of Acoustical Research at Bell Telephone Laboratories. With the assistance of the orchestra in Philadelphia, Dr. Fletcher then performed several experiments to demonstrate the important characteristics of the new apparatus. On the stage of the Academy of Music in Philadelphia, where the pickup microphones were installed, a workman busily constructing a box with hammer and saw was receiving suggestions and comments from a fellow workman in the right wing. All the speech and accompanying sounds were transmitted over cable circuits to

(*Continued on page 53*)

Output Transformer Specifications

A thorough discussion of the methods used by amplifier manufacturers to obtain transformers which will perform in accordance with the specifications laid down—all tending to show the importance of matching transformer to amplifier.

NORMAN H. CROWHURST*

WANTED—an output transformer around which to build an amplifier. Maybe, on the other hand, the amplifier is already designed and we need a suitable output transformer to complete it. Either way, this situation can provide a serious problem—especially so since the advent of feedback amplifiers. How do you find or acquire the right transformer for the purpose?

Available Data

Some specifications on the manufacturer's list give the tubes with which the transformer is to be used. Others specify the primary impedance, which means the impedance that the secondary loading will reflect into the primary circuit, when correctly loaded, as either a plate or plate-to-plate load. They all list the appropriate secondary tappings or load values. Most listings will also give a maximum power or level figure, which should show whether the transformer is big enough to handle the power you intend to use in the amplifier. A few of them specify a frequency response—at least in frequency limits (which can mean almost anything), although some give tolerance figures too. Some of them specify the permissible current in the primary, either for single-ended operation, or as a maximum d.c. unbalance in push-pull operation.

One can get some idea of the prospective "goodness" of the transformer by reading the dimensions and weight, if these details are given. But even a specification which gives *all* of this data (if any does!) is not sufficient to prove that the transformer will be just right for the amplifier in which you intend to use it.

It is presumed that the rating of maximum power indicates that the transformer will "handle" this power down to the lowest frequency indicated in the frequency-response range quoted. However this is not always true. Even though it were true, it does not prove that the transformer is suitable for using *in the particular amplifier in question* at this power level and frequency.

We need much more information about the electrical characteristics of output transformers if we are to use them satisfactorily in building an amplifier. Manufacturers have an even more difficult problem, because they are concerned, not with just building *one* amplifier, but with producing a consistent production item. This means they must be assured of a *repeatable* output transformer for the type of amplifier involved.

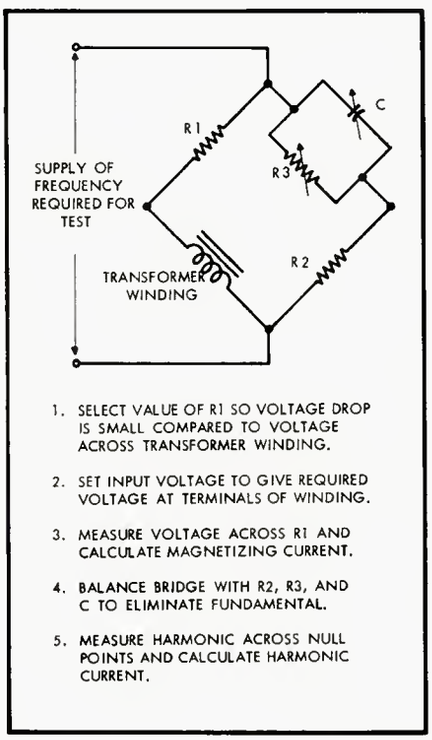


Fig. 1. Simple bridge arrangement for measuring low frequency magnetizing characteristic of audio transformer.

"Practical" Procedure

The word "repeatable" has more meaning than may be immediately apparent. Manufacturers naturally like to have more than one source of supply for the various components in their line, in case of possible supply difficulties. But in the case of the output transformer this has often proved to be quite a problem. Out of the difficult situation, a quite unscientific practice has arisen throughout the industry.

For want of better means of specifying the performance of an output transformer many amplifier manufacturers provide prospective suppliers of transformers for their product with a "prototype" amplifier in which the transformer should operate. The performance of the transformer is then specified as operating in the prototype amplifier. For example, the over-all frequency response, distortion at various levels, and the square-wave response, are specified by the amplifier manufacturer as though these were direct functions of the output transformer. It is then the transformer manufacturer's responsibility to produce a unit which will perform according to these standards *in the prototype amplifier*.

While this approach immediately strikes one as being unscientific, it would at least seem that it provides some practical safeguard to the operation. It should enable the transformer manufacturer to ensure that his product will work in the circuit for which it is intended. Unfortunately, however, the solution is not as simple as this.

Assume that the amplifier supplied as prototype has design center values for all the other components except the output transformer (and this is not always practiced): then how much tolerance must you allow for the fact that production amplifiers into which the transformer will be fitted have components differing from design center values by some acceptable tolerance? What effect will various possible deviations have on the performance of the output transformer? Does exact repeat performance in the prototype, even, assure exact repeat performance in a production model?

The problem of permissible tolerances, and how they may combine to put the resultant amplifiers out of tolerance range, is further complicated by the fact that the transformer manufacturer and the amplifier manufacturer may, and probably do, use different measuring equipment. The net result of all this is that the approach is not as practical as could be desired.

If the tolerances on transformer performance in the prototype amplifier are tightened to allow for deviations in

* *150–47 14th Road, Whitestone 57, N. Y.*

other components in production amplifiers, this may well result in the rejection of transformers which would work satisfactorily in the majority of production amplifiers. On the other hand, specification of output transformer performance tolerances compatible with tolerances elsewhere may well result in the transformer manufacturer passing transformers which will later be rejected by the amplifier manufacturer, due to the cumulative effect of tolerance deviation.

The fact remains that this method of test does not provide a real measure of tolerance in the characteristics of the transformer itself. Thus it provides no absolute measuring stick to guide in determining whether a transformer is satisfactory or not satisfactory. This situation, as can be imagined, has led to its quota of "differences" between the transformer and amplifier manufacturers.

In all other fields methods of test are specified which measure up certain quantities pertinent to the components themselves, not the way they perform in a complex piece of equipment like an amplifier. For example, a surge-limiting capacitor is not tested in every manufacturer's prototype amplifier to determine whether it meets specification. The capacitor manufacturer first finds what are the desirable characteristics of such a capacitor. Then he sets measurement standards which the capacitor has to meet to ensure satisfactory service. It would seem that the whole procedure of mating an output transformer to an amplifier (or vice versa) would be considerably simplified if a similar set of specifications could be provided relative to output transformers.

This problem is not exclusive to manufacturers. The constructor meets it too. The specific component listed may not be readily available everywhere. Is an "identical component" offered by another manufacturer really a duplicate? Within the present framework, the constructor too, can never be sure.

Recommended Specifications

On the basis of preceding articles concerning the performance of transformers, the following method of specifying *electrical* performance is suggested:

1. Ratio. Turns or impedance ratio, together with a suitable tolerance on the ratio. Where the transformer is center tapped, a tolerance should be set on the accuracy of the center tap.

2. Efficiency. This should be specified at a middle frequency, such as 600 or 1000 cps. It is necessary, because without specifying this, the effectiveness of the transformer in providing the rated maximum output of an amplifier over the majority of the frequency range cannot be assessed.

2a. Winding Resistance. Sometimes, in addition to the over-all efficiency of the transformer, it may be desirable to specify a maximum permissible resistance of the primary winding, since this will determine how much of the high-voltage supply is lost by d.c. drop before the current reaches the output tube plates. However, if the transformer meets the efficiency requirement laid down, usually the primary winding resistance will be taken care of without this additional specification.

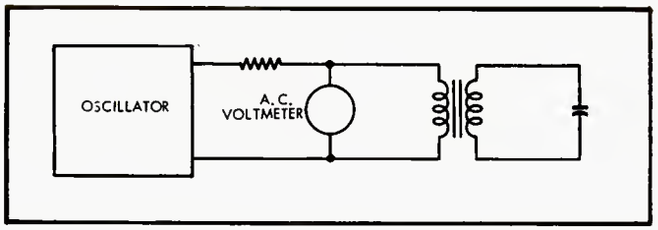


Fig. 2. A simple method of measuring leakage inductance between two windings.

3. Magnetizing Characteristic at Low Frequency. If the transformer is to be operated single-ended, with polarizing current flowing through its primary, this characteristic can be specified as a minimum inductance value at a stated polarizing current.

Most transformers nowadays, however, utilize push-pull operation of the output tubes and thus there is not resultant polarizing of the core, unless there is a d.c. unbalance. However, d.c. unbalance is more likely to upset the frequency response at the low-frequency end *in low level operation,* than it is to restrict the power output seriously.

3a. Low-Level Inductance. For this reason the low-frequency magnetizing characteristic should specify a minimum inductance value with specified unbalance current, if this is considered necessary or vital to the amplifier performance at low levels.

3b. Full-Power Magnetizing Current. What should *always* be specified, in the interest of providing satisfactory power output at the low frequencies, is the magnetizing characteristic of the transformer at full level—the rated voltage for full power—at some specified low-frequency limit, possibly 40 cps.

As distortion in this region can be due either to non-linearity of the magnetizing current or the reactive loading on the output tubes, limits should be set (1) to the maximum component of magnetizing current permissible, compared to the full load current, and (2) to the maximum component of harmonics, that may constitute part of this magnetizing current.

To illustrate this part of a transformer specification: where the rated power is 25 watts and the output impedance 16 ohms; the output voltage and current corresponding to this power and impedance would be 20 volts at 1.25 amps. Examination of the tube characteristics may show, for example, that satisfactory performance will be achieved if the magnetizing current is not more than 30 per cent of the load current and the harmonic generation in this magnetizing current is not more than 10 per cent of the load current. The specification then could read "with 20 volts r.m.s. sinusoidal waveform applied to the transformer secondary at 40 cps, the magnetizing current should be not more than 0.375 amps, while the harmonic component of this magnetizing current should be not more than 0.125 amps."

This is something that can be conveniently measured on the bridge shown in *Fig.* 1. If the transformer meets this specification the amplifier should be able to deliver its maximum power at the low frequency end.

4. High-Frequency Parameters. The primary parameters to consider are leakage inductance and winding capacitance. The relative importance of these parameters will vary from amplifier to amplifier and the specifications should be drawn up with this relative importance in mind.

For example, one amplifier may need additional shunt capacitance on the primary to stabilize the amplifier. It is evident that the primary winding capacitance of the transformer is relatively unimportant in this case. As the transformer manufacturer is not likely to try winding a capacitor into the transformer as an experiment, it is unnecessary to provide any particular safeguard when this condition prevails. However, the leakage inductance value will probably be an important criterion in the amplifier design.

4a. Leakage Inductance. In some amplifiers it may be mainly important to ensure that the leakage inductance is *less* than a certain critical value—it is not important *how much less.* Consequently this should then be specified only as a maximum limit for leakage inductance.

In other instances it may be important to hold the leakage inductance *within* limits, because deviation either way may adversely affect the stability criterion of the amplifier under over-all performance tests.

The next question that may be asked is, "How do you measure leakage inductance?" The simplest method of achieving this is by resonating it with a capacitor. There are two ways of doing this. One method is to short circuit one winding (preferably the high-impedance winding) because this will eliminate the effect of any capacitance across the

winding), and measure the inductance at the terminals of the other winding, in this case the low-impedance winding. This could be measured either by resonance or bridge methods.

The other method, which is more versatile in allowing measurements to be made between different windings, is to measure the voltage across one winding when the transformer is fed through a relatively high resistance, and place the resonating capacitance across the other winding, as shown at *Fig.* 2. This virtually eliminates the effect of capacitance across the input winding, but not across the output winding, since the capacitance used to tune is in parallel with any self-capacitance of the winding. The capacitance of the input winding, however, is in shunt with a series tuned circuit and will not affect the frequency of minimum impedance.

The value of inductance obtained in this way will be referred to the winding across which the capacitor is connected.

4b. Winding Capacitance. Where it is important to measure winding capacitance, the effective method of doing this is to connect the ground points, including the center tap of the primary which is virtually at ground, to a common ground point and then find the self resonance of the transformer between leakage inductance and winding capacitance. This can be achieved by inserting the signal through a large resistance into the secondary of the transformer and measuring the terminal voltage for a minimum value. Then additional capacitance is connected across the open circuited primary of the transformer until this resonance is dropped by some specified ratio, usually the ratio $\sqrt{2}$, in frequency. This will indicate that the capacitance across the primary of the transformer has been doubled. So the effective winding capacitance of the transformer will then be equal to the additional capacitance connected externally. From these values the leakage inductance can then be calculated as well.

4c. Relative Coupling. This is also an important feature in some transformer designs. By this we mean the tightness of coupling between two halves of the primary relative to the tightness between whole and secondary; or, in the case of an ultra-linear transformer, the tightness of coupling between screen and plate taps as compared with coupling between other sections of the transformer.

In amplifiers where relative coupling is important, it is not the *actual* values of leakage inductance between one section and another of the transformer that are important, but the *relative* values of leakage inductance. If, for example, it is important to the design of the amplifier to maintain tight coupling between the two plates of a push-pull stage, then the leakage inductance between one half of the primary and the other should always be lower than some fraction of the leakage inductance between the primary considered as a whole and the secondary referred to the half primary. The leakage between halves will need to be lower than the leakage inductance between one half primary and the secondary. The important thing is to establish an acceptable *ratio* between these quantities.

For example, the leakage inductance from each half primary to secondary may be established at a maximum figure of 10 millihenries. This means that the transformer can use a leakage inductance of 5 millihenries—if it comes out to this value—and will still be acceptable. Any value is acceptable provided it is not greater than the maximum specified, of 10 millihenries. If, in addition to this specification, there is a relative tightness specification which says the leakage inductance between halves of the primary must be not greater than one fourth of the leakage inductance between each half primary and secondary, this means that the leakage inductance between halves of the primary must be less than 2.5 millihenries if the leakage inductance between primary and secondary reaches the maximum permissible value of 10 millihenries. On the other hand, if the leakage inductance between each half primary and secondary drops to, say 6 millihenries, because of closer coupling, then the leakage inductance between primary halves must be not greater than 1.5 millihenries. This ties in with the *relative* stability criteria applicable to high-frequency performance in amplifier design.

5. Balance. Another factor that needs to be specified as a separate entity in most instances is the *degree of balance.* In some features of the transformer design this will not be important. For example in the case where the winding capacitance was not important anyway, the balance of capacitance across the separate halves of the transformer will not be important either. But balance between the leakage inductance from each half primary to secondary may well be important. In this case it should be specified as a tolerance deviation between the leakage inductance from the respective halves.

All of these electrical properties can be measured on any transformer, unless its design incorporates so many internal resonances that it is impossible to separate them, in which case it is not a highly desirable transformer for incorporation in an amplifier.

This remark frequently applies to transformers of the ultra-linear variety. Different sections of the primary have their own independent resonance points which put the screen out of phase with the corresponding plate and produce quite erratic effects in the performance of the amplifier. Very few ultra-linear type transformers are entirely free of this effect. This is one reason for specifying tolerance in leakage inductance deviation and also in the tightness of coupling—because this is the only way to eradicate these effects from an ultra-linear transformer. *Figure* 3 shows some typical test results on an unsatisfactory ultra-linear transformer.

The balance of d.c. resistance: if the transformer is of reasonable efficiency for the size output used, equality between the resistance on the two halves of the primary is not vital to good operation of the tubes, in producing a reasonably distortion-free output. However some circuits employ a d.c. voltmeter across the winding to determine the voltage drop and thus the current in each tube. This is then used as a means of adjusting the bias, or differential bias, on the tubes so as to ensure equal operating conditions. If the circuit is intended for this purpose, not only should the d.c. resistance be closely matched be-

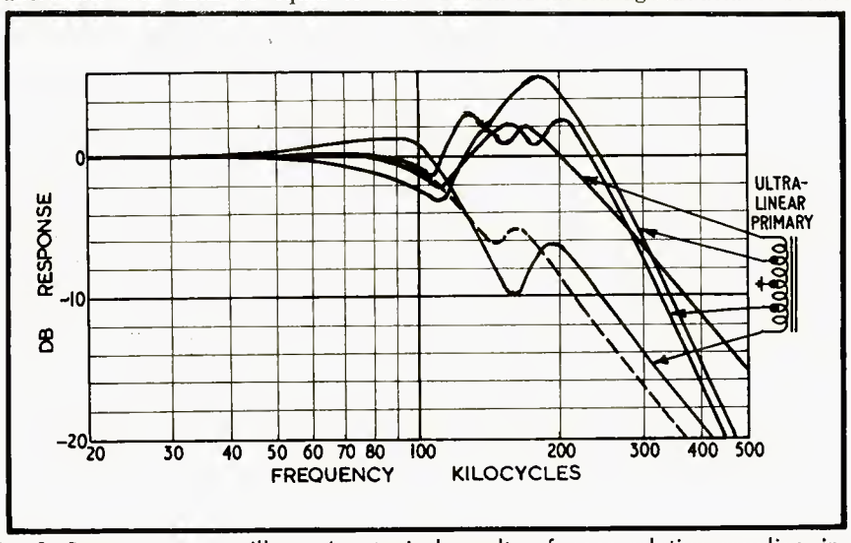


Fig. 3. Response curves illustrating typical results of poor relative coupling in a transformer intended for ultra-linear operation. Dashed line represents measured characteristic of the transformer in a typical ultra-linear circuit, but does not indicate what happens to the waveform.

tween halves, but its value should be closely controlled. This will necessitate a closer control on the wire diameter for the primary than would be necessary for other purposes and will add to the over-all cost of the transformer, because of this additional quality control feature.

Practical Cases

Someone is going to notice at this point that we have not specified frequency response as such. Even before the advent of feedback amplifiers, the published frequency response for an output transformer bore no direct relationship to the frequency response it would achieve in a given amplifier. This is because the frequency response in the transformer varies with the different circuit conditions to which it is connected.

The transformer may be specified, for example, as matching 6000 ohms plate-to-plate on the primary, to 16 ohms on the secondary. This specification tells us that terminating the secondary with 16 ohms will cause the primary to look like 6000 ohms plate-to-plate. Now, how do you measure the frequency response of the transformer?

The generally recognized method is to feed from a source resistance of 6000 ohms on the primary side, maintaining the voltage constant at the input to the source resistance, as shown at *Fig.* 4, and then measure the output across the 16 ohms. This may give an excellent frequency response of the transformer.

But very few amplifiers, even without feedback, operate under this condition: the average triode amplifier provides a source resistance considerably lower than the optimum load resistance—in this case 6000 ohms; whereas the average pentode or tetrode provides a source resistance in the region of five times the optimum load resistance. Either of these conditions will produce a frequency response quite different from the one published, taken under the condition of *Fig.* 4.

Now we add feedback. This complicates matters even further, because the parameters of the transformer contribute to the over-all feedback stability characteristic, and determine whether closing the over-all feedback will cause the response to drop off, peak, or achieve maximum flatness. This variety of possibilities is quite independent of the frequency characteristic of the transformer by itself. It depends entirely on the way the relevant parameters in the transformer combine with time constants through the rest of the amplifier circuit to produce a resultant closed-loop characteristic.

Obviously, then, specification of the frequency response of an output transformer for a feedback amplifier is completely meaningless—*unless the amplifier is specified in complete detail as well.* This is not then the response of the transformer, but of *the amplifier using this transformer* for the output. It is therefore suggested that the foregoing electrical specification should be substituted for the frequency response normally called out for output transformers.

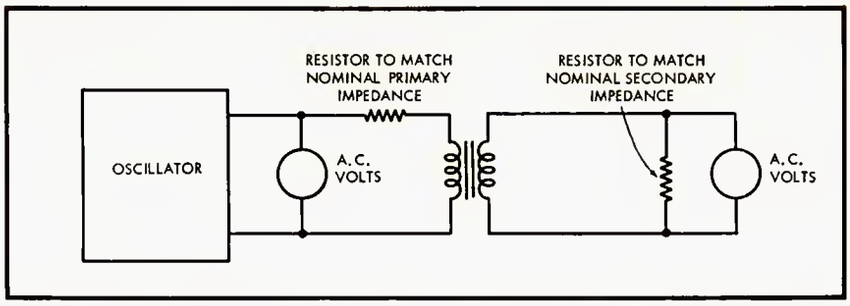


Fig. 4. The standard method of specifying the response of an audio transformer, in the absence of other information. But this does not tell how it will behave in any practical circuit.

Such a specification as we have outlined in this article provides a useful tool for determining, to the satisfaction of both transformer and amplifier manufacturers, whether a given product *meets its specification.* All these electrical quantities can be measured and thus the facts accurately determined as to whether the transformer does or does not meet its specification. It is not dependent upon a prototype amplifier and upon possible deviation due to tolerances of components in other parts of the amplifier.

The over-all effect of using this approach should be a considerable improvement in the general quality of amplifiers and a more satisfactory control over the performance of output transformers for them. But some transformer manufacturers dislike working to this kind of specification. They would prefer working the other way—even though eventually it may cause trouble due to the differences discussed earlier.

It is difficult to see why there should be any objection to using this kind of specification, unless it is that the more generally accepted method allows a more sloppy operation. What happens seems to go something like this: transformers deviate by some factor or other; maybe a certain wire gauge is not available, or the quality of laminations may vary. This alters the performance of the transformer slightly, but there is not definite evidence that the transformers are not meeting specification. When this deviation is combined with the available tolerances in other components, in some samples of production amplifiers, the transformers may still work, while in other samples the combined effect of the tolerances results in an unsatisfactory performance.

After making checks that discover this fact, the manufacturer probably comes to the conclusion that the trouble was a matter of component tolerances and so he virtually sets up new tolerances for the transformer, by adjusting other component values and tolerances as necessary in the rest of the amplifier to suit "for the time being."

Maybe at this stage the amplifier manufacturer decides he would like to see what some other transformer manufacturer can do, so he submits a sample of this deteriorated transformer (although the deterioration has not been identified), together with a prototype amplifier and specification, to another transformer manufacturer. This man makes an approximate copy of the poorer transformer and proceeds to supply to this specification, possibly at a slightly lower cost. The amplifier manufacturer thinks he is doing well on the deal.

This kind of process can go on, gradually relaxing the tolerances until the amplifiers no longer anywhere near meet the original specification, developed in the original prototype amplifier. This can explain why many amplifiers do not perform according to the specifications laid down in the catalogue. With this method of working it is extremely difficult for the quality-control department of an amplifier manufacturer to secure satisfactory results and the transformer manufacturer can easily supply components which do not satisfactorily meet the requirements, although a reasonably satisfactory argument can be put up to show that his transformers do meet the specification as provided.

Development Procedure

Finally, we should have a few words about the development of amplifiers. Under the present method the usual procedure seems to be to utilize a transformer that approximates to the requirements of the amplifier, or to obtain a sample from a manufacturer that he predicts will give the required performance.

The amplifier is then built around this transformer and the circuit adjusted to obtain the required performance. If it proves impossible to achieve the desired performance with this particular transformer, an estimate is made of the changes required—for example, better primary inductance to improve the low-frequency performance, or tighter coupling to improve the high-frequency performance—and a new sample is submitted.

(*Continued on page 51*)

Transformer Impedance Transformation

Audio amplifier constructors and experimenters can readily ascertain optimum transformer-impedance ratios to obtain minimum distortion in output stages

HAROLD REED*

IN CHOOSING A transformer to work between the output stage of an amplifier and loudspeaker, line, or other load, it is necessary to select a transformer with specified characteristics that will be capable of satisfying a number of conditions. One of these important characteristics, of course, is the impedance of the primary and secondary windings.

When we select an output transformer for a certain amplifier the secondary impedance working into the amplifier load is no problem since we know before we initiate the amplifier design what load we desire to feed. The primary, however, is usually selected in accordance with published data in electron tube handbooks pertinent to the output tube, or tubes to be used in the output stage. This data recommends a certain load impedance for the tube selected. The load impedance holds for certain operating and circuit conditions of the output stage. If operating or circuit conditions are otherwise, then for best results the load impedance specified would not necessarily apply and distortion may rise considerably.

Until recently, most audio amplifier constructors and experimenters were not in a position to make critical tests for optimum transformer impedance unless he had access to expensive analyzers available in laboratories or radio broadcasting stations. His oscilloscope, if he had one, would not tell if distortion had increased or decreased in amounts of the order of 1 per cent or 2 per cent with changing circuit conditions. Today, audio analyzers in kit form, such as the Heathkit Model HD-1 shown in the *Fig.* 1, are available at a price within the reach of most audio workers. A distortion analyzer will quickly provide the information concerning the effects of changing transformer impedance. The following tests may be made with the test setup as shown.

Before discussing test procedure, a review of basic transformer equations and formulas concerning turns ratios and impedance ratios will be considered.

* *3917 Madison St., Hyattsville, Maryland.*

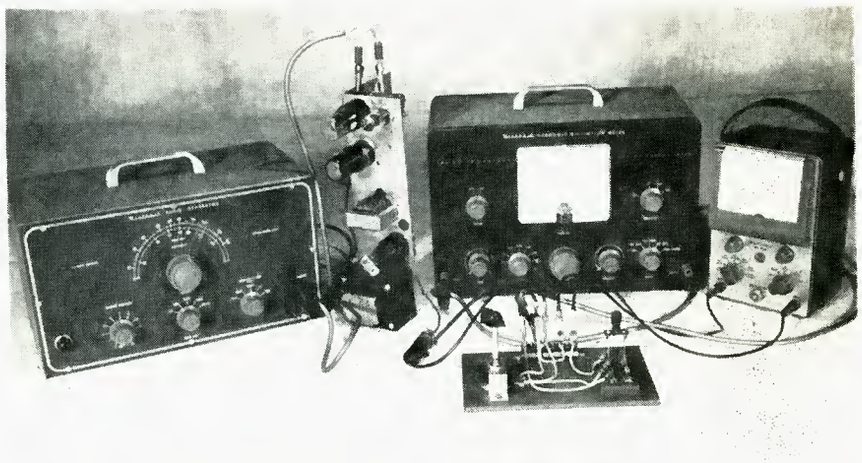


Fig. 1. Test setup used by the author to find optimum reflected primary impedance for minimum distortion. Note the knife switch for switching in the ohmmeter, vacuum-tube voltmeter, and audio analyzer or distortion meter.

The turns ratio of a transformer, N_p/N_s, where N_p is the number of turns in the primary winding and N_s the number of secondary turns, is equal to the square root of the impedance ratio, or $\sqrt{Z_p/Z_s}$. As an example, consider a transformer with a primary impedance of 7000 ohms and a secondary impedance of 4 ohms. Then, 7000/4 equals 1750 and the square root of 1750 is equal to 41.84, approximately. It is to be understood that this resultant, 41.84, does not represent the number of primary or secondary turns but the ratio of the number of turns of the two windings. Also, the primary impedance is equal to the square of the turns ratio multiplied by the secondary impedance when properly terminated. That is, $Z_p = (N_p/N_s)^2 \times Z_s$, where Z_p is the primary impedance and Z_s the secondary impedance. In the example under consideration $Z_p = 41.84 \times 41.84 \times 4$, or *7000* ohms. This transformer would work satisfactorily between a 6F6 or 6K6 output tube and 4-ohm load with operating conditions, including a plate potential of 250 volts, as recommended in tube handbooks for these tubes.

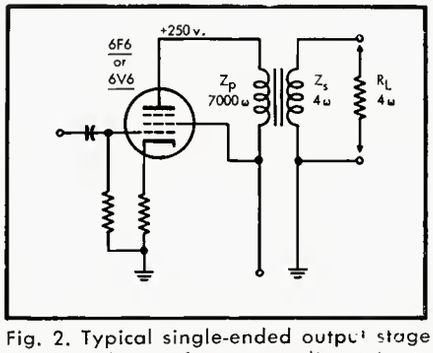


Fig. 2. Typical single-ended output stage circuit with transformer coupling tube to load—in this case, a resistor.

The popular 6V6 tube is interchangeable with the 6F6 and 6K6 in that socket connections are the same and typical plate potentials are similar. However, with a plate potential of 250 volts, the recommended load resistance for the 6V6 is 5000 ohms.

The circuit of *Fig.* 2 would present satisfactory operating conditions for the 6F6 or 6K6. Here, a primary impedance of 7000 ohms is indicated with a secondary impedance of 4 ohms suitable for working into a 4-ohm load. Now instead of using either of these tubes, say a 6V6 is plugged into the tube socket. The audio constructor may now observe the variation in distortion percentages with the audio analyzer and the circuit arrangement of *Fig.* 3. The tests to be described were made through the complete amplifier. This is not an extreme

(Continued on page 52)

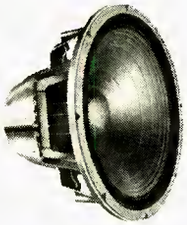
when it sounds like this...

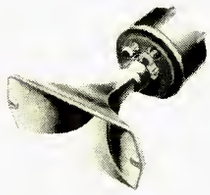
instead of this...

it's time for...

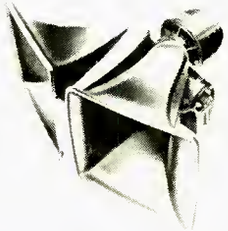
University

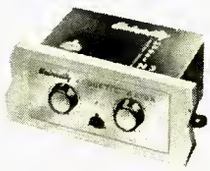
A FEW OF UNIVERSITY'S MANY



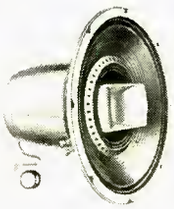


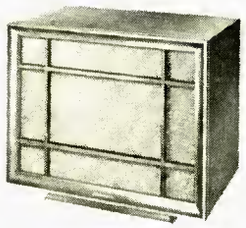
WOOFERS AND TWEETERS,



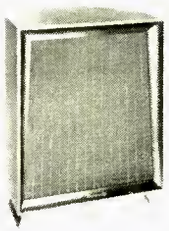


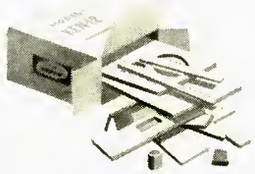
MID-RANGE AND NETWORKS,





DIFFAXIALS AND SYSTEMS,





ENCLOSURES AND KWIKITS

FROM THE WORLD'S LARGEST SELECTION
TO GRATIFY EVERY NEED AND BUDGET

When your hi-fi wears out its welcome . . . tires your ears with shrill, discordant highs, muddy lows and general tonal fuzziness . . . you've probably got a case of "listening fatigue." It's a common trouble for which a University loudspeaker or system is the cure! The reproduction of music is a fine art . . . as skillful, in its way, as creating it. Since the speaker is the last link of your high fidelity chain, University spent two decades perfecting the craft of making this link the strongest.

When next you visit your hi-fi center . . . LISTEN *University sounds better*® HIGH FIDELITY

UNIVERSITY LOUDSPEAKERS, INC., 80 SOUTH KENSICO AVENUE, WHITE PLAINS, N. Y.

Hum Specification Measurements

MANNIE HOROWITZ*

In order for the prospective buyer to make comparisons between amplifiers, it is necessary that characteristics be specified in the same terms. The author proposes a practical and suitable means for specifying hum and noise levels.

MANY STANDARDS have been set up for the measurement of the hum and noise output from amplifiers with self-contained preamplifiers, as well as for separate preamplifier units. These methods have several obvious shortcomings.

The most popular method employed today is that of stating the number of db the hum level is below the rated power output of the amplifier. This system makes the number of db appear very large, giving the impression that an amplifier has a low hum level. This factor can explain its wide acceptance as a standard by equipment manufacturers.

At this point, the comparison problem arises. How can the hum output from a 10-watt amplifier be compared with that of a 20-watt amplifier? If both amplifiers specified hum at 60 db below rated power output, the 20-watt amplifier would have 3 db more hum than the 10-watt amplifier had, at the same listening level. It is obvious that the same figure for hum of 60 db below rated output represents an entirely different absolute value when it is applied to a 10-watt amplifier than when it is applied to a 20-watt amplifier.

An alternative is the rating of hum below a set level, no matter what the power capabilities of the unit may be. One such level was chosen as 1 watt. Any amplifier would be rated by the number of db the hum and noise level is below 1 watt. At first glance, this seems to be a fair way to compare the hum of amplifiers with different maximum or rated power outputs.

This method does not take into consideration amplifiers of different sensitivities. Amplifiers that require 5 millivolts to be driven to a 1-watt output would have twice as much hum as amplifiers which require 10 millivolts to attain the same power output. The less sensitive amplifier would then appear to have 6 db less hum, although under identical working conditions, the hum would be the same.

* *945 E. 26 St., Brooklyn 10, N. Y.*

In the preamplifiers, similar inconsistencies exist.

Many manufacturers rate the hum level as a certain number of db below some arbitrary output voltage. It is obvious that the higher this chosen output voltage, the greater will be the number of db below the output voltage. It is frequently found that this arbitrary output voltage is inconsistent with the undistorted output capabilities of the preamplifier.

To solve this problem of non-uniformity in preamplifier ratings, a standard was suggested. Instead of using any arbitrary output voltage, the hum below 1-volt output should be stated in specifications. This has the obvious fault of not taking the sensitivity of the preamplifier into account.

Method of Measurement

Hum level of amplifiers and preamplifiers should be measured under actual working conditions. This can be accomplished in the following manner.

A signal level, chosen as a standard, should be fed into the amplifier. A logical choice for this value is 10 millivolts. This figure can be defended since it is the average output of most magnetic pickups. The pros and cons of this value can be argued, but some input figure must be chosen as a standard. 10 millivolts seems to be a good over-all average.

The output power of 1 watt is considered by many as the average listening level. Actually, many people usually listen at levels that are one fourth to one half this value. Since a choice for average power output must be made, 1 watt is as good and reasonable a value as any.

Let us then assume two standard values. There is an input voltage of 10 millivolts fed into the amplifier. The amplifier is adjusted by the listener so that 1 watt appears at the amplifier's output.

To get this 1-watt output, the listener turns down his volume control, or his loudness control, if available. A fair hum check would do just that.

The loudness control or the volume control should be turned down. The hum check should be made at this control setting. Only then would the sensitivity and power output of the amplifier—as well as the actual listening conditions—be taken into account.

The procedure for measuring hum can therefore be summarized as follows:

1. Feed 10 millivolts at 1000 cps into the amplifiers, using RIAA equalization.
2. Turn the loudness control (or volume control when there is no loudness control) down until 1 watt is observed on an output meter.
3. Remove the input signal and observe the remaining hum level on the output meter.
4. State this hum level below 1 watt in decibels.

Preamplifier Hum Measurement

The preceding procedure for power amplifiers when combined with preamplifiers can also be used with preamplifiers alone. It should be noted that it takes an average of 1 volt to drive a power amplifier (less preamplifier) to full rated output. Thus 1 volt from the preamplifier can be regarded as its maximum required output.

The average power amplifier on the market today delivers about 25 watts. Since the 1-watt level (the output at which the amplifier's hum level is rated) is 1/25 of the amplifier's power output capabilities, the required voltage input to the power amplifier to deliver 1 watt is $\sqrt{1/25} \times 1$ volt (since the power is proportional to the voltage squared, $P = V^2/R$), or 0.2 volts. This value of 0.2 volts can thus be chosen as the output from the preamplifier at the average listening level. The fact that a 25-watt amplifier was chosen as standard will not add more than a 5-db error to a combined amplifier-preamplifier comparison in any conceivable situation.

The procedure for measuring hum level in a preamplifier-control unit can be summarized in four steps similar to the above.

(*Continued on page 33*)

* simple installation

PHOTO BY ALLAN D. CRUICKSHANK

Another reason why today's fastest selling high fidelity record changer is **Collaro**

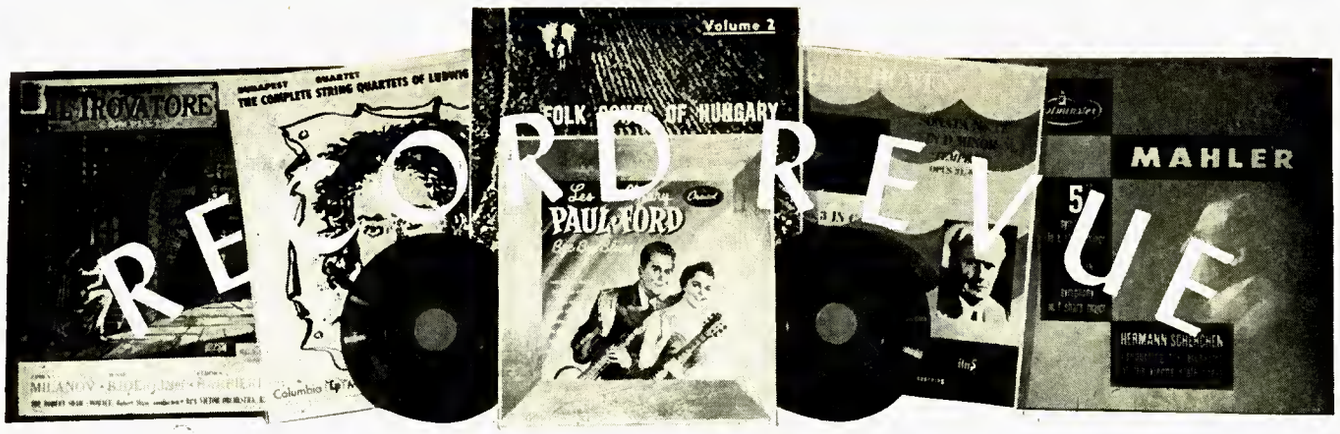
*** Simple Installation —**

the pre-wired audio cable and
the power cord with standard plugs eliminate
need for making solder connections.
Pre-cut mounting board
available.

MEMBER INSTITUTE OF HIGH FIDELITY MANUFACTURERS INC

For other features and new popular price, see your hi-fi dealer or write Dept. PF-1

ROCKBAR CORPORATION 650 Halstead Avenue, Mamaroneck, N. Y.



EDWARD TATNALL CANBY*

1. VARIETY

Offenbach in America. Boston Pops, Fiedler. **RCA Victor LM 1990**

Music of Offenbach. Lucerne Festival Orch., Ernest Falk. **Period SPL 303.**

It's a small world. Here are two very similar Offenbach mixtures, neither one from Offenbach's own locale, Paris, and they are outwardly as alike as a French pea and a telephone pea. The latter is a bigger package, from Boston, and there is, in direct comparison, a smart, polished hard finish to the Boston Pops playing that shows up against the slightly softer, somewhat more lyric playing from Lucerne. Very nice illustration of the difference between the European performance and the often slightly higher-tension American playing of orchestral music.

Both discs offer a series of connected excerpts from various Offenbach operas, all-instrumental. Doesn't really matter which—you'll settle down to an ultra-familiar one every few minutes. High class background music and both albums are good ones in a hi-fi sense. The big RCA package has built-in notes and background material, on pink paper with fancy drawings. Verrah nice.

Viennese Delights. Vienna Symphony, Franz Salmhofer & Eduard Strauss. **Epic LC 3246.**

A Hi-Fi Frolic with Strauss. Vienna State Opera Orch., Anton Paulik. **Vanguard VRS 476.**

I cite each of these as representative of a series, the first from Epic and the second from Vanguard. By coincidence, both of these feature largely the non-waltz music of Johann Strauss—Polkas, Galop and the like. Others in the two series offer waltzes galore.

There is no finer place to buy Strauss than in Vienna. If you want cocktail waltzes or hi-fi waltzes or what-have-you, look elsewhere, but if you want the genuine, musical, sweet, lilting, fetching waltz itself, don't shop anywhere else. These two series will fill your shopping bag nicely.

Epic has secured the magic name of Strauss as a conductor, a latter-day descendant, no doubt. No special extra musical virtue, but it looks good and is good musically. Vanguard's Paulik is just as cognizant of the tradition. The differences between these two are more pronouncedly in the audio area; Epic seems to have got a bit of edginess into the Viennese sound, along with a big liveness a trifle too big; Vanguard's sound is truly hi-fi, and a bit better focussed.

The Automobile—The Sounds of Fifty Years. Directed and recorded by Peter Bartok. **Unicorn UDS 1A.**

Perhaps old man Bartok, the famous composer, would be amazed, but this new operation of his versatile engineer-son is a first-rate job of intelligent and interesting dramatic presentation, at least in its major area. (A filler at the end on the races at Mount Washington is just a lot of noise for an outsider.)

You may think that recording old autos is just a matter of sticking a mike at them. True enough, and they make plenty of noise, too. But what do you do when it comes to turning out an LP record that must be interesting to hear, informative, unconfusing, as well as (natch) hi-fi? Some producers would do the usual thing and hire a pompous announcer—the kind who tells you about highs and lows and transients with all the flamboyance of a toothpaste commercial. Such accounts are an insult to the record buyers' intelligence, but we've had plenty of them in the hi-fi field already.

Peter Bartok's auto record is in the form of an easy track-side (or road-side) interview—with the autos themselves and with their owners and drivers. I don't know who they all are and don't much care—but they talk like people and without evidences of rehearsal.

Right at the very beginning, along with the lovely sound of a one-cylinder Cadillac, you'll be delighted to hear a true-blue down-East accent talking about his "cah." (No doubt at all as to the region where the cahs in this recording are pahked!) Brief discussions, like conversations, while the engine idles in the background—then a take-off, circling around, roaring past; the engine stops with a fine wheeze, the crank is inserted with a clank and she starts up again . . . so it goes. For expert variety, some of the recording is done in the cars as they travel, notably in a Stanley Steamer. Just how this was managed is not announced, but the travelling hi-fi seems exactly as good as the stationary sort and the equipment would seem to have been the same.

A gaily illustrated booklet in color comes with the album and—please note, after the Vox "Spotlight on Brass" and its relatives (see April issue)—the running text follows the order in which the examples are heard on the records, so you may look and listen simultaneously. Very sensible, and well done.

Brass and Percussion. Morton Gould and His Symphonic Band. **RCA Victor LM 2080.**

You can't make a bad musician out of Morton Gould; he just isn't one. He has a genius for playing around with material that I say, with all reverence, is beneath his talents. He's always done it. But he does manage to put snap and verve into just about anything he touches, no matter how banal.

This is a walking (or revolving) illustration of the most advanced in big-time hi-fi recording, as of our year 1957. The technical quality is one aspect, but I'm thinking more of the sound itself, which is of that new electronic sort, close-up music in a vast Mammoth Cave of a space that is so live that it could not possibly be imagined as anything literal or realistic in the way of a "hall."

Whether the actual liveness is artificial or natural I can't say, but the effect is positively supernatural! Interesting, decidedly, just in itself as a phenomenon. Especially since this is the kind of sound that is now popular in the more recent hit recordings, including Elvis's.

Are we entering the age of surrealist recording? Seems so.

The music? I almost forgot it. Mostly hepped-up band works, from Sousa on out, and there's one "hi-fi" passage of the sort that is obligatory on high-selling records these days, a collection of bangs and whams and sizzling percussion that goes on for a minute or so between two band numbers. A pale imitation of old Varese's "Ionisation"—written in 1926—but it'll sell this record to a lot of hi-fi souls.

(N.B. There's a brand new stereo tape recording of "Ionisation" coming soon. I heard a sample of it. Wow!)

Magoo in Hi-Fi. Jim Backus. Dawes Butler. **Farnon: Mother Magoo Suite.** Dennis Farnon and his Orchestra. **RCA Victor LPM 1362.**

If you want my honest non-hi-fi opinion on the content of this disc, I'd say it was for the birds. Pretty sorry birds, too. Mr. Magoo in his original form as the portly little gent of the UPA cartoons was quite priceless; this padding-out and blowing-up of the Magoo idea is tasteless, humorless, about twenty times too long, and enough to bury the little man under tons of sheer ennui. The subject: Mr. Magoo gets himself a hi-fi system. Umph. Yawn.

The reverse has on it a musical suite of the semi-pops sort that gets around these days. Not very funny, and awfully turgid. If you want the original, with real musical stuff to it, try Ravel's wonderful "Mother Goose Suite." This one is a country-bumpkin imitation with city-slicker hi-fi dressing.

Only fair to say that RCA does a remarkably fine job on the technical side with this empty material. If you want a hi-fi record pure and simple and you don't care what it does, so long as the fi effects are good, then you can ignore all the above and buy this quick.

Brahms: Symphony #1. Symphony of the Air, Markevitch. **Decca DL 9907.**

Toscanini's orchestra plus a rising youngish conductor from Europe, a combination that in this case is good, but not best.

Markevitch, whose strong point is, as I hear him, the French-Russian music that came out of the great ballet days in Paris before the First War, is not particularly suited to this ultra-Germanic music. He has done superb recording for Angel, out of England and France, and for Deutsche grammophon (Decca in the U.S.) out of Germany. This job seems less comfortable, less sure.

Maybe just a lack of rapport and not enough intimacy between hurried conductor and hard-working orchestra. Whatever the reason, this Brahms, though generally well played, has more rough spots and nervousness than it should and less incandescence. With all the competition in the catalogue, a new Brahms First has to be something ultra-special. This one isn't that.

* *780 Greenwich St., New York, N. Y.*

if it's

AUDIO FIDELITY

then it's

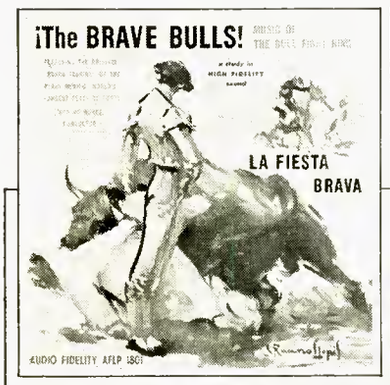
HIGH FIDELITY

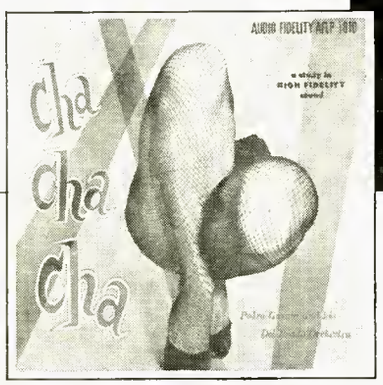
Audio Fidelity recordings are Not ordinary recordings—but *Guaranteed Total Frequency Range Recordings.* Here is the powerful and vital sensuous impact of sound in its purest and most natural form. *This* is True High Fidelity as you always want it to sound! . . . on Audio Fidelity Records.

Each 12-inch LP, in individual polyethylene bag, attractively packaged in full four-color jacket—**$5.95**

Come wander thru Rome — down narrow picturesque streets, past imposing churches, elegant palaces, hundreds of little art shops and galleries, past the cafes in Piazza de Spagna and Piazza Esedera, the flower stalls and beautiful girls in Via Margutta to the Trevi Fountain — accompanied by the enchanting melodies of Rome. Jo Basile, his accordion and orchestra, play familiar favorites — Luna Rossa; Non Dimenticar; Sorrento; Anima e Core; La Piccinina, etc.

AFLP 1822





THE BRAVE BULLS! La Fiesta Brava!
Music of the Bullfight Ring by the Banda Taurina. Complete with book of 24 full color Bullfight Poster Reproductions. AFLP 1801

PLAZA DE TOROS! La Fiesta Brava! Vol. 2
New selections of Bullfight music by the Banda Taurina. Complete with 4 full color reproductions of famous paintings suitable for framing. AFLP 1817

TORERO! La Fiesta Brava! Vol. 3
More music of the Bullfight Ring by the Banda Taurina. Complete with illustrated book, *El Toreo,* in English. AFLP 1818

CHA CHA CHA
The moon-drenched music of Pedro Garcia and his Del Prado Orchestra. Complete with illustrated dance instructions. AFLP 1810

FIESTA EN ESPANA
Authentic Flamenco by Rafael Molero, Guitarist; Alberto Salicru, Dancer; Paco de Jean, Esperanza La Macarena, Vocalists. AFLP 1819

HONKY TONK PIANO
Eddie "Pianola" Barnes at the ol' upright playing old-time favorites. AFLP 1827

WRITE FOR FREE CATALOG

MEMBER HIGH FIDELITY MANUFACTURERS INC.

NATIONALLY DISTRIBUTED BY

DAUNTLESS INTERNATIONAL

750 TENTH AVENUE • NEW YORK 19, N. Y.

It's understandable that Deutche Grammophon and Decca should want a repertory work from their combined artists, but I suspect that a more colorful, less standard sort of music (with less catalogue competition, too) would have brought out the high potential of quality that there is in this conductor-orchestra combination. They received fine notices in their larger concert programs in New York.

Liszt: Piano Sonata in B Minor; Benediction de Dieu dans le Solitude. Ernst Levy. **Unicorn UN LP 1035.**

This is a neatly controversial piano disc in more ways than one, and very interesting too. First (since this is AUDIO) I mention Peter Bartok's sonorous, enormous, fulsome piano sound—which makes this instrument seem bigger than any piano ever was. Fabulous, and I only cite its peculiar tonal qualities as worth study, whether "realistic" or no—since I feel they are perfectly suited to the fat, round, big-noise Liszt music. Don't know how he did it, but there is a very odd effect here—the lower tones of the keyboard are very close to you in the live space, as you listen, but the top tones seem about fifty feet away! A giant, extended keyboard, heard from a cat's ear viewpoint, maybe.

I suspect—a wild guess?—there is a mike not too far away from the bottom of the piano sounding board. At least, I've got similar big-bass effects that-a-way.

Musically, old man Liszt was the huge-volume, low-pressure giant of 19th century pianism. (Put it another way: high amperage, low voltage—where so many moderns are high voltage and tight-squeezed amperage)—Liszt requires a "big" pianist who really can let go, and there are few of them alive.

Ernst Levy hits the spirit of this music to a fabulous degree. But he misses notes in the detail work. He has therefore been panned by meticulous critics who want all the notes, at any cost; I'm all for him, because I think in this playing he has a largeness of spirit and understanding that fulfills the old man's musical intentions, notes or no. That means that you, and *you*, will understand and enjoy it. You won't even notice the slips, but you'll get the sense, and with pleasure. Try it.

Weber: Grand Duo Concertant, Op. 48. Schumann: Phantasiestücke, Op. 78. Debussy: Première Rhapsodie. Reginald Kell, Clarinet, Joel Rosen, piano. **Decca DL 9744.**

Here's a whole disc ful of clarinet music, played with big, poetic, colorful tone and musicianship by the famous Mr. Kell, who is no jazz hornist. (Note: Benny Goodman has recorded the Debussy piece above.) There is no sound as lovely as a good clarinet in a good listening space, and these U. S. audio engineers have given Mr. Kell a positively brilliant background of liveness, to make his instrument sing like one hundred. Superb clarinet sound.

There's only one little trouble. Somebody forgot the piano. The classic, eternal blooper has been made again, for these are all, with no exceptions, works for a *team*, for clarinet *and* piano, on equal terms. They could as well be called piano pieces with clarinet obbligato as the opposite. Decca has put the piano "accompaniment" too far away and too far down in volume and thus the balance is wrong, from start to finish. Too bad.

However, the over-all sound is so fine and the playing so good that almost any reader will get a melodic kick out of the gorgeous hi-fi. I'd vote yes, on a choice, piano or no.

2. SCOUTING THE FIELD

My two indefatigible Scouts, an extra two pairs of ears for my typewriter, have been industriously playing through a perfect mountain of records for me and their reports on same are rapidly piling up towards my ceiling. I continue to find their ears remarkably trustworthy—in the areas where each is good—and I only deprecate some of their language, which is apt to be intemperate if enthusiastic! That's why I take pleasure, as an old hand at writing with decorum for the public prints, in re-interpreting their excellent opinions into language of my own. It works well, this teaming-up, and we could not cover nearly as much useful ground separately as we do together, the three of us. As always, I'll back up the Scouts to the hilt—otherwise I'd print their names and let 'em sink or swim, via their own language. (They'd sink.),

Here are some of the most interesting items reported to me, summed up briefly.

Strauss: "Fledermaus" Suite. Phila. Orch. Ormandy. **Columbia ML 5166.**
Strauss Sparkles in Hi-Fi. Vienna Philharmusica, Hagen. **Urania UR 8009.**
Music Under the Stars. Vienna Philharmusica, Sandauer. **Urania UR 8004.**

Add these gems to the Strauss polkas noted elsewhere—and, while you're at it, to the several Offenbach offerings also mentioned. The batch will keep you sparkling for weeks on end.

Scout #1 approves highly of both these Strauss items. The Philadelphia is as good as the similar past offerings from that orchestra, with "excellent lift and elan," plenty of buoyancy and glitter. The Viennese record is less glittering but makes up for it in sunny, warm Viennese sentiment, rightly styled (as Strauss seldom is).

As for "Music Under the Stars," though the cover design unabashedly suggests the Hollywood Bowl the music actually is the same soft, nice Viennese playing, the composers various and mostly light. If you ask me, I'd prefer this to anything in Hollywood, anyhow.

Gershwin: Rhapsody in Blue; Concerto in F. Jesus-Maria Sanroma, Boston Pops, Fiedler. **Camden CAL 304.**
Great Jazz Pianists Camden CAL 328.

Approval for these two also comes from Scout #1, who appreciates the high value of many of the RCA Camden reissue items. He points out that the Sanroma-Pops version of the Gershwins, which were for many years widely known, have a certain swing and subtlety of Gershwin-style rhythm that isn't too common these days. They aren't hi-fi, but they are unique, these playings, and perhaps the best around. The jazz pianists, lumped together from RCA's huge vaults, include a baker's dozen famed names—from Duke Ellington to Mary Lou Williams, Fats Waller, Jelly Roll, and so on. We won't argue as to the choice; you try 'em and decide for yourself. You can't go wrong in this company.

Mozart: Bastien and Bastienne. Streich, Holm, Blankenheim, Munich Ch. Orch., Stepp. **Decca DL 9860.**

This is the tiny humorous operetta that Mozart tossed off at the age of 12 to a German text, music that stays alive century after century thanks to its sheer charm and skill. Scout #2, my Mozart specialist, says this is it—"*the* Bastien, just gorgeous. Especially Rita Streich as the sappy little heroine." As to the fi, Scout #2 observes in characteristic Scout #2 lingo, "Hi-fi-dee-di!" That means it's good, in case you couldn't tell.

Carl Seeman Plays Piano Sonatas of Mozart (#1 through # 4). **Decca DL 9867.**
Mozart: Piano Sonatas #12, #13, #14, #17. Robert Casadesus. **Columbia ML 5149.**

These two recordings of Mozart sonatas don't overlap, but they can be compared, as Scout #2 has done. He likes the Seeman very much, says Seeman "brings the largeness and strength of these sonatas to a small size . . . lovely, small and lyrical." In their very littleness (and, I suggest, this has long been a standard way of playing Mozart on a big piano) there is much refinement and sweetness. A much smaller effect than the Landowska playings on RCA, but good. (See AUDIO for May).

As for Casadesus, Scout #2 finds him much bigger and more dramatic in approach than Seeman, but also rather hard and fierce. His sonatas don't "transcend" like the Landowska versions, nor are they warm and lyric, like

Seeman. Merely strong. This is heartily in agreement with my own feelings about Casadesus in the past. A strong, hard, but cold player, not unmusical, just insensitive.

Mozart: Piano Concerti #12, K. 414; #13, K. 415. Cor de Groot; Vienna Symph., van Otterloo. **Epic LC 3214.**
Mozart: Two-Piano Concerto in E Flat, K. 365; Piano Concerto #12, K. 414. Robert and Gaby Casadesus; Columbia Symph., Szell. **Columbia ML 5151.**

Here is the Concerto #12 in two versions, paired off with other concerti. Scout #2 finds, again, that the Epic version with De Groot is "much more gratifying" than the Columbia Casadesus and again he speaks of the hard quality of Casadesus' Mozart. De Groot, he feels, is a broader, warmer player of a somewhat Romantic cast, with a good Mozart sense of humor. He likes Szell's orchestral Mozart, however, and thinks it colorful and nice in detail. Casadesus, again, is "brittle and humorless."

The Concerto for two pianos seems to get the hard treatment again and again (except in the too-soft and un-brilliant version with Badura-Skoda and Gianoli) and it gets it here. It's a brilliant piece by nature and so may well please in spite of the Casadesus touch. Gaby, the wife, is a fine pianist.

Mozart: Violin and Piano Sonatas #23, K. 306; #34, K. 526. Brenton Langbein, Maureen Jones. **London LL 1173.**
Mozart: Violin and Piano Sonatas in F, K. 377; B Flat, K. 454. Carl Seeman, Wolfgang Schneiderhan. **Decca DL 9862.**

. . . And here is another pair, comparable though not overlapping in content. Scout #2 is badly bothered by the London disc with Maureen Jones and Brenton Langbein; it is for him out of style, "gushy," lacks clarity, humor, is heavy, over-emotional in the wrong places, too hysterical. Now Scout #2 has a very sharp sense of Mozart style and I would suggest that this was a fairly solid sort of "no," on musical grounds.

Alas, Scout #2 isn't overly happy about the other disc either. Stylistically much better, cleaner, more sensitive, but still somehow . . . these playings seem to lack shape and focus. That isn't a very detailed argument, I admit, and I sort of wish the Scout had been able to pin it down. But though he couldn't in words, I suspect he is to be trusted for good intuition. Still—if you are after this kind of Mozart, I would suggest a good personal try at this one, with Seeman and Schneiderhan.

Kempe Conducts (Selections from Lohengrin, Meistersinger, Der Rosenkavalier.) Munich State Op. Orch., Saxon State Orch. **Urania UR 8010.**

Herr Kempe has been doing a job at the Met. among the German operas—hence, perhaps, this collection, which Scout #1 finds includes "very superior readings." Kempe is the sort of German conductor who can take his music at a very leisurely pace yet build an inner tension and line as well. That is a rare quality these days and it is surely what this music needs. Seems like an excellent bet, if you like Wagnerian instrumental excerptings. The sound seems typical of the old Urania (before the new management took over)—"serviceable but hardly first class." More German radio recordings, I'd guess, and perhaps not brand new ones, either. Small matter, if the music is good.

Beethoven: Symphonies #1, #8. Orch. Suisse Romande, Ansermet. **London LL 1493.**

Says Scout #2, "Both nice performances, clean and airy; they sweep along beautifully . . ." but even so, he detects just a shade of the routine in them. I would interpret this simply to mean that here is the excellent, highly professional product of a top conductor and fine orchestra who can't, every

(*Continued on page 50*)

ABOUT MUSIC

HAROLD LAWRENCE*

Splices May Be Seen—But Not Heard

LESS THAN A DECADE AGO, the microgroove disc was thrown into the lake of the record market. Among the many ripples formed by this historic event was the program notes' new look. In pre-LP liners the music was the thing, with perhaps an occasional nod to the performer. But since the application of magnetic tape to commercial discs was first introduced, most record jackets reserve an honored place for a report on the technical aspects of the recording. Among the topics covered are the kind of microphones and tape recorders employed, the acoustical properties of the hall, details of the tape-to-disc transfer, etc. Somewhere along the way, the following expression usually crops up: "... and the edited tape is then transferred to disc by means of ..."

The words "edited tape," so casually inserted in the body of the text, refers to a completely new development in recorded music: the birth of the tape editor. No such middle man was required in 78-rpm days. Once the wax disc was cut, it could not be altered in any way. After the artist's audition, the approved "test" was put into production. Now, the entire recording session on tape is dumped into the lap of the tape editor whose painstaking job it is to splice together the master copy.

An expert tape editor is first and foremost a trained musician whose ears are as sensitive as a VU meter. He should be mechanically adept, possess an infallible sense of rhythm and pitch (relative will do), and manipulate scissors or razor blade with the skill of a surgeon. (In some record companies, the tape editor actually comprises a team of two: the recording director or a representative of the A. and R. department, working with an engineer.) Confronted with a 'virgin,' or unedited set of tapes, he must be able to predict where a splice can be made, and where not. It's as simple as that. Yet a heavy responsibility rests with him in reconstructing the patchwork quilt of the session's takes and retakes.

Ideally, the place to make a splice is at a pause in the music, not necessarily a complete stop: the tail of a melodic line can sometimes suffice. But, as the experienced editor knows, it's usually a long way between pauses, especially when you need them. In general, splices in orchestral works are possible at the introduction of new instrumental timbres as, for example, when a wind choir follows a section scored for springs alone, or when brass and percussion join the tutti after a brief absence. At slow speed the new sounds will be at once apparent. Percussion, brass and wind families provide excellent splicing opportunities, particularly in forte passages. In slow speed detection, there is a vast difference between a loud flute attack and the same instrument easing into a soft legato tune. In the former instance, the tone leaps into aural view, while in the latter case, it steals up upon you. Of course, everything depends on what is going on in the rest of the orchestra. But even if the scoring is complex, the cut may still be feasible.

"Pulsing" is the answer. This can be done by reversing the tape a few measures and then playing at slow speed up to the beat before which the splice is to be made, marking the tape at that point. This requires pinpoint rhythmic precision.

Loud trombones and tubas in more or less exposed positions offer easy targets; at slow speed, the tonal vibrations sound like a stick being run along the posts of an iron fence. Snare drum, trumpet, piccolo, cymbals and oboe are fine aural landmarks provided that the attacks are cleanly articulated and unmasked by thick layers of orchestration.

Generalizations, however, are often misleading in the art of tape editing; what will work in one case will often fail in another. Other equally important factors affect the splice. Let us assume that we have cut at the end of a phrase. After joining it to another take, we discover that we have made a mismatch: the *tempo* has changed from the first to the second take.

Another factor that could disqualify a splice is a change in *dynamics*. This change may be so slight as to pass unnoticed at the session, but in the cold light of the editing room, the difference will suddenly appear obvious when played side by side. This is particularly risky in soft passages. On the whole, it is safer to cut into an ascending dynamic line than into a *diminuendo*, or an unchanging *piano* section.

Tempo, dynamics, and pulse may all be correct, but there still could be something wrong. The *pitch* may have altered from take to take. This is a common ailment of choral groups, but it affects orchestral players as well.

Change in *balance* between instrumental choirs could also make a splice impossible. Take a passage for solo clarinet above two accompanimental clarinets. In the retake, the pair of accompanying clarinets is played at a higher level. When spliced to the first take, the impression one receives is that a fourth and fifth clarinet have suddenly been added to the scoring. In another instance, an oboe enters under a sustained high "C" played by violins. A minimal change in the level of the strings will become immediately apparent despite

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

the fact that the featured oboe has remained uniform in level throughout its solo.

Splice points at full orchestral attacks must be clean in both takes. However, special tape surgery can be performed to correct an uneven situation: the operation involves snipping off the offending early-comer (if he can be singled out)—a highly dangerous procedure.

Dry acoustics make for fewer splicing problems. The most fiendishly difficult editing can be caused by recording a large 19th-century French organ in an excessively reverberant hall. When the reverberation overwhelms the original tone, you're in trouble.

An efficient recording director will always call for "overlaps" on retakes, even when the start of the retake occurs after a pause. He will have the conductor play from a bar or two before the needed material. Although the tape editor will splice after the pause, the first notes of the splice will contain *overhang* from the previous chord, thus matching the original. The absence of such overhang is as disturbing to the listener as the sudden drop of an elevator is to a full stomach.

Above and beyond the matching of takes, the tape editor often has to exercise musical judgements of a high order. What may sound fine at the recording session may often seem somewhat less than that after the excitement has subsided. It is up to him to mine the most precious fragments out of each session so that the finished product represents the artist's best work. When all is cut and spliced, the highest tribute one can pay a tape editor is to say: "I didn't hear a single splice." •

HUM

(*from page 26*)

1. Feed 10 millivolts at 1000 cps into the preamplifier, using RIAA equalization.
2. Turn the loudness control (or volume control when there is no loudness control) down until 0.2 volts is observed on an output meter.
3. Remove the input signal and observe the remaining hum voltage on the output meter.
4. State this hum level below 0.2 volts in decibels.

The above method is approximate (within 5 db) when it is used to compare the hum of a preamplifier-amplifier combination with that of a preamplifier alone. It is still the most accurate way of making this comparison when considering only amplifier-preamplifier combinations or when considering only preamplifiers. A system of this type should be adopted by the equipment manufacturers and their organizations to take at least this amplifier or preamplifier rating out of the chaotic condition in which it exists. •

AUDIO ETC.

Edward Tatnall Canby

Wow Meter

I OWE some sort of record-breaking apology to a West Coast concern named the Donner Scientific Company. Just about a year ago I ran across an announcement of theirs and my imagination, perhaps a bit inflamed at the moment, went wild. A Wow and Flutter Meter, portable and self contained—and it suddenly struck me that here was a marvelous gadget for those who don't trust the plain, simple old human ear for the detection of irregularities in pitch.

Now I've always thought that the ear itself, if given half a chance, could outdo any old meter when it comes to hearing wow and flutter in musical reproduction. And indeed it can—in the case of actual music. No meter of *any* sort, you see, can detect distortion in a recorded musical sound. Once a recording is down in terms of musical sound, or approximation thereof, it can be judged *only* by ear.

And so, if I'd really been thinking the Donner meter could "listen" to the music coming from my system and tell me whether it fluttered or wowed—I was nuts. However, I didn't think *that.* I merely speculated on the possibility that such a device could measure the wow and flutter content directly from, say, my nearest turntable. Or tape recorder. It can almost do that, if you're ready to give it a little help.

I sent for the loan of a Donner Wow and Flutter Meter, and presently it arrived—just as I was getting myself ready for a summer in Europe. Two months' work to do ahead of time, and the Meter, complete in a large box, was shoved under my living room table for future reference. There it stayed, for futurer and futurer, until the Company politely reminded me, 'tother day, that I owed them $295—or one meter, by return mail. How right they were. And so I took the gadget to the country with me, but quick. I always have more time there. (It has a neat handle on top and is genuinely portable, without the least trouble.)

Now if you've listened to piano records and died seven deaths through sheer chagrin when your piano came out with an unctuous vibrato on that nice new table of yours—like a Hawaiian guitar—you can understand that a Flutter Meter might be a tricky gadget to have around. For the very same degree of flutter or wow that slayed you on piano would be entirely inaudible in a string orchestra recording and in most orchestral recordings. Ear detection of waver in music depends strictly upon the type of music—and the piano is the ultimate test. If you have no piano records, your turntable can flutter like crazy and you'll never care a fig nor will your hi-fi friends. Same goes for vocal records with orchestra—they can tolerate a large flutter or waver from the equipment without seeming musically unpleasant.

Thus many musical souls, knowing nothing of all this, have been mystified and distressed at the way on some days their phono equipment seems to waver horribly and on other days, other times, it appears quite OK. It is the same all the time, actually, as a Flutter Meter should show. Just different kinds of music.

(I'll add, in figurative small type, that some people can't even tell a piano from a Hawaiian guitar when it comes to flutter. I've watched 'em. These happy souls don't need flutter meters.)

. . . So, to get back to the point, I finally dug out the Donner Flutter Meter for a try. Well . . . I had visions, by this time, of something that just sort of lowered down onto a turntable like a pickup arm and read the flutter straight off a meter. Nice idea and I pass it on to Donner, who can take care of the headaches of designing and building that. Could be done—definitely.

However, this Flutter Meter, Model 28, was never intended for dopes and amateurs like me and so it first requires a 3000-cps input tone. Give it such a tone and it will tell you at once the percentage of wobble, insecurity, jiggle, heave, vibrato, tremulo, or flutter in said tone, directly on its big, lit-up meter, right down to an incredibly small figure. Say 0.1 per cent. What's more, it has a built-in 3000-cps tone, in case you don't happen to have one around in a spare corner. I didn't, natch, and so I was most grateful for the loan of it.

But how does this thingamajig operate? It simplifies things for itself by limiting its action to one single type of tone, the 3000-cps sine wave. It will detect any modulated flutter, wow, or what-have-you from 0.5 cps to 300 cps in any device which can produce such a tone.

You can feed it the right information if you play the tone off of a tape recorder, or off a turntable. The only problem is to get the tone there in the first place, and that isn't much of a problem, particularly with a tape recorder.

All I did was to feed the built-in 3000-cps tone into my Ampex and record it. Then I played the recording back and measured the flutter as the playback signal fed into the Flutter Meter.

To measure turntable flutter you have two choices. Make yourself a disc recording, as above, and play it back again. Or make use of one of the commercial test records, on which a proper tone may be heard. The test recording itself will not be perfect, of course, but the directions will undoubtedly tell you what sort of accuracy to expect on the disc itself; anything in the way of flutter or wow added to this is necessarily produced by the turntable in your system.

Remember (you amateurs) that if you

record a test tone and play it back—whether via disc or tape—you are doubling the waver or flutter present; one set of wavers for each time the machine runs. (Yes, I know, it's possible that the two will cancel each other out by being 180 degrees out of phase. If so, then try the test a number of times. That ought to average things up.)

What did I find? Very interesting. It wasn't so much the fact that my Ampex stood up very nicely to the test as that I noticed a number of tricky side effects that showed how accurate the meter really is in detecting deviation from a fixed frequency. For instance, any tape machine user knows that when you start a recorder there is usually an instant of wobble, very slight, before the machine settles down. On my Ampex 350 the flywheel idler must be set turning by the tape before ultimate stability is reached—I usually figure, by ear, a couple of seconds.

Now the Donner Flutter Meter showed me at once that though the major flutter component disappeared almost at once when I started the machine—as my ear said—the ultimate stable state actually isn't reached for ten or twelve seconds. The meter needle kept dipping lower and lower for that long, though I could hear no change at all.

You'll understand that this is no reflection on Ampex when you realize that this slight deviation in flutter percentage was between roughly 0.1 and 0.8 per cent! It simply shows the degree of finesse with which this gadget operates. The plain fact is that it detects wow and flutter far beyond the ear's ability to do so. And so my faith in the musical ear has been weakened a wee little bit. Thought I was pretty good, but Donner has me beat.

I didn't take the time to adjust everything to exactitude nor was the meter itself quite on the zero mark at rest, but, just to give you an idea of what comes out of this gadget, I quote the figures below as I quickly read them off. Note that the Donner Meter has three sensitivity ranges, with full-scale indications of 0.3 per cent, which is the one I used, 1.0 per cent, and 3.0 per cent for the coarsest reading. (*That's* enough to be heard!) There are three frequency ranges too, 10–300 cps (flutter), 0.5–300 (over-all wow and flutter) and 0.5–10 cps (wow).

At 15 ips my Ampex 300 recorded the test tone and then played it back with these accuracies:

Flutter (10–300)	About .06 per cent
Over-all (0.5–300)	About .08 per cent
Wow (0.5–10)	Betw. .01 and .03 per cent

I trust Ampex is pleased with that figure. The percentages at the 7½-ips speed were comparable, and only slightly different.

I almost sent the meter into a tailspin when I fed it by accident a recording of a small boy giggling at the delayed sound of his own voice played back into earphones as he recorded. This sound had a rather high wobble content. Say 95 per cent. The meter hit its pin with a bang and just stayed there. Fortunately the Donner people seem to have incorporated overload circuits into their design, expressly for people the likes of me. Never can tell where wow and flutter are likely to show up. Wow!

'Nuff said, except to add that this device, though an entirely professional piece of equipment, was deliberately designed to be as simple in operation as possible—so simple that the Donner literature claims "accurate and dependable readings may be obtained by relatively unskilled personnel . . . " That's me. I'm the Unskilled Personnel of AUDIO.

The machine, indeed, is so ingeniously laid out that you can't even make a mistake due to mistuning or weakness of the incoming signal. A tuning eye and knob are provided and as long as the eye is closed, your readings are correct. If it opens or wobbles—something's wrong. Nice idea.

I deliberately tried out this meter in a wholly amateur way, just to see what it could do in the hands of somebody of my sort. But, of course, it has many professional uses, for which it was primarily designed. And it seems to me that a Donner Flutter Meter would be a very useful gadget around any shop where recorders and other equipment must be kept in condition or put into good condition. Might well be worth the $300 or so that it costs —especially if your Unskilled Personnel have tin ears.

Little Arm, Big Changer?

'Way, 'way back in this department, somewhere during our early years, I talked about the advent of the miniature phono cartridge, brought on by the LP record. It was far tinier than the standard big half-inch-mounting units then in use everywhere and, I thought, was quite sensational in many ways. Best of all, it came in its own miniature light arm, designed for it. I suspect that those early Columbia-Astatic models would test out remarkably well now, not only in low tracking force but in the then high compliance, far ahead of the contemporary magnetics first used for LP.

Well, the "sugar lump" cartridge-and-arm combination didn't catch on, and before long the smaller cartridges were being mounted in those clumsy birdcages of metal and plastic that now adapt them to the relatively huge half-inch-base cartridge shells which until this year have perversely remained standard. And this though more and more cartridges of all types—crystal, crystal ceramic, and magnetic—have been miniaturized.

Well, at last the big "standard" shell is beginning to go, though a new smaller standard has not yet been hinted at. Instead, we are seeing a new and interesting trend. Cartridges and arms are growing together.

The old and superficially convenient idea of the interchangeable cartridge-head system is, slowly but surely, on the way out. Too bad for interchangeability, but very good for ultimate hi-fi. The increasingly tight requirements for top quality sound (not necessarily at super prices, either) are encroaching on this interchangeability precisely as the same requirements finally put the old interchangeable needle out of the running. That was a very fine convenience! But it's gone, and no regrets in this department.

And so today one buys, increasingly, an arm-and-cartridge combination, the two designed for each other. The idea hasn't got very far in the changer department yet, but it will, I am sure. When arm-and-cartridge changer equipment finally gives up the old large-size head, we will, at last, see a *really* hi-fi type of changer with only a minimum of compromise in audio quality.

I don't see any reason why the changer —given really progressive, forward-looking redesigning—can't come back into its own as a hi-fi piece of equipment. In fact, while I'm at it, I had better say quickly that I feel there is a tremendous need for a line of competitive changers of wholly new design that will recapture some of the enormous business that has gone by default, so to speak, to the makers of separate manual tables and separate high-quality arms and cartridges. The price differential has been for a long time increasingly cockeyed here. I've had, time and again, to explain to neophytes that you can get a changer and a good magnetic cartridge complete and ready-to-play for fifty or sixty dollars—but you must pay even more than that for most manual-play tables alone, plus as much again for the arm and the cartridge that are to go with it. Why does a manual system cost more than an automatic, they ask? Matter of quality and of the goals in view.

My envisioned changer line would straddle this price difference and bring the changer into the hi-fi running, at a higher cost. But I insist that it can *only* be done properly by abandoning the old large-size cartridge head and arm and beginning all over again with the new smaller arms *and* tiny cartridges to match, and from there on out making use of every bit of the enormous mechanical advantage that should result from the greatly lessened weights and masses involved.

The trouble with the standard changers is the classic difficulty that has always beset audio equipment—they are too crude, too big, too heavy, relatively too unrefined in mechanical action. They are inherently non-hi-fi, in spite of the ingenuity in their mechanical make-up. With a really light arm and a tiny cartridge the whole changer mechanism might be revamped on a lighter, more delicate, tinier scale, and there should be no reason to anticipate less than a revolutionary improvement in sheer hi-fi performance, when the engineering has been completed.

An easy job of development? H---no! It's undoubtedly underway already in many areas, but the revolution I speak of will have to be so thorough—straight down to the last mechanical drive component—that progress is bound to be slow, if sure. For if you begin with a tiny cartridge, operating at a gram or two, mounted in a tiny head on the end of a really slim arm that is beautifully damped to match, you must go straight on to a new and delicate lifting and dropping device—quite possible under these new circumstances. And from there you work backwards until, maybe, you end up with a wholly new motor that doesn't have to work so hard, but must produce a lot less rumble and shake into the bargain. And from thence you must reconsider, while you're busy, the whole table system to make it match the new potentialities—a heavier, steadier table of course, with much lower rumble-flutter in the all-over. (That is, you must adapt your table to the standards now current in home hi-fi manual tables.) And having got this far, you will also consider a "compromise" in arm size that will allow for a better, longer arm, more nearly approaching the excellence of the independent hi-fi arms now being sold. Why not?

More expensive? Of course. But this new changer is to be a true hi-fi changer, to go right along with the presently large-selling hi-fi manual equipment. That stuff already costs plenty, and it sells. If people understood that the new changer was *not* a compromise but a high-standard item that really could compete with manual equipment, then they'd buy it quick-like.

The only real trouble I see is linguistic. Since *all* changers and *all* turntables are already hi-fi by name and admit to nothing but superlatives, somebody will have to do some tall finagling with the English language to get over the idea that the new-type changer is *really* different. Not merely super-terrifically-ultra hi-fi, but actually even better than that, honestly, cross-you-heart, truly, utterly great.

Well, I'm lucky I'm not a copy writer. I don't have to figure *that* problem out.

Shure Fire

All of which leads up to an item that was instrumental in provoking these thoughts on small cartridges and matching arms, a new Shure arm-and-cartridge, not yet announced as of this writing (long before publication date), which I've had in a pre-production sample for a good while. It's the Shure Studio Dynetic, and you won't be able to miss it, if only because of the top-bracket price.

On the basis of a good deal of home use so far, I'd say it was worth it. The Shure pickup is by no means the only new combination in this quality category and I also have a Pickering Unipoise combo on hand—the very first arm, to my knowledge, where the cartridge is actually a physical part of the arm itself. That, I might point out to Pickering, is an item which should be made a noise about. But chronologically I got hold of the Shure first and so will treat it here, in chronological order of acquisition.

The Shure arm-and-cartridge is a long, thin straight arrow of a device, reminding me vaguely of the dart effect on the sides of Chrysler cars. It is less than an inch wide at the rear and tapers to a quarter of an inch, roughly, with the cartridge itself a tiny little offset end-piece mounted on a separate spring-loaded hinge effect. The arm doesn't go up and down; only the tiny cartridge tip moves vertically, and the movement is controlled by a push button which lifts the point when you push it down.

Now there are some tricky things right here. Oddly, this arm takes over the principle that Pickering used in its larger separate arm but has not used in the new lightweight Unipoise, due mainly to a different concept of suspension. I had my doubts about the original Pickering arm. People dragged the needle across the record mercilessly by grabbing the arm itself instead of the "nose" or head. And the magnetic arm-rest was risky in that the pickup head often bounced off it and screetched across the record. Sure, it didn't happen if you were careful. But who's careful? Nobody, except maybe, you.

Now this merely shows that fundamental over-all design changes can carry along unsuspected fringe benefits of varying importance—it's not really vital, but it's worth noting that (a) the Shure cartridge is so light and small that if you do drag the point over the record no harm is done, either to cartridge or disc, and (b) the arm is light enough so that it will not bounce off the magnetic arm rest. I tried to make it bounce and could not. It sticks. Incidental, but interesting.

As to the Shure in action, I can only say that among the small number of top-flight arm cartridge combinations this new Shure miniature must "surely" take a very secure place. The sound is just plain superb. I wouldn't be able to compare it directly by ear to its immediate peers in this class—they are all so superbly good in sound that differences are minute and for all but very expert ears quite undetectable. This cartridge's music is as smooth as silk and natural to a fantastic degree. So, I might add, is the newer Fairchild 225 (I reviewed the 220 awhile back) which is also in the top bracket, and so by my experience is the ESL and, via an as yet short sampling, the Pickering Unipoise. So, too, with the Weathers FM cartridge . . . I could go on and on. As a group these highly refined top-bracket pickups are—for a price—something once heard you just gotta have. No, they don't eliminate the more modestly priced cartridges by any means, for the law of diminishing returns operates here with a vengeance. You can't beat the GE cartridge for sheer sound value, excellent quality at a very low cost; but you can't beat Shure *et al.* for sheer sound, if the small but crucial difference is worth the cash to you.

The Shure tracks easily and faultlessly at one gram or two. It rides the inner grooves with unparalleled luxury. The arm is uniquely damped at the rear with a rubbery-mounted counterweight and you can stamp on the floor and it won't skip—at one gram. It is a long arm but not unduly in the way, without knobbly projections; the screws in its mounting base are neatly hidden below a black panel disc. A jewel bearing allows wonderfully free sidewise movement, the light weight minimizes the danger in accidental collisions and the like. The tiny head, like a baby turtle's, moves up and down on its mount only a very short distance. You can operate it directly with your finger end, but the approved method is via the pushbutton on top of the arm, which does the lifting.

My only moderate complaint, applying to all these new light arms and tiny cartridges, is that I find it surprisingly difficult to avoid loud blops and squawks when I move the stylus onto or off the record. The fact that no harm is done is important, of course—but it doesn't help the nerves nor salve the jangled ears! This is not a criticism of Shure, but simply a factual observation that has to do with all very lightweight arms. The trouble is that though you can refine the arm and cartridge indefinitely, you can't refine the human finger system. It's getting now, in this type of equipment, so the human mechanism (like the changer) is simply too crude and coarse for the delicate motions needed.

The Shure arm tends to stick to your fingers, so to speak. You put it down and it practically comes back up again with your hand. The pushbutton is a good solution of the problem but not, in my experience so far, ideal. Maybe I'll get used to it. But I haven't as yet been able to start or stop the music without at least a bit of a squawk each time. Such finesse! Even the very slight downhill inward slope at the raised edge of the new LP's is enough to cause a bit of unexpected skittering as you lower the point. Guess I'm just a nervous type and maybe my hands would shake if I lit a cigarette, anyhow.

I must say, in advance, that Pickering's large finger-loop holder, curving up above the Unipoise arm, is for me somewhat easier to manage, though it is less compact in a design sense. The trouble with the pushbutton idea is that you push *down* to raise the point *up*, and that is somehow against nature. I find I just can't be as delicate pushing down as lifting up. Even so—this is a minor point and maybe just a quibble. But I suggest again that a revamped, new-type changer, or even a single-disc player with automatic mechanical start and stop, would be the ideal solution to this interesting new problem of arm delicacy. We haven't seen the end of this trouble yet by any means, and we won't until the human finger is eliminated altogether as a starter and stopper.

The Shure pickup has an interesting stylus point, measuring 0.7 mil, which could well end up as a new standard for LP and 45 reproduction with light arms. Why 0.7 mils? Note that if you halve the point radius you *quadruple* the effective point pressure. Thus a standard-size car-

tridge weighing the regulation 6 to 8 grams equipped with a half-mil (half-size) stylus tip suddenly equals, in pressure on the LP groove, 24 to 32 grams with the conventional 1-mil stylus! For this reason, half-mil needles are to be used WITH CARE. No nickels on the cartridge, please. And *only* an arm like the Pickering Unipoise is safe for the half-mil point.

On the other hand, the Shure 0.7 mil merely doubles the effective point pressure, more or less. In the Shure pickup the maximum possible weight adjustment (without nickels and pennies on top) is only 2 grams. Double this and you still have the equivalent of merely 4 grams, which is roughly the same pressure as a standard GE cartridge. Good idea, and 0.7 mils does help reproduce the finer wobbles in hi-fi LP recording, especially in the inner grooves where curves begin to get pinched and violent, and the 1-mil standard tip has trouble in cornering.

Afterthought: The Shure cartridge head is so small that you can't put a nickel or a penny on top of it. There isn't room. Just as well, my friends. I've seen too many nickels on top of entirely too many cartridges in my recent hi-fi years. Everybody does it.

How Much Amplifier Power?

I gather that a storm has been raging in many a hi-fi letter column anent the amount of wattage that is desirable in home hi-fi installations. Well, ever since I got my AR-1 speaker system I've been wondering just how much wattage *I* could use. As you'll remember, the AR-1 is about the most inefficient speaker system on sale. It converts only about 1 per cent of the energy it receives into sound. The biggest Klipsch systems, at the opposite extreme, are said to get from 30 to 50 per cent efficiency! Now this ain't necessarily a disadvantage. Power comes quite reasonably these days in amplifier cost. But how much power do you need to make an AR-1 play loudly enough to please you—and you, and you?

First, it is absurd to talk about needed power without taking two major technical aspects into account. One is, of course, the efficiency of the speaker system to be used. The ratio of difference, as you see, can be as great as 50 to 1. Who's trying to decide on needed power without including the speaker? The other aspect is the room situation. Have you ever tried a tiny portable radio first in a closet, bathroom, foyer, then in a large auditorium? You can scarcely believe that the output power is the same. In one place it is loud, in another scarcely audible and a mere pipsqueak at full volume. So you must judge your room too, as to size and as to its absorbing powers.

We'll say no more about a third little matter—personal taste. *It* has, in my experience a ratio of about 10,000 to 1 in preference. Are YOU going to try to set up an arbitrary amount of power to suit all listeners? I'm not.

And so it remains for me to report on my own ear findings, in a relative and comparative way. Take the AR-1 as low-efficiency standard. If you can drive the AR-1, you can drive anything.

(Must I interpolate here my favorite popular fallacy—that most people think a big speaker needs much more power than a little one, like gas for a big truck and a scooter. How wrong they are! Big speakers are generally far more efficient than little ones and so need *less* power, not more.)

10 watts. The AR-1 people do not recommend less than about 30 watts for their speaker. I find that with a ten-watt amplifier the AR-1 will play at a comfortable low volume in an average living room. But the slightest extra push in the music, or loudness via your volume control, and the amplifier—not the speaker—goes fuzzy. If you play mostly quite low to medium music, 10 watts'll do it.

20 watts. With 20 watts, I find listening at home to the AR-1 is *musically* quite satisfactory for 95 per cent of all material. By this I mean deliberately to exclude what is commonly called hi-fi listening, or whomping it up. Modest souls who merely like music don't usually whomp it up very much in the hi-fi sense. 20 watts in an AR-1 will take care of all but, maybe, the Bach Great Fugue in G Minor on a big organ. That sort of thing will break up the amplifier and the AR-1 sound will go fuzzy and blast. (The amplifier blasts, *not* the speaker.)

65 watts. Well, finally I couldn't stand my curiosity and so I asked for and have been lent a gorgeous hunk of 65 watts from Fairchild. This lovely basic amplifier is power-mad, and it has speaker damping controls too. It can make a bass reflex boom box sound more or less like a horn-loaded outfit. (But the damping control has virtually no effect on the AR-1, except to increase bass volume a bit. The AR-1 is pretty well damped down already for a fare-thee-well.)

The Fairchild is an imposing bit of amplifier gadgetry—in case you're thinking of acquiring 65 hi-fi watts. It weighs so much that the first time you pick it up you're likely to sprawl in a heap in sheer astonishment. It tips sidewise on you, too. When you turn it on, the house lights go dim a bit. A solid burst of heavy current, all right! And there are explicit warnings not to plug in speaker and input connections with the power on. Something might blow up. This is merely the inevitable, when you buy a lot of power in a package of this sort.

Now, first, with 65 watts, well, the AR-1 still can break it up and blast. Still, it is the amplifier that blasts, *not* the speaker that is overloaded. Yes, I can overdrive this 65-watt hook-up any time I want, and far short of full volume on the volume control, too. But, may I say, the sound that comes out at the blasting-point with 65 watts shouldn't be heard in any house without earplugs. It's deafening. In a lecture hall, a small auditorium twenty times the size of a living room, I found that the maximum 65-watt AR-1 output short of blasting was enough to make people cover their ears.

However, there is an important further point. At *lower levels,* ordinary listening levels, the extra capacity of the 65-watt amplifier, plus the big transformer, made a clear and noticeable difference in the musical sound, with sharper, cleaner bass and a more transparent texture than in the case of the 20-watt amplifier previously tried. How much of this was due merely to better components in a more expensive amplifier and how much a matter of sheer power reserve I don't know. But common sense suggests that the extra power does help whenever a sharp or sudden transient sound or a heavy bass passage comes along.

100 watts. Ed Villchur, AR-1 designer, says (you try it) that the speaker will take 100 watts without damage of any sort. Also the JansZen tweeter often associated with it. If you want to blow the roof off cleanly with neat transients slicing straight through the shingles, by all means go out and buy 100 watts. But you'll have to replace all your windows

if you open things up, not to mention that blown-off roof.

My recommendation? With the inefficient AR-1 system, low-level listening is fine at 10 watts, medium-level but without loud hi-fi playing at 20 watts. With 30 watts you have enough to get a good deal of hi-fi bang and whang if you want it, but not anything deafening. It'll blast if you push that hard.

I would say that for any reasonable, sensible, intelligent hi-fi listening at home, 50 watts ought to be plenty of reserve.

And if you want the mostest and can pay out—and don't mind burning up juice—then go for the Fairchild 65 watt and others in the same category.

If you have large spaces to fill, a really big living room, and/or lots of absorbent padding, then up the ante all the way along by 15 or 20 watts. You might even try 100.

Last word: I continue to use the 20-watt amplifier for convenient everyday listening, with AR-1. I honestly find it OK for *musical* listening in a smallish living room of rather live acoustics. But when I get the Fairchild hooked up, every so often, I invariably enjoy it. And I find myself playing everything louder. •

COMING EVENTS

June 6–7—First Annual Conference on Production Techniques, IRE PGPT, Willard Hotel, Washington, D. C.

June 17–19—First National Meeting, IRE PGMIL, Park Hotel, Washington, D. C.

August 20–23—WESCON (Western Electronic Show and Convention) sponsored by the 7th Region of I.R.E. and the West Coast Electronic Manufacturers Association. Cow Palace and Fairmount Hotel, San Francisco, Calif.

Aug. 28–Sept. 7—National Radio & Television Exhibition, Earls Court, London, England.

Sept. 18–21—Chicago High Fidelity Show, presented by the Institute of High Fidelity Manufacturers. Morrison Hotel, Chicago, Ill.

Oct. 7–9—National Electronics Conference, Sherman Hotel, Chicago, Ill. For information about exhibits, write J. S. Powers, Nat'l Elec. Conf., 84 E. Randolph St., Chicago 1, Ill.

Oct. 9–12—New York High Fidelity Show, presented by the Institute of High Fidelity Manufacturers. N. Y. Trade Show Bldg., New York City.

Oct. 16–18—I.R.E. Canadian Convention, Toronto, Canada. For information, write George Sinclair, 70 Sheffield St., North Park P.O., Ontario, Canada.

Oct. 24–26—Fifty-fourth Meeting, Acoustical Society of America, Ann Arbor, Michigan. Chairman, Julian Frederick.

Nov. 8-10—Puerto Rico Hi-Fi Show, Normandie Hotel, San Juan, Puerto Rico.

LONDON LETTER

(from page 12)

latest deck is push-button controlled and has an admirable tape measuring device.

Other companies who showed stereophonic tape reproducers included H.M.V. Spectone, Brenell and Beam-Echo.

An E. M. I. new production is their TR-51 Tape Recorder. This is claimed to be a professional model and certainly has an ambitious specification. Basically, however, the deck seems to be very similar to the model E. M. I. have put on the market for many years. Although two versions are available, providing from 15 and 7½ ips or 7½ and 3¾ ips, they are single track machines. The decks have been modified recently to accommodate 8¼" reels and are fitted with a drum type numerical indicator. This deck, however, incorporates one feature which may be considered to be a disadvantage insofar that the tape is wound on the right reel in the same direction as it comes off the left reel. The rewind time of 2½ minutes on a 7" reel of standard tape also seems to be excessive.

There was a trend to provide for 8¼ inch reels on tape decks and among manufacturers now having this facility available were Brenell, E. M. I., Ferrograph and Vortexion.

Record Changers and Transcription Motors

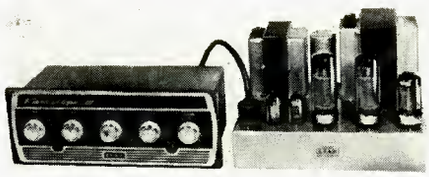
Of the vast output of British made record changers, a considerable proportion are distributed throughout the U. S. A. and thus any new developments are bound to be of interest to readers of the Journal. Collaro were exhibiting their new Challenger Model, which is probably the lowest priced record changer ever manufactured. This simple design is most ingenious and it will undoubtedly be widely used throughout the world for the less expensive phonograph reproducers.

Garrard were showing at both Exhibitions models of some of the lines which have been seen previously. The majority of firms demonstrating amplifiers and loudspeakers at the Audio Fair were using the Garrard Model 301 Transcription Motor as the source for playing demonstration records. This motor has now been adopted as standard by the British Broadcasting Corporation and many other overseas Broadcasting Authorities. Even E. M. I., who have not previously acknowledged that they have used a motor not of their own manufacture, showed a Garrard 301 in their new Model 3053 Console playing desk.

It will be remembered that the three speeds of the Model 301 are adjustable by approximately plus and minus 2½ per cent. Garrard have now produced a moving coil pick-up with a special arm providing a quality of performance comparable with the transcription motor.

Among the new Garrard lines shown were inexpensive four-speed single record players. Garrard Record Changers exhibited at the Show are already too well-known in the U. S. A. market to warrant description.

So many amplifiers were on show that it is difficult to refer to them all. Lustraphone, previously well-known for their microphones, were showing their all transistor amplifier and all-transistor public address equipment. Mullard were demonstrating circuits embodying transistors. Champion, Pilot, and R. G. D. are radio manufacturers who, having commenced to manufacture high fidelity equipment, were exhibiting for the first time. E. K. Cole (through their subsidiary company Dynatron), Decca, Pamphonic, and Pye were

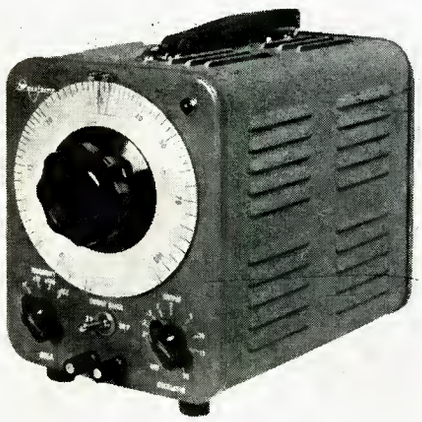


other well-known British radio and television manufacturers who were demonstrating their amplifiers and allied equipment. Chapman, Dulci, E. A. R., Grampian, Lowther, R. C. A., Sound Sales, Tannoy, Thermonic, Vortexion and Whiteley were other specialists in high fidelity equipment who were demonstrating amplifiers and tuner units, practically all the latter now being FM.

The new Leak amplifiers, exhibited for the first time at the Show, because of their wide distribution in the U. S. A., will be of particular interest to readers of AUDIO. Harold Leak, with an eye to overseas markets, has had one of Britain's leading industrial designers, Richard Lonsdale-Hands, style the new Varislope III preamplifier. The transparent moulded Diakon control panel, trimmed in gold, is likely to set a standard which will be difficult to surpass. Facilities provided by this new model, as compared with its predecessor, include a rumble filter, two switched pickup inputs and duplicated tape input and output sockets situated on the front and rear of the control panel. Two new amplifiers, at most competitive prices, were shown for use with the Varislope III. The TL/12 Plus has a 12-watt output and the TL/25 Plus has a 25-watt output. Maximum distortion of 0.1 per cent and feedback of 26 db are claimed for both amplifiers.

The enterprising Trix people showed a new idea to the British market—a packaged high fidelity outfit in two cabinets, in one of which provision is made for a record changer or transcription motor, but these items are not included in the outfit. British purchase tax is avoided by this unusual practice. The new T43 amplifier, which is already installed in the player-amplifier cabinet designed for chairside use, has an 8-watt output with a four-input selector switch. The loudspeaker cabinet is designed to fit in a corner of a room. This modest system is likely to appeal to enthusiasts with limited accommodation, particularly as the player amplifier has detachable legs which, with the use of a smaller loudspeaker, converts the system into a portable one.

Although electrostatic loudspeakers were being demonstrated by Acoustical, Goodmans, Leak, and Rola Celestion, it is still not possible to walk into a store and buy one.



G. E. C. Periphonic Speaker System

The G. E. C. Periphonic Speaker system was demonstrated to the public for the first time, it embodies several novel principles and was invented by F. H. Brittain. A fundamental factor is the use of two G. E. C. metal-cone speakers in a push-pull "periphonic" arrangement. The speakers are mounted in a V-shaped enclosure and power is applied so that the speaker cones are driven in a push-pull mode. This differential action of the diaphragms produces cancellation of any residual harmonic distortion in the cones. The result is a total 2nd + 3rd harmonic distortion content of 2.7 per cent at 40 cps with an input power of 10 watts.

The speaker assembly is mounted outside the bass reflex enclosure which is double-pipe loaded to give a flat frequency response extending well below 30 cps. The sound pressure is transferred through a narrow slot into the cabinet, which is specially designed to eliminate all structural resonances fully and to exploit the outstanding bass performance of the periphonic principle. The cabinet structure is reinforced with substantial struts and diaphragms are placed within the enclosure to break up air column resonance.

A crossover network is used—frequencies below 1000 cps being applied to the metal cone loudspeakers and above 1000 cps to a system of Presence Units. The system takes advantage of the wide arc of distribution of high frequencies associated with the Presence Unit. By the use of three sets of units installed at the front and sides of the cabinet an effect of spaciousness is given and the impression of depth produced particularly enhances orchestral works. By switching the Presence Units it is possible to vary the apparent nearness of the orchestra according to individual listening requirements and conditions.

Plessey, with a promise of deliveries commencing shortly, were demonstrating an improved version of their Ionophone—the speaker which generates sound waves by means of a glow discharge in a quartz tube. Wharfedale have now adopted plastic foam surrounds for most of their speakers and introduced at the Show was Mr. Briggs' latest creation—a reflex cabinet for his ten inch speaker. Vitavox were showing a new duplex-coaxial speaker with a replaceable low frequency cone. The Stentorian people, who make one of the widest ranges of speakers and who have pioneered in Britain the manufacture of "ready-to-assemble" cabinets, have now been joined by Grampian, who showed a kit for a reflex baffle cabinet.

Pickups and Microphones

New pick-ups were shown by Cosmocord, Decca, Garrard, Goldring, and Philips. Among new microphones probably the most pleasant, from the point of view of design, was the Simon ribbon Cadenza model, which is available in high- or low-impedance outputs.

Although A. E. Foster, an enthusiastic New Jersey AUDIO reader, had been good enough to send your correspondent, by air mail, two specially recorded stereo demonstration tapes, the crowds in the demonstration rooms were so great that by the time the four-day show closed your correspondent had given up hope of hearing them. Nearly fifty thousand enthusiasts had packed the Exhibition Hall and demonstration rooms and, like the exhibitors, he looked forward to the peace of an English garden in which to recuperate from a crowd which made the New York subway in the late afternoon seem comparatively empty.

CHARLES A. ROBERTSON*

Alonzo Levister: Manhattan Monodrama
Debut DEB125

THE COURSE OF A WORK of music which falls outside a few well-trod commercial paths is often tortuous and beset by hazards. Such is the nature of this jazz ballet and its companion pieces by a young composer with classical training, and the story of its progress to recorded form is as poignant and stark as some of its themes. In an effort to tell a little of what lies beneath the surface, I have talked to the composer, the record people and the men at the studio.

Thirty-one-year-old Alonzo Levister was born in Greenwich, Conn., and grew up in Harlem. In World War II, he served for ten months in the Navy on a submarine chaser. This enabled him to begin the study of music when twenty at the Boston Conservatory of Music on the G.I. bill. After two years, he returned to New York to work on his own for a year. With the encouragement of friends, he sailed for Paris intending to study piano with Nadia Boulanger, landing with $20. The proceeds of the sale of his piano, along with other promised sums, were supposed to be on the way to him. A vain wait compelled him to use his return-trip ticket to New York, before his tutoring had barely begun. There he learned the American Express had received the money order the day after he left. As Levister reflects now, "Perhaps it is just as well I didn't stay as the training would have been so far from what I am trying to do now. And I might have liked it enough to still be there."

He continued to compose and practiced piano, violin and French horn. A windfall from a radio quiz program enabled him to travel to California and then Mexico where he met Leonard Bernstein in Cuernavaca. This led to an examination of Levister's work and the comment on a technically-correct piano sonata of twenty minutes, "This could have been written by any one of hundreds of conservatory students." It was then that he stopped being a student and started to become a creative artist.

"I can't remember when I was first conscious of jazz and spirituals," he said. "They were always a part of my life until I began the intensive pursuit of the classical muse in an attempt to find a place in the world and impress people. I knew Bernstein was right and realized the only possible chance I had of writing music worth anything to me or anyone else was to write of what I felt, and of what I had come from."

Bernstein was teaching at Brandeis and Levister returned to the States on the prospect of a scholarship there. It developed that a general arts course would be included. With the aid of Aaron Copland and the National Academy of Arts and Letters, he switched to the Juilliard School of Music to study orchestration under Henry Brant from 1952 to 1953. This interlude he describes as "Stimulating, to say the least." It was then that *Manhattan Monodrama* was prepared for a ballet, originally titled *The Street*, by the modern dancer Donald McKayle. It was first performed on a program for Negro History Week at Phythian Temple, to be repeated later at the Brooklyn Academy of Music.

Another visit to Mexico followed and he played cocktail piano in Acapulco to support his family. "This was an attempt to live a normal life and bring my musical activities into focus," he said. "They had been taking all my time and I thought it would be better if they were made just a part of my life. It didn't work out because I have found a job in the jazz or popular field interferes with my composing. There are so many clichés and so much of the obvious that it sometimes takes weeks to get it out of my system and go back to serious work. The same is true of arranging, but there is satisfaction in doing an original like *Black Swan* for an artist such as Miles Davis. A period as accompanist of rehearsals for the Katherine Dunham group was good for the experience and discipline, but rather wearing. This included a much-needed general music course for the dancers. Personally, I am happiest working in a bookstore.

"Also I decided it was time to start pushing, after years spent in learning and writing. So it was back to New York with my wife Lucille and son Kurt, who is now three years old. For the past year I have tried to sell myself for the first time.

"Bartok is the modern composer I admire most. He assimilated the source material of Hungarian folk lore and expressed its essence on a high plane. I would like to do the same with jazz, not losing any of its native qualities in the process. One ambition is to do an American opera in the direction *Porgy and Bess* was headed. I think today it would reach a wider public than a symphony. It would be about the world I know, but I need to find a librettist first. I have completed a chamber opera based on Max Beerbohm's short story *The Happy Hypocrite*. It was started as an exercise and is not in my present vein, but I thought enough of it to put it in shape for performance.

"Of a jazz nature, I have an eighteen-minute piano concerto and a ten-minute piece for large orchestra. Now I am concentrating on pieces for a group of the size used on the record as it may be possible to obtain booking for it. As to whether it is jazz or classical music, I leave it up to the listener to decide. But I have tried not to make the error of many classical composers when dealing with jazz. They are apt to take only the most hackneyed characteristics, just as the jazz writer is likely to do a paste up job when he turns to classical forms. I consider Duke Ellington the most gifted writer in jazz. He is aided by the collective spirit of the band and the creative ideas of his instrumentalists.

"It helps to work with a static group and I would like to be able to do so for awhile. The instrumentation is set up to permit the widest choice of colors with the smallest number of performers. In most arrangements the writing for percussion is not specific and much depends on the ingenuity of the drummer. I use percussion instruments as individual lines in the musical structure, and the rhythmic variations form the keystone of the sound and my creative thinking. Everything is written and it requires intensive work for a classical man to attain the spontaneity of jazz. The choreography was set when I was asked to write the ballet. Since then I have revised and tightened it.

"Four sessions were needed and the first illustrates what I mean by the need for a compatible group. It was marked by clashes of temperament and blew up. The conductor never did return, and the original cellist Jackson Wiley, a Juilliard graduate now with the New York City Center orchestra, took over that post. Gunther Schuler referred me to Lorin Bernsohn, a concert cellist who has appeared at Town Hall, and I persuaded him to join us. The second date was spoiled on the technical side, both costing $300 just for the musicians at union scale."

An effort was made to interest the larger companies in issuing the record. One wanted the ballet only, another offered a flat fee with no royalties and a third turned it down with the explanation, "We are at a loss as to where to put it in our catalogue and our distributors won't know what to call it." Finally it was placed in the hands of Debut Records, a company for which Levister had done arranging. It it run by the well-known bass player and composer Charles Mingus, and his wife Celia. They were present at the premiere as Mingus was also on the program. The possibility of recording it for the newly formed company was discussed then as, in the words of Mrs. Mingus, "We are always looking for new talent and new works.

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

They are the stock-in-trade of the small label. But we even like it when someone who started with us moves on to bigger things. This is one of our most ambitious projects and we like the way it finally turned out."

Like many of the struggling independents, Debut has no studio or technical equipment. It schedules time in various studios around Broadway and the pitfalls of this procedure can be numerous. The last two sessions were handled by Audiosonic Recording Company in the Brill Building, where its three studios keep busy all day and part of the night.

For this side of the picture there is the authority of its thirty-one-year-old president, Bob Guy. He started out in radio fourteen years ago in his hometown of Cedar Rapids, Iowa, and has been a producer for stations in Green Bay, Wisconsin, Bristol, Va., and Newark, N. J., before taking on his present job three and a half years ago. "This is a highly competitive field," he said. "The independent studio has no income from the sale of records to take up the slack. Consequently technical advances are made by the engineering specialists and big companies and gradually filter down to us. It takes experience and ingenuity to try to match their sound without their resources.

"We have to give the customers what they want. Too often the blame for gimmicks and sound enhanced to the point of distortion is placed with the studio and engineers. Mostly it belongs with the artist and repertoire men in their search for something new and different. When we are left to our own devices, we prefer to make an honest, straightforward recording. The artists are asked to set up in the way most comfortable for them. Then the mikes are placed without altering this any more than necessary. A balance and level are set and the controls aren't touched again. Close, multimiking is used in the studios, but for a chorus of two hundred in Steinway Hall a single Altec condenser mike was used.

"Frequently our last part in production is the completed tape. This is satisfactory when it is meant for radio broadcast as is much of our work. We do programs for Benton and Bowles, The American Chemical Company, and Cunningham and Walsh. But records can be ruined in the mastering and pressing. Our engineer Fred Vargas is kept busy with maintenance, but he managed to design and complete an amplifier for Grampian Feedback Cutter Heads to be used for the first time on the Levister master. He is a twenty-seven-year-old graduate of the Massachusetts Institute of Technology and worked for three years on the REL tuner before coming to us.

"This is Broadway," he continued, "and the standards are pretty much those of the popular field. Around here we like what Capitol does and use its best efforts as checkpoints. They are comparatively high, as anyone familiar with the rest of the field knows. Our mastering equipment was constructed with this kind of sound in mind. Other labels we have done work for are Transition, Prestige, Star, Jubilee, M-G-M and ABC-Paramount. Of course, anyone can go to the custom department of one of the big companies and get the whole job done down to the finished pressing. But

there is a great desire for secrecy about some dates, and we are cheaper.

"When Debut came to us with the Levister project it was out of the general run and presented somewhat of a challenge. We determined to make a special effort on the sound, especially when we heard two dates had ended badly. For the most part the shorter numbers were made in our studio and the ballet across the street at Carroll Drum Studios. There a larger room gave the musicians more space in which to work. Because of the close-milking the difference between them is virtually indetectable. I think the dead studio sound is well suited. A large hall might help the tympani, but not the cello. At best percussion on discs is a compromise with the live sound. Of any of a number of ways to record it, someone is going to prefer another." He said in conclusion, "we are content to keep it clean, clear and in balance."

The six players are evenly divided between jazz and classical, with Jackson Wiley, the conductor, throwing the balance in favor of the latter. The composer is at the piano, Lorin Bernsohn is cellist and Morris Lang, a Juilliard graduate now with the New York Philharmonic, is tympanist. Louis Mucci, trumpet, was with Claude Thornhill and now works mostly in studios. John LaPorta, alto and clarinet, and Teddy Charles, vibraphone and percussion, are well-known jazzmen of the modern school. Percussion instruments used include xylophone, big bass drum, triangle, tambourine, cymbals, and gong.

Each of the three movements of the ballet is a short descriptive sketch of the action set on a New York street. But this music does not require visual realization to express the mood of a small corner of the big city. The cello is an almost constant voice, giving utterance in turn to a pungent sadness, a biting anger, or haunting humor. It is this dry, taut writing for strings that should be heard more often when they are employed in a jazz group, though some of its intensity might be lost in a large section. Bernsohn does a memorable job, both in bowed passages against the kettledrums alone and in plucked, percussive statements.

In the first scene outside a candy store, a trumpet is effective in a travesty of the blare of a juke-box with a growling figure, rich in vibrato but unjazzlike in the theme. The more creative ideas are given to the cello and rhythm, and these instruments carry the weight of the performance. Levister frequently uses the piano for percussive accents, and in the final section draws a crippled janitor by representing his walk in uneven alterations of 4/4 and 5/4 tempos.

Five short pieces, also bound to memories of the metropolis, are represented on the reverse side. Here Mucci and La Porta are given greater opportunities and some space to improvise in *Conclave, Slow Dance* and *Leap Frog. Sugar Hill Strut* is a part of *Suite Negra,* written for Walter Nix, formerly one of the principal dancers with Katherine Dunham. The graceful *Black Swan* is an impression of Miles Davis and Mucci paints a firm portrait.

On the liner Levister describes his music as, "A mixture of equal love for Blues, Bartok, Bach, and Baptist shouting. It is an attempt to translate into music emotions felt while growing up in Harlem, or standing on a corner wondering why a bus didn't stop, or feeling ten feet tall. Or standing on some other corner, in some other time and place—too full of unwanted things at four in the morning, feeling the things a person feels standing on a corner at four in the morning with no place to go that he wants to go." I think he has succeeded well enough to warrant a considered hearing. Knowing its history, it is a record I will return to repeatedly. As for the sound, the same procedures followed a year or so ago would probably have ended poorly. The result does not equal what is being done by the specialists and some big companies, but it is clean and the tympani are distinct, showing that standards along Broadway are improving in some areas.

Thelonious Monk: Brilliant Corners
Riverside RLP12-226

After releasing two albums of Thelonious Monk at work with trio instrumentation on standard tunes, if Duke Ellington can be called standard, Riverside reveals the method in its planning: "a plot to seduce non-followers of Monk into giving him a hearing." The test of this theory is in the four originals on this disc as his unorthodox construction and approach make a demand for the undivided attention of the listener.

That this sort of handling should also help a non-conformist develop and broaden as an artist is a happy, though unforeseeable, incident. The assurance of a carefully prepared outlet for his creative talent seems to have resulted in almost a spiritual rebirth for this molder of modern jazz. It is one of his most important records, representing a maturity and security he could not feel before. And it was Monk who suggested a change of pace with his moody piano solo of *I Surrender Dear.*

Brilliant Corners finds him at his most challenging, and *Blue Bolivar Blues* has room for inventive solos by Sonny Rollins, tenor sax, and Ernie Henry, whose work on alto justifies this label's faith in him. On the balladic *Pannonica,* Monk uses a celeste to good effect. A definitive *Bemsha Swing* has Clark Terry, trumpet, replacing Henry, and Paul Chambers substituting for Oscar Pettiford on bass. Here Max Roach uses tympani as well as drums for added excitement and depth of tonal color. It is extremely effective and kept in balance by engineer Jack Higgins for some of the best sound from kettledrums on a jazz side.

Monk is one of the few pianists of any period who knows what not to play, and he seems to have entered on a new era of growth as a composer. Riverside's planning is beginning to bear fruit.

Thomas Talbert: Bix Duke Fats
Atlantic 1250

A thirty-one-year-old composer and arranger from Minneapolis, Thomas Talbert puts the stamp of the modernist on the writings of three jazz greats. All are revered in their original form by jazz musicians and fans so he is treading on dangerous ground. That he succeeds so well is the result of a varied approach and wise choice of soloists.

Bix Beiderbecke is met on his own terms. *Candlelights, In a Mist,* and *In the Dark* are broadened and given depth by fresh instrumentation. The brunt of the interpretation is borne by the sure trumpet of Joe Wilder. I think Bix would like it.

Fats Waller is examined for his wit and humor. Much of it is extracted by pianist George Wallington, a modernist who might seem an odd choice until he is heard in *Black and Blue, Keepin' Out of Mischief, Clothes Line Ballet,* and *Bond Street,* which is the first American recording of any part of the *London Suite.* I think Fats would be inspired to take the second chorus.

Duke Ellington is treated most freely, but he is around to speak for himself. Eleven men are used on *Prelude to a Kiss, Do Nothin',*

and *Koko*. Talbert, a protege of Budd Schulberg who has engaged him to write the music for his fall play *Disenchanted*, adds one original, *Green Night & Orange Bright*, a tribute to Bix and Fats.

Hans Koller Quintet: Hans Across the Sea
Vanguard VRS8509

Progressive jazz from Vienna is offered by five of the most accommplished jazzmen of Central Europe as it might be presented at the Hot Club Vienna when the spirit of improvisation flows freely. Hans Koller is a Viennese who has headed bands since 1947, and in 1954 won the German *Jazz Echo* poll as "musician of the year" for his work as leader and tenor saxophonist. Wili Sanner, baritone sax, hails from Cologne and Rudi Schring, drums, from Frankfurt. John Fischer, bass, is also from Vienna as is pianist Dr. Roland Kovac, a Ph. D. in Musicology.

Kovac started on piano at the age of six and toured with the Vienna Boys Choir. A position as permanent arranger for radio station RIAS helped support him while he earned his degree. Now twenty-nine, he has been occupied with jazz along with his classical studies since the age of sixteen. He claims credit for the polyphonic texture of the creative ideas on the disc. As he describes it on the liner, "Polyphony means the development of all the voices from a single voice, from the thematic material of the first few bars . . . Each melody must be written so as to sound just as good played backward or forward." Whether this means there will be a backward and forward school in modern jazz, as well as cool, contrapuntal, fugal, vertical, etc., remains to be seen.

His inventions are all musical, but no more original or exciting than those on this side of the Atlantic over the past few years. *Iris* and *You'd Be So Nice To Come Home To* are examples of his polyphonic writing. *Heinzelmannchen*, depicting a German folk character, was written with Koller and is a witty, rollicking bit. The ballads *April in Paris*, *Laura*, and *Thou Swell* are well handled. Good sound, on a level below that achieved by Vanguard in this country.

J. R. Monterose **Blue Note 1536**

In the swing era this capable tenorman would probably have found a spot as featured soloist in a big band before this stage in his development. He started out with Henry Busse seven years ago and then moved on to Buddy Rich and Claude Thornhill. Such activities were limited to short stretches as the emphasis on section work and curtailed solos of the modern big band sent him back to freelancing with small groups. So thirty-year-old Frank Anthony Monterose, Jr., with his prefixed nickname in the correct place, has sifted out his style and parlayed an early admiration for Coleman Hawkins and Chu Berry into an assimilation of Rollins and Sonny Stitt, before making a bid for the attention of the record-buying public.

He is heated and forceful with an ability to build consecutive choruses of growing intensity as shown in the three he takes on *Wee-Jay*, his exercise on the chord changes of *Out of Nowhere*. His other tunes are *Bobbie Pin*, with a Latin-rhythm twist, and the fast-moving *Marc V*. Monterose is a justification in reverse of the present practice of rushing newcomers on the jazz scene into the studio. In his case it would be valuable to have more early examples of his work preserved. Though his style is hot and extroverted, there is structural evidence that he has listened to the more progressive men of the cool school. The next time around he may show a more relaxed and moody side.

Two recent arrivals from Chicago, Ira Sullivan, trumpet, and Wilbur Ware, bass, are members of the reorganized Jazz Messengers. They are allied with the drums of Philly Joe Jones and the piano of Horace Silver to complete the quintet. Sullivan grew up in a musical household and plays virtually every instrument, though he has been limiting himself to tenor and trumpet, and has fine form and phrasing in vigorous solos. An excellent rhythm section, both for stimulus and contrast, and Jones is responsible for *Ka-Link*, a title taken from the cymbal beat setting it

in motion. *The Third* is a Donald Byrd number and Paul Chambers sent along the smooth-flowing *Beauteous.*

Zoot Sims Quintet: Zoot!
Riverside RLP12-228

Arranger George Handy scores four melodies by his wife, the singer Flo Handy, and joins the quintet at the piano in one of his rare efforts with a small unit. Known mostly for his modern big band writing, here he restricts himself to refreshing changes on the voicing of the two horns, adding the riches of form without limiting the space for improvisation. *Echos of You,* based on an idea seemingly too trite for consideration, is carried off so well that it is a highpoint of the album, another being Sims' benignly virile tenor on *Taking a Chance on Love.*

Sims also shows his skill on alto in *Swim, Jim* and *Osmosis,* an original by drummer Osie Johnson, who with Wilbur Ware, bass, makes up the bracing rhythm section. Nick Travis, trumpet, complements Sims well in the ensembles and is given more opportunity than usual to solo on his own. A varied program, in fine sound, from the kicking *Here and Now* to the ballad *Fools Rush In.*

Rolf Kuhn Quartet: Streamline
Vanguard VRS8510

When Benny Goodman and Artie Shaw made the clarinet king of jazz instruments, aspiring youngsters were quick to take up its study, though in most cases they subsided into the sax section. Now it is in such a decline that more young flutists attempt to carve a career than new clarinetists. So the appearance of a European virtuoso with a respectable tone and technique is worth noting with more than cursory attention.

Twenty-eight-year-old Rolf Kuhn is an importation from Germany. He began studying the piano at nine, took up the clarinet at twelve, had made his solo debut at seventeen and was on the way to becoming one of the best known jazz clarinetists in Europe. In May of 1956, he entered the United States under the wing of John Hammond and was signed by Willard Alexander. A quartet was formed to spotlight him in club and concert dates, including the Birdland Tour of 1957, and this record prepared to introduce him to a wider audience.

Four of the ten tunes are Kuhn originals, including the up-tempo title tune, and display his technical prowess. His purity of tone is shown on the ballads *Laura, Love Is Here to Stay, Street of Dreams,* and *I Remember You.* Ronnell Bright, a young Chicago pianist with some Juilliard training is given his first opportunity for extended playing on discs and contributes the pulsing *Bright Pace.* Bill Clark, former drummer of the Shearing Quintet, is well equipped for this type of ensemble as is bassist Joe Benjamin. The recording leaves little to be desired in the way of realistic sound.

Kuhn is in the position of many European stars on their arrival in this country. He has all the ability needed to fit into the jazz scene, but his associations and the ideas he assimilates in the next year or so will do much to determine his future direction. It is wishful thinking to speculate on what a guitarist of the calibre of Charley Christian could do to mold Kuhn and the quartet. But there are other competent men who could add another voice to the group and make it less a showcase and more a unified group. Kenny Burrell, who recently took over the guitar chair with Benny Goodman, is one example.

Marion McPartland Trio **Capitol T785**

In this exemplary album, Marion McPartland reaches a point in her perception of the piano that makes for universal appeal. Her creative force digs deep enough to satisfy the more advanced listener, particularly as she is supported by the pulsing accents of Joe Morello, drums, and the flowing lines of bassist William Britto. But she never becomes so involved as to depart from the spirit of a number, and her knack for climactic surprise will please the middle-of-the-road fan. Finally, there is a tasteful, feminine warmth to draw the plaudits of the mood music crowd.

Those who have heard the McPartland piano only on noisy, badly-balanced radio broadcasts may have misjudged her assets. They are considerable when detailed in the fine over-all sound alloted the trio as it runs through *Stomping at the Savoy, Hallelujah,* and *Carioca.* Among the ten selections are a Britto original *The Baron,* and Oscar Pettiford's *Bohemia After Dark.*

Jackie Gleason: For the Love Hours
Capitol W816

Cees Verschoor: Dutch Sax
Capitol T10061

Just how many jazz admirers of Bobby Hackett follow him in his controlled flights with Jackie Gleason and assembled strings will never be determined, but millions of people have liked his mellow cornet in this setting. He gives his usual polished reading to sixteen more or less familiar standards, including *Poor Butterfly, Just One More Chance,* and *Lover Come Back to Me.*

Those millions who believe the phonograph made for the mood music of a skilled soloist and sumptuous strings will also like the silky alto saxophone of the virtuoso Cees Verschoor with thirty violins, led by Dolf van der Linden, conductor of the studio orchestra broadcasting daily over the Netherlands government station. He is the Holland version of a group of European altos who absorbed the influence of Benny Carter and suited it to their own temperament. Of a dozen pieces, six are by Duke Ellington, and the others show the effect of his writing on young composer Vernon White.

Stanley Stern and a crew of E.M.I. engineers set up their equipment in a large, old church in Hilversum to produce some of the finest sound yet given mood music. It will be released in thirty-one nations and is available in the Capitol of the World series. Indications are that the classical side of E.M.I. will continue to be issued by Angel, while Capitol will catalogue the popular and semi-popular in increasing numbers.

This Could Lead to Love
Riverside RLP12-808

The reissue of four songs from Barbara Lea's first album has led to a $150,000 law suit against Riverside. Whether it will be carried beyond the publicity releases to a court hearing is a matter for conjecture. Supported by pianist Billy Taylor and the trumpet of Johnny Windhurst, she is heard in Willard Robison's *A Woman Alone with the Blues* and other tunes which gained her a devoted following. Also reissued are four Tony Burrello piano solos. Mundell Lowe's guitar provides the new portion in four romantic numbers, backed by Jack Greenberg, English horn, and George Duvivier, bass, at their most sensitive.

Rafael Molero: Fiesta en Espana
Audio Fidelity AFLP1819

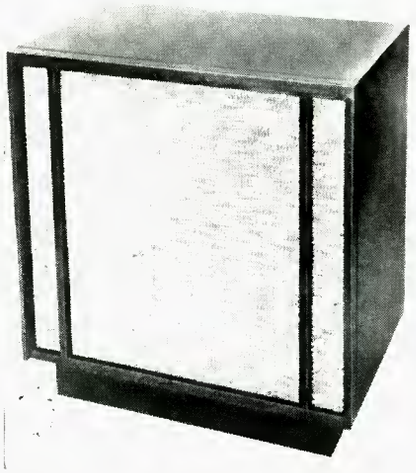
Designed to present the variety and color of the art of flamenco at its most festive, a rounded program of a dozen numbers is offered by Rafael Molero as he accompanies two singers, a dancer with castanets, and demonstrates his ability on his own as soloist. Taught and encouraged by his father, Malagueno Andaluz, he is recognized as an ascendant exponent of the Spanish guitar, though still a comparatively youthful member of a profession requiring years to master.

Dancer Alberto Salieru shows an uninhibited feel for rhythmic design in *Alegrias* and *Zapateado Tanguillo,* and is heard with castanets in *Sevillanas* and *Por Soleares.* The singer Esperanza La Macarena conveys the abject despair of the mournful *Elegia a Manolete* and the more vibrant *Dolores La Petenera,* named for a famous flamenco artiste. Her voice holds the fire of emotion in an almost white tone, in contrast to some of the more earthy gypsy vocalists. Paco de Jaen employs the nasal male tone peculiar to the form in *Por Alegrias, Fandango,* and *For Seguirias.* The solos are the lively *Farruca* and *Ojos Verdes.*

The guitar is recorded well-forward with voices, heel clicks and foot stomping in good balance. •

NEW PRODUCTS

● **Pilot Hi-Fi Phono Console.** Built around the new Model AA900 Williamson-type amplifier as its heart, and incorporating a unique 3-way speaker system, the PT-1028 is the newest in the Ensemble series of hi-fi consoles manufactured by Pilot Radio Corporation, 37-06 36th St., Long Island City 1, N. Y. The speaker system design is based on three separate speakers, each of which is in its own enclosure for acoustic isolation. The record changer is



the Garrard Model RC121 equipped with a GE cartridge and diamond stylus for microgroove recordings. A newly-developed automatic shut-off control governs both the record changer and amplifier, although the amplifier may be used independently when desired. A 3-position selector switch permits use of internal speakers, external speakers, or both simultaneously. Concealed silent castors are furnished as standard equipment to facilitate moving the instrument without lifting. **F-9**

● **Racon Crossover Network.** Developed for use in either 2- or 3-way speaker systems, the Racon Model COX-4M provides crossover points of 300, 600, 1200, and 5000 cps. It is of the half-section type, with attenuation of 12 db per octave. Selection of the various crossover frequencies is made by

strapping terminals as shown by data stenciled on the terminal panel and incorporated in a detailed instruction sheet which is included with every network. Free literature will be supplied by Racon Electric Co., Inc., 1261 Broadway, New York 1, N. Y. **F-10**

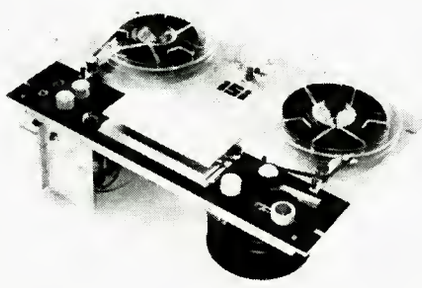
● **Easy-to-Assemble 50-Watt Amplifier Kit.** Only 90 minutes or less is required to assemble the new PERI-50 amplifier kit which utilizes a deep-etched photo-electronic circuit board which replaces wiring and forms the complete base of the amplifier. The kit is not only complete as to all components, including tubes, but even provides the necessary solder and soldering iron. No special tools are required. Pre-engineering of the circuit board virtually assures every builder that he will duplicate the laboratory model. Using a Dynaco output transformer, the PERI-50 has a power output rating of 50 watts continuous. Intermodulation is less than 1 per cent at 50 watts, less than 0.25 per cent at 35 watts and under 0.125 per cent at 10 watts. Frequency response is flat ±1 db from 20 to 25,000 cps and harmonic distortion is under 0.1 per cent at full rated output. The manufacturer offers a free

illustrated brochure showing the complete unit and supplying full specifications and operating characteristics. Write Printed Electronic Research, Inc., 4212 Lankershim Blvd., North Hollywood, Calif. **F-11**

● **Improved Garrard Model T.** Many improvements over the original Garrard Model T. manual turntable are inherent in the new Mark II "Crest," a 4-speed unit featuring unusual operating simplicity and durability. Compact in size, the player provides all the basic record-reproducing features of the latest Garrard changers, and was developed for the growing number of hi-fi systems in the low- and moderate-budget groups. It is designed to provide

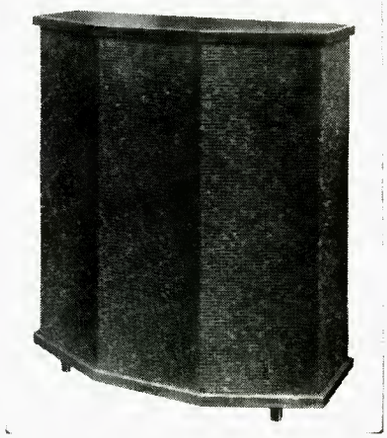
quiet, trouble-free performance from one complete turntable-and-tone-arm assembly. By eliminating automatic record changing features, it has been possible to incorporate in the Model T Mk II such major advances as the Garrard 4-pole shaded induction surge motor and the new belt-free True-Turret drive, at the same time holding the unit in the same price category as the former Model T. The new player starts with a simple movement of the tone arm and shuts off automatically at the end of the record. Complete information may be obtained by writing Dept. K-23, Garrard Sales Corp., 80 Shore Road, Port Washington, N. Y. **F-12**

● **I S I Tape Recorder.** This is the first tape recorder to incorporate a transport mechanism which utilizes a magnetic-differential clutch-and-brake system in place of the conventional friction clutch and brake. The mechanism has been designed to operate for life without adjustment. Use of a mechanical servo-feedback



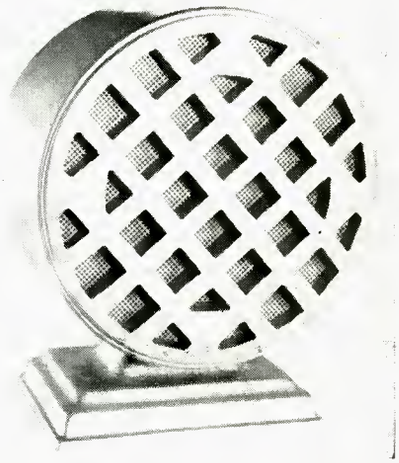
system with magnetic differential applies the correct torque to the supply and take-up spindles, maintaining constant tape tension and stability, whether in play-record position or in fast forward or rewind, eliminating the tendency to spill, stretch or break tape. The system provides continuously variable speeds for ease of editing. The I S I recorder incorporates a 2-speed synchronous hysteresis motor and is available with either 3¾–7½ or 7½–15 ips recording speeds. Positions for six heads permit any combination the user desires. Half-track heads are standard. Ten-inch reel adapter, VU meter, and stereo playback kit are available as accessories. Address inquiries for further information to International Scientific Industries Corporation, 15 Ellis Road, Weston, Mass. **F-13**

● **Weathers Speaker System.** Called the Barrington, this new speaker system is capable of filling an auditorium without overloading the drive units, yet will provide comfortable home volume with as little as 0.1 watt audio input. Consisting of 12 moving-coil speakers, the Barrington is unique in a number of respects. Among



its features are the Weathers "radial damping" back-wave control, a new multiple-octave crossover, and a new type of cone edge treatment which improves performance in the middle register. Impedance is 4 ohms, power handling capacity is 60 watts, and frequency range is 15 to 20,000 cps. Dimensions are 47½"h × 40½"w × 15½"d. Complete specifications may be obtained by writing Weathers Industries, 66 E. Gloucester Pike, Barrington, N. J. **F-14**

● **Prison Speaker Baffle.** A rugged cast aluminum bi-directional speaker baffle especially designed for use in prisons and other correctional institutions, has been added to the intercom equipment line of Lowell Manufacturing Company, 3030 Laclede



Station Road, St. Louis 17, Mo. Built to withstand virtually all possible abuse, the Model BRLK baffle is 11 in. in diameter, weighs 2 lbs. and accommodates 8-in. speakers. It mounts to ceiling or wall. **F-15**

NEW LITERATURE

• **Rek-O-Kut Co., Inc.,** 38-01 Queens Blvd., Long Island City 1, N. Y., will mail upon written request a handsome new 8-page booklet titled "Turntable or Record Changer: Which Shall I Buy?" Included in the publication is a series of facts concerning many elements of record reproduction. Graphically illustrated, this Rek-O-Kut brochure is a striking example of effective salesmanship in print. **F-1**

• **Semiconductor Division, Radio Receptor Co., Inc.,** 240 Wythe Ave., Brooklyn 11, N. Y. gives all specifications of the Siemens dwarf, a 5-ma d.c. half-wave rectifier which will handle up to 125 v.a.c. with a resistive load, in Bulletin No. 242 which is available upon request. The dwarf rectifier, made in West Germany by the Siemens Company, is about one-quarter the length of an ordinary paper clip and weighs but 0.015 oz. **F-2**

• **California Chassis Company,** 5445 E. Century Blvd., Lynwood, Calif., lists more than 400 different models, styles and sizes of its products in Catalog No. 357, a 20 page 2-color publication which is now being distributed. Among new CalChassis models are six amplifier foundations. Other items illustrated range from full-size cabinet racks to miniature housings for 2-in. meters. **F-3**

• **Stahlin Brothers, Inc.,** 226 Maple St., Belding, Mich., outlines new raceway techniques for wiring of electrical and electronic equipment in an informative 8-page bulletin which has just been released. Bulletin S-301 describes methods for simplifying wiring operations from the drafting room to the assembly floor by use of raceways and pre-cut wires. The bulletin is a worthwhile reference aid for anyone concerned with equipment or panel wiring. Copy will be mailed free upon written request. **F-4**

• **Panoramic Radio Products, Inc.,** 10 S. Second Ave., Mt. Vernon, N. Y., lists all of the company's standard instruments, plus some significant new equipment, in a new catalog digest which has just been published. Instruments are grouped by type and application. Panoramic's broad range of waveform analyzers is broken down into subsonic, sonic, and ultrasonic groups, with accessory equipment for each group also illustrated and described. A brief history of the company's background is given, and illustrated for the first time is the new Panoramic plant which will be ready for occupancy in the near future. Available upon request. **F-5**

• **Alpha Wire Corp.,** 200 Varick St., New York 14, N. Y., in a new 2-color 4-page Catalog T-1, describes all the engineering characteristics of its Altemp "Teflon" high-temperature insulated hook-up wire which uniquely suit it for high-frequency, miniaturizing, weatherizing and ruggedizing applications. Both the extruded and spiral-wrapped insulation types are detailed as to conductor sizes, conductor strands, insulation thickness, voltage rating, outside diameter and stock colors. A free copy of Catalog T-1 will be mailed on request. **F-6**

• **S.O.S. Cinema Supply Corp.,** 6331 Hollywood Blvd., Hollywood 28, Calif., announces availability of the "S.O.S. Bookshelf," a compilation of almost 100 different volumes, said to be the largest listing of technical books ever offered in the motion picture and television industries. Everyone interested in professional film making, whether theatrical, non-theatrical, TV, commercial, or industrial, can broaden his knowledge by acquiring some of these books. Listing of the titles in the S.O.S. Bookshelf will be mailed free upon written request. **F-7**

RECORDS

(from page 31)

time, in every piece, turn purple in the face with utter inspiration!

We expect that sort of thing too often, thanks to over-zealous publicity. We should be pleased to get what is more trustworthy nine times out of ten, a performance like this. I recommend it. Fine sound, too.

Beethoven. Symphony #6. N. Y. Philharmonic, Szell. **Columbia ML 5057.**

While I'm at it, this one from last year was tried for size by Scout #1 and described in terms not unlike the above. "Good, serviceable, but not particularly distinguished" playing. This time I got curious and went out and listened to a good slice of the disc myself, just to check.

Well . . . he's right, but so am I, as of the review immediately above. Nope, this isn't a fabulous Beethoven 6th, and it does have a rather firm, unyielding beat, not overly "plastic." But I enjoyed it even so. Once more, this is the expert product of a very skilled team and it decidedly by-passes a good many difficulties in this work that have caused other versions to fall flat, even with famous conductors. Routine perhaps, in a good sense, but, definitely, not bad. Not bad at all. Give it a whirl.

Choral Masterpieces from the Russian Liturgy. Male Choir, All Saints Church, Worcester, Mass., Wm. Self. **Classic CE 1022.**

Well, I can't overlook Scout #1's perfervid account of this item, from that highly un-Russian provincial city, Worcester. "About as Russian . . . as a singing commercial," he says. "Earnest, exhaustively rehearsed, massively inflexible, enthusiastically inexpressive. . . . This choir should stick to " 'Nearer My God to Thee.' "

I can only add that it really takes Russian-style voices trained in the Russian tradition to sing such music right—whether it's the Don Cossacks or the Russian Cathedral Choir of Paris. A choir of our own local church members is asking for trouble when it puts down this sort of music in permanent recorded form, for all to hear.

Cambridge Treasury of English Prose. 1836-93: Dickens to Butler. (Vol. 5) **Caedmon TC 1058.**

Scout #2, who is an ardent reader of 19th century English literature, is crazy about this. His only complaint, a rather violent one, is that he can't stand the sampling and wants MORE of each. Recorded in Cambridge, England, at the University, this is the fifth of a series, read "in great style with humor and feeling." The British do things like that so wonderfully well! There are parts of the *Pickwick Papers, Vanity Fair, Tess of the D'Urbervilles, Treasure Island*, and the like, plus essays by Ruskin, Pater, Matthew Arnold . . . an excellent cross-section and an ultra-easy way to slide pleasantly into the literary world. Nothing like a good reading.

Poems of Shelley. Read by Vincent Price. **Caedmon TC 1059.**

If the Caedmon girls sparkle when they read the above appraisal, they'll wince at this one. Caedmon, I should explain, has done a truly noble and intelligent job picking good actor-readers to produce the sound tracks for authors and poets not alive to read their own stuff. I admire the Caedmon genius for finding the right big name to fit each kind of literature. *Almost* every kind. . . .

For I tried this one out on both Scouts and the reactions were immediate and violent. Both of them found Mr. Vincent Price thoroughly distasteful. Says Scout #1, "Mr. Price is an actor with a fulsome delivery. In plainer language, he is a ham." Says Scout #2, "He reads like a grade D movie thriller." I guess that settles Mr. Price for the moment. But don't overlook Caedmon's other actor-readers, who are often superb. •

TRANSFORMER

(*from page 23*)

When an amplifier has been built which does fulfill the specification, the sample transformer in the prototype amplifier, or one built exactly like it, is used as a basis for obtaining quotations from transformer manufacturers and is further used as a basis for quality or type testing, to see that batches of transformers conform to the original specification, within acceptable limits.

This is not an economic way to approach the design of either the output transformer or the amplifier. As has been pointed out in earlier articles, there should be liaison between the two to enable an optimum transformer design to be worked out for the particular type of amplifier in mind.

Where the transformer and amplifier are made under the same roof, closer cooperation is possible. Very often, in companies that have both facilities combined, the design for the transformer, in the form of winding data, is prepared by the amplifier design engineer and sent to the winding shop for a sample to be made. In this way a variety of samples can be tried until an optimum design is achieved, with the minimum loss of time. When a satisfactory design is achieved, it is measured for electrical performance, and standards of test are established for the transformer production test department.

Why couldn't we use a similar procedure when working between an amplifier manufacturer and a transformer manufacturer not under the same management? A few transformer manufacturers are amenable to some arrangement such as this. But a successful method of collaboration has to be worked out.

A winding specification, even though it ties down closely wire gauge, thickness of insulation, and all the other details is not too satisfactory a standard for acceptance and rejection of transformers. The only available way to prove that a transformer does or does not meet its winding specification involves destruction of the transformer, either by stripping it down and counting the turns off, or by cutting the winding open and counting the turns in cross section. There is no non-destructive way of determining that the transformer complies with the specification.

For this reason the electrical specification is to be preferred as a protection to both the parties involved. Another reason why the electrical specification is to be preferred is that different trans-

former manufacturers may use different construction methods. So specification of a given lamination size and quality, method of winding and mixing the windings, etc., according to a procedure adopted by one manufacturer, may not be considered an acceptable process for a second manufacturer.

The important thing, of course, is that he shall be able to duplicate the *electrical* specification. Then the transformer will work equally well, whether it is wound in exactly the same fashion or not. A procedure that has worked in several instances to the writer's knowledge is for the amplifier manufacturer to write an electrical specification based either on a practical transformer that works in the amplifier, or an a critical analysis of the amplifier's requirements, or on both. With the electrical specification he also provides a suggested winding specification which will produce a transformer that conforms to the electrical specification if followed carefully and accurately.

This leaves the transformer manufacturer the option. If he chooses he can follow closely the recommended method of winding and he will be able to produce a transformer that complies with the electrical specification. Or, if he finds this method of winding arduous for his particular setup, he can modify the arrangement in any way that suits him, provided the result still complies with the electrical specification laid down.

This method of working will also take care of deviations that may be desirable from time to time—whether it is permissible, for example, to switch wire gauges due to temporary shortage of a certain gauge. This can be determined readily by examination of the winding specification with the electrical specification, to see whether an alternative gauge can be satisfactorily wound, on the one hand, and whether it will produce a transformer that meets specification for efficiency and winding resistance, on the other hand.

In an urgent case it may be considered acceptable to deteriorate the efficiency of the transformer by 1 or 2 per cent to obtain transformers in a hurry. But this method of specification will act as a precaution against *progessive* deterioration due to a succession of deviations, such as have a tendency to occur using the method of operations outlined earlier, and which is all too common. •

IMPEDANCE TRANSFORMATION

(*from page 24*)

case but will serve to illustrate the point of discussion.

Table 1 gives the actual results obtained from measurements made with this setup. The value of the variable load resistor was changed between 2 and 5 ohms. It is recommended that the power rating of the load resistor be at least four times the audio signal power output to avoid heating which will cause unwanted resistance variations. The experimenter may wish to make these tests with other power outputs as required for the output circuit in which he is interested. Power output will be equal to E^2/R, where R is the value of the load resistor and E the signal voltage across this load.

TABLE I

R_L ohms	E* volts	W E^2/R	$Z_p = N^2 \times Z_s$ ohms	D % Distortion
2.0	1.42	1	3500	0.7
2.5	1.58	1	4375	0.5
3.0	1.74	1	5250	0.48
3.5	1.87	1	6125	0.49
4.0	2.0	1	7000	0.52
4.5	2.12	1	7875	0.56
5.0	2.24	1	8750	0.58

* E values were rounded off

In *Fig.* 3 a separate vacuum-tube volt-

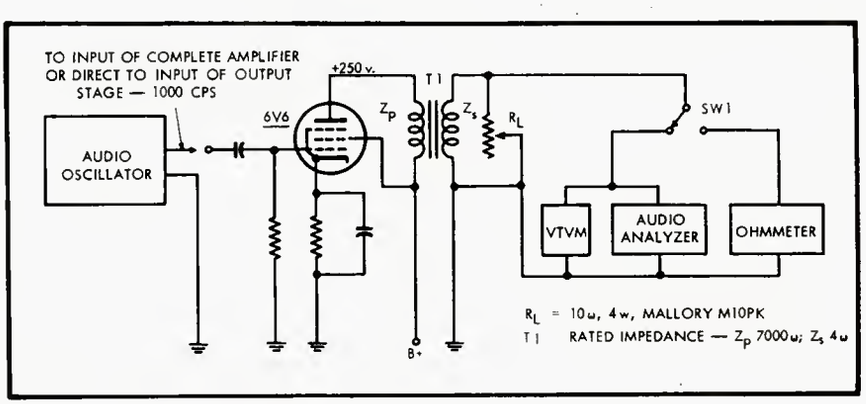


Fig. 3. Schematic of test setup shown in Fig. 1.

meter is indicated; however, an audio analyzer is customarily equipped to measure rms voltages and therefore a separate v.t.v.m. may not be required, it being only necessary to close SW_1 and set the analyzer controls for output voltage measurements, then resetting the switch for distortion tests.

With each value of load resistance the magnitude of the signal voltage was adjusted to obtain the same power output, which in the tests described was 1 watt. A distortion reading was then taken for each load-resistor setting. Using the equation given previously, that is $Z_p = (N_p/N_s)^2 \times Z_s$, the various values of "reflected" primary impedance with changing load impedance were arrived at as given in the Table. Note that as Z_p approaches the recommended value of 5000 ohms, the distortion percentage reaches a minimum, rising as Z_p increases or decreases from the optimum value. The same reasoning, of course, applies to push-pull output stages as well.

The audio constructor will realize from the foregoing discussion that it is not always necessary to purchase a transformer with the exact listed primary impedance as recommended for a tube with certain operating conditions. Frequently the load impedance he wishes to use will present the correct "reflected" impedance to the output stage he desires to employ and transformers already on hand could be put to use. With an audio distortion analyzer he can observe when optimum operating conditions have been established. •

AUDITORY PERSPECTIVE

(*from page 19*)

the loud speakers on the stage of Constitution Hall in Washington. So realistic was the effect that to the audience the act seemed to be taking place on the stage before them. Not only were the sounds of sawing, hammering and talking faithfully reproduced, but the correct auditory perspective enabled the listeners to place each sound in its proper position, and to follow the movements of the actors by their footsteps and voices.

For another demonstration, the audience heard a soprano sing "Coming Through the Rye" as she walked back and forth through an imaginary rye field on the stage in Philadelphia. Here again her voice was reproduced in Washington with such exact auditory perspective that the singer appeared to be strolling on the stage of Constitution Hall.

An experiment which demonstrated both the complete fidelity of reproduction and the effect of auditory perspec-

tive was performed by two trumpet players. One, in Philadelphia at the left of the stage of Constitution Hall but and reproduced in such true perspective of the stage of the Academy of Music, invisible to the audience, alternately played a few phrases of the same selection. To those in the audience there seemed to be a trumpet player at each side of the stage before them. It was not until after the stage was lighted that they realized that only one of the trumpet players was there in person. The music of the other was transmitted from Philadelphia with such perfect fidelity and the other in Washington at the right that it was impossible to tell that one of the players was absent.

The auditory perspective effect is not restricted to placing sounds in their correct positions across the stage, but is three dimensional. This was shown by having several sources of sound moved around the stage in Philadelphia, not only back and forth but high up in the center of the stage as well. The movement of each sound was faithfully reproduced by the loud speakers in Washington even when the sounds were carried high above the level of the stage floor.

To show the volume range possible with the new equipment, the orchestra played a selection at a constant level of loudness while the output of the loud speakers was varied from a level so low that the instruments could scarcely be heard, up to a loudness almost great enough to be painful. Throughout the whole range, the reproduction was faithful in all respects except the level of loudness; there was no distortion or noise to mar the perfection of the reproduction, and the wide range in volume was vividly impressed on the audience.

The effect of limiting the range in pitch, or frequency, was illustrated by employing electric filters to cut out one octave at a time—first from the upper end of the range and then from the lower. The new apparatus reproduces faithfully about 9 octaves or from 35 to 16,000 cycles, compared to about six for ordinary radio reproduction. By this demonstration the audience had the opportunity of judging the importance of the complete range to the full aesthetic appeal of music, and of comparing it with the more limited ranges ordinarily heard.

The technical features of these new developments, which were carried on as part of the research program of the American Telephone and Telegraph Company, were disclosed for the first time by Dr. F. B. Jewett, Vice President of the American Telephone and Telegraph Company in charge of development and research, at a meeting of the National Academy of Sciences on Tues-

day afternoon of April 25. In discussing the future of the new system, Dr. Jewett said:

"As to the future of the accomplishment shown here today, it is difficult to make any definite prediction. What we have done is to produce pickup microphones, amplifiers, electrical filters, transmission lines and loud-speaking reproducers so perfect that the entire frequency and volume range of the most exacting orchestral and vocal music can be reproduced at a distance without impairment of quality. We have also worked out the arrangements by which substantially perfect auditory perspective is possible. This latter is an essential part of the problem if realistic illusion as to the physical arrangement of the component parts of an orchestra is desired.

"We can place at the disposal of the musical director instrumentalities which will enable him to produce at a distant point, or at many distant points simultaneously, a completely faithful replica of the tonal effects produced locally in the auditorium on the stage of which the orchestra is performing. Likewise, portions of this same equipment place at his disposal the means of very greatly extending the range of orchestral reproduction and of making possible artistic effects hitherto unattainable.

"With these instrumentalities available, the questions of the manner and extent of their use are primarily questions for the musician and those interested in music rather than for the physicist and the engineer. Our job has been to produce a set of tools. The musicians and musical directors, and back of them the musical composers, must determine just how these tools can best be used and what they can best produce. By its very nature the ensemble of what we have created is primarily of value for musical production or reproduction in halls, theatres or auditoriums. In a word, its field of applicability is where a large number of people might congregate for the common enjoyment of music of distinction. In its present form it is not directly applicable to the limited environment of the home.

"These new tools offer not only an enlarged field of possibility to the musician and the composer for the production of auditory effects, but likewise a great broadening of the audience which derives pleasure from such effects. Many people, especially in our smaller cities, are now deprived of the ability to hear good orchestral music by the factors of cost and distance, and the element of time in going to the cities where orchestral music is normally produced. What we as physicists and engineers have done is to provide a mechanism for obviating these factors. Whether the results justify our hopes is for others to say." •

ADVERTISING INDEX

SIMPLE AS A B C

To make it just as easy as possible for AUDIO's readers to subscribe, order books, get further information about the new products and the new literature mentioned in the pages of the magazine, or to get catalog sheets and brochures describing articles advertised, we provide herewith three cards. We know that many readers are loath to cut coupons from the pages of their favorite magazine because they have told us so. And we know that many times one would like to have complete and thorough data about something he sees in these pages, yet he considers it too much trouble to hunt up paper and envelope—not to mention the stamp—and write a long letter detailing what he wants to know. This is just as simple as we know how to make it with the exception of stenciling each subscriber's name and address on each of the postcards—an operation which would be highly impractical from the printing standpoint. But from now on, when you want more information about something you have seen advertised or mentioned in AUDIO you need only indicate it on the appropriate card, print your name and address, and drop it in the nearest postbox. We pay the postage, and it goes without saying that we wouldn't include these cards if we didn't welcome your use of them. And, for the first time, you can enter your subscription without sending a penny with your order—we'll bill you later. For books, we'll have to ask for the money in advance, but only for books.

Readers have told us that they often want to know more about some of the items mentioned in the *New Products* and *New Literature* pages of the magazine, but that they do not want to take the time and effort to write to each one of the sources individually to get all the information they need. As a matter of fact, in an average issue there are usually ten items in the *New Literature* column, and between ten and fifteen on the *New Products* pages. It is conceivable that the average reader might want information on at least ten of these items, since they are selected with the interests of most of AUDIO's readers in mind. Thus one would have to have ten envelopes, ten sheets of paper, and ten three-cent stamps, together with the need for writing the ten letters and inscribing each with name and address. We do it all for you, assuming that you are willing to circle the items about which more information is desired and to write your name and address once. We will forward your inquiries to the organization involved, and you will receive the data you want with only one inquiry. Isn't that as simple as A B C?

In just the same way you can get more information about any product that is *advertised* in the pages of AUDIO. Note the page on which the advertisement appears and circle it on the back side of this card. When there are two or more ads on the same page, the page number is followed by a letter, and the designation appears under each individual advertisement. Write your name and address clearly—someone has to decipher it—and it is a good idea to mark the card for all the information you want the first time, for there is only one card in each copy of the magazine. Of course, you *could* subscribe to two copies.

Audio, P. O. Box 629, Mineola, N. Y.

GENTLEMEN:
PLEASE ENTER MY SUBSCRIPTION TO **AUDIO**

FOR:

1 YEAR - $4 ☐ (FOREIGN - $5)
2 YEARS - $7 ☐ (FOREIGN - $10)
LIFE - $50 ☐ U.S.A. ONLY
BILL ME ☐ PAYMENT ENCLOSED ☐
CHECK ☐ MONEY ORDER ☐

F

FOR OFFICE USE

NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

CUT APART ON DASHED LINES

No Postage Stamp Necessary If Mailed in the United States

BUSINESS REPLY CARD
First Class Permit No. 142, Mineola, N. Y.

AUDIO
P. O. Box 629
Mineola, N. Y.

Postage Will be Paid by Addressee

Postage Will be Paid by Addressee

BUSINESS REPLY CARD

First Class Permit No. 142, Mineola, N. Y.

AUDIO

P. O. Box 629

Mineola, N. Y.

No Postage Stamp Necessary If Mailed in the United States

BOOK ORDER

Please send me the books checked below, postage paid. I enclose check ☐ money order ☐ for $ in full payment.

Tape Recorders and Tape Recording
Harold D. Weiler
☐ Paper Cover, $2.95
☐ Board Cover, $3.95

☐ **the 3rd Audio Anthology**
Board cover, $3.50

☐ **the 3rd Audio Anthology**
Paper cover, $2.50.

☐ **Handbook of Sound Reproduction**
$6.50

☐ **AUDIO—Bound Volumes—1956 issues**
$10.00 (In U. S. only)

NAME _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

To start receiving **Audio** monthly without any effort on your part to locate one on the newsstands or at your jobber's, mark the appropriate boxes with crosses, tear out the card, and drop it into a handy postbox. If you are one of those who always pays in advance, we will accept your check or money order—we do not recommend cash to be sent through the mails—enclose the card in an envelope, and mail. This will cost you an extra three cents, so if you wait until we send you a bill, we'll enclose a business reply envelope for your convenience. We try to make it as easy for you as we know how.

NAME _____

ADDRESS _____

CITY _____ ZONE ____ STATE _____

AUDIO — Please send me further information about the coded items circled below and about those advertised on the circled pages of the June issue.

(PLEASE DO NOT USE THIS CARD AFTER OCTOBER 1, 1957)

F-1	F-9	F-17	C-2	4	15	33	43	52a	55e
F-2	F-10	F-18	C-3	5	16	34	44	52b	55f
F-3	F-11	F-19	C-4	6	25	35	45	53	55g
F-4	F-12	F-20	SB	7-9	27	36	46	55a	55h
F-5	F-13	F-21		10	29	37	47	55b	56a
F-6	F-14	F-22	1	11	30	38	49	55c	56b
F-7	F-15	F-23	2	12	31	39	50	55d	56c
F-8	F-16	F-24	3	13	32	40-41	51		

NOW IT IS EASIER — ONLY ONE CARD

is necessary to get more information about any New Product or New Literature item, or about any product advertised in these pages.

At the end of each item of **New Literature, New Products,** or **Equipment Reports** you will notice a letter and a number—the letter indicates the month and the number indicates which item it is. All you have to do to get full information about the product or to get the literature described is to circle the appropriate number, add your name and address and mail it to us. We'll do the rest, and you may be sure that we'll be prompt because we are just as anxious for your inquiries to get to their destination as you are—and besides, we don't have room enough around the office to accumulate a lot of cards. Circle one item, if you wish, or all of them—we'll carry on from there. This whole system breaks down if there is a charge for the **New Literature** described, so if you can suggest any improvements in this service, we would appreciate hearing about them.

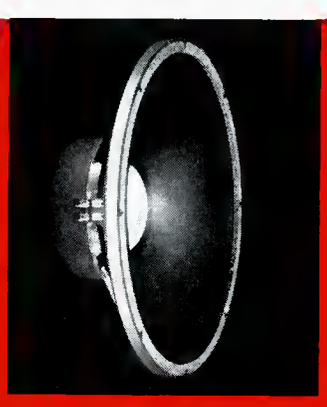
To get more information about the products that are advertised in each issue of AUDIO—use the new card at the left. Fill in your name and address clearly and circle the number of the page on which the advertisement appears. When there are two or more ads on a page, each one has under it a notation such as Circle 23a, Circle 48b, or Circle 76c and the same numbers appear on the card. Numbers C-2, C-3, and C-4 refer to the covers—C-2 is the inside front cover, C-3 the inside back cover, and C-4 is the outside back cover. SB is "The Sounding Board."

The only way to derive any benefit from this service is to use the card for all the information you want. We think you will find this new system more convenient and that you will use it more and more.

the only fifteen-inch extended range speaker made with a 4" voice coil

the JBL SIGNATURE D130

The four-inch voice coil in the JBL Signature D130 stiffens the speaker cone to form a rigid acoustic piston. Combined with suspension which permits long linear excursion, the D130 produces crisp, accurate bass. • The four-inch dural center dome is attached directly to the voice coil to form a large, effective high frequency radiator. The shallow curvilinear cone permits an excellent distribution of highs. • The large voice coil is made of edge-wound aluminum ribbon so that, with small mass, an unusually large amount of conductor is subjected to the lines of force in the gap of the precision-machined Alnico V magnet. • A pot structure of pure iron provides a low-reluctance return path for the magneto-motive force. Such extremely efficient use is made of the permanent magnet material that stray magnetic fields are virtually non-existent. • Tight electrical coupling and meticulous, close-tolerance workmanship combine to produce the most efficient extended range loudspeaker made anywhere. It is unsurpassed in its handling of transients. Bulletin number SB1002 describing the JBL Signature Model D130 will be sent to you free upon request.



specifications

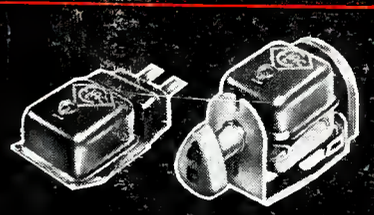
PHYSICAL DIMENSIONS • Voice coil diameter 4"
Baffle hole diameter 13½" • Shipping weight 23 lbs.

ELECTRICAL • Power input 25 Watts • Impedance 16 Ohms
Field—Permanent Alnico V Magnet
Bl factor—1.7 x 10^7 Dynes per Abampere

ACOUSTICAL • Free air cone resonance 37 cps
Frequency response, usable range, as a direct radiator, enclosed in an adequate baffle 30-17,000 cps

"JBL" means **JAMES B. LANSING SOUND, INC.** *3249 casitas avenue • los angeles 39, california*

FAR AHEAD THE FINEST BY FAR



MST-1 *Single* MST-2 *Turnover*

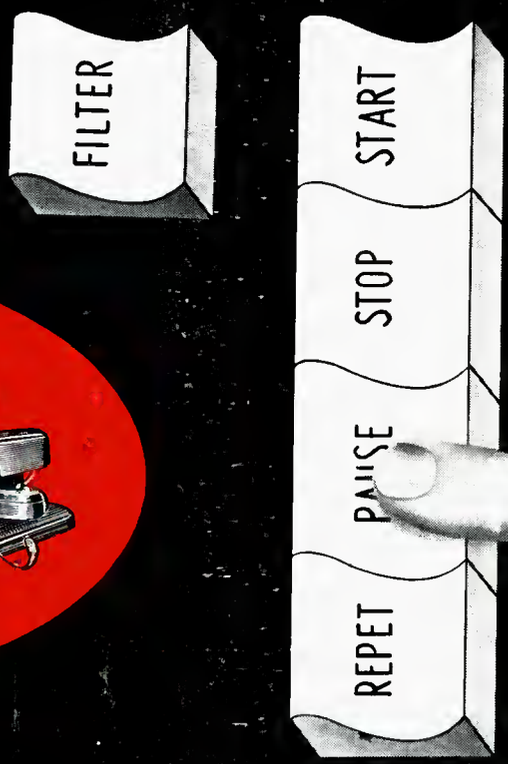
MIRATWIN *Cartridges*

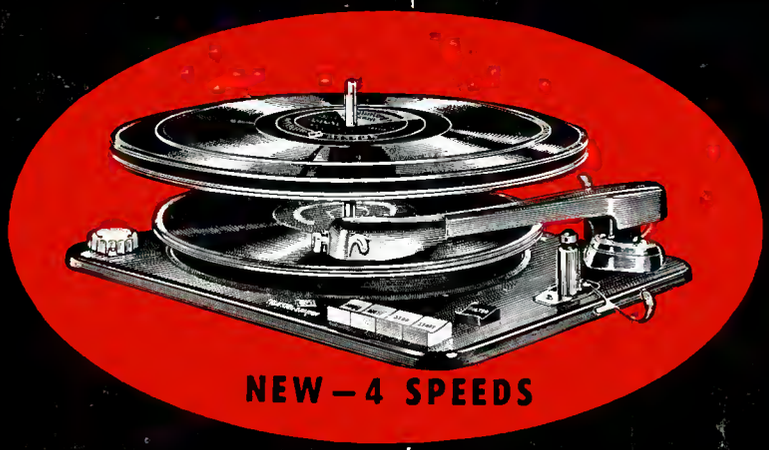
MIRAPHON XM-110A

Manual Player

in a pushbutton world . . .

This is Your Hi-Fi Life!





MIRACORD XA-100

A "2-in-1", Fully Automatic Pushbutton Record Changer and Manual Player with the Exclusive "Magic Wand" Spindle!

From start to stop pushbuttons do all the work in this new *Miracord XA-100* . . . the closest approach to full automation in record playing perfection. Performs so beautifully you will welcome the MIRACORD into *Your Hi-Fi Life!*

Complete With Plugs and Leads Attached. Ready for Operation.

$67.50 *less cartridge*

Both MIRACORD and MIRAPHON perform **all** operations at **4 speeds.**

At All Hi-Fi Dealers • Write for Complete Brochure

AUDIOGERSH CORPORATION

514 BROADWAY, NEW YORK 12, N. Y. • WORTH 6-0800

In Canada: Atlas Radio Corp., Ltd., Toronto

MEMBER INSTITUTE OF HIGH FIDELITY MANUFACTURERS, INC.