AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

MAY, 1957

50¢

TENTH ANNIVERSARY ISSUE

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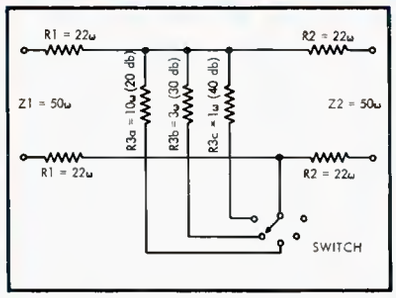

Simplification of an attenuator makes it possible to use a single-pole switch for any three desired losses. See page 46.

A transistorized remote for broadcast stations, but many of its design features apply to other applications. See page 36.

ABOVE ALL, THE EAR

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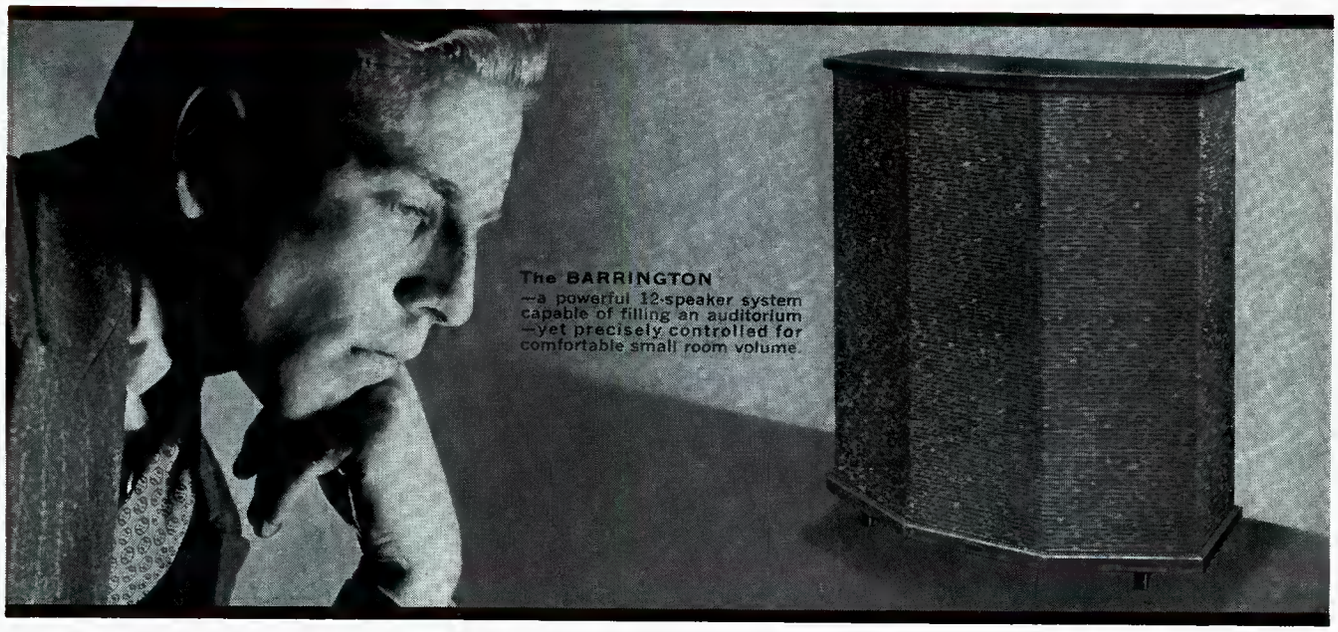

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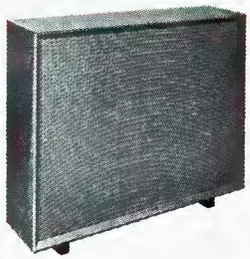

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MAY, 1957 VOL. 41, No. 5
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AUDIO

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CONTENTS

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AUDIOCLINIC??

JOSEPH GIOVANELLI*

As all readers know, this is the tenth anniversary of Audio Magazine. I have been privileged to be a regular contributor for somewhat more than a year and a half. Considering this, it seems to me that I should try to find some way for me and Audioclinic to offer help to even more readers. There are times, though, when it seems that the response to this column has been such that I seem to get letters from at least three times as many readers as there are subscribers.

To come down to earth, I believe I have found the means for giving you, the reader, a better Audioclinic. As it stands now, I answer all questions submitted to me, regardless of their suitability for use in this column. I shall continue doing this. What I have in mind is a How-To-Do-It section. If you have had difficulty in doing a particular operation, but finally did come up with a solution, let me know. If I can use your hints in this section I shall do so, with credit to whomever sends in the idea.

These ideas are typical of what I mean: How you finally prevented overheating shielded wire when soldering it into place; a method you developed for simple assembly of speaker or equipment cabinets; or perhaps something along this line. In conjunction with Robert W. Gunderson, the author developed a means for running crystal mikes over long lines. This came about because I had to make a recording under conditions where the mike was located two hundred feet from the recorder. (At the time I did not have any low-impedance mikes.) We accomplished this by triode-connecting one of the sub-miniature hearing aid tubes so common on the bargain counter today, and wiring it as a cathode follower. From the usual vacuum tube formulas we determined the correct bias resistance for this tube. We had to figure for ourselves since no data were available for these tubes in the triode connection. The mike was mounted directly to the box containing the cathode follower, with the other end of the box attached to the microphone stand. With a 200-ft. cable we could not detect any serious degradation of high frequencies.

You can see that this How-To-Do-It section can take in almost everything. If your suggestions can be used, they will be printed in Audioclinic over your name.

Needle Talk

Q. *Quite often, while playing records, I notice an unpleasant sound coming from the speaker similar in quality to needle talk coming from the pickup. This is especially true of loud trumpet passages. How may I correct this difficulty? Harold E. Lamb, Atlanta, Georgia*

A. The trouble you describe is not at all uncommon, and it stems from two sources. The first of these is that too many discs are recorded with far too much lateral deviation. Secondly, certain cartridges do not have sufficient compliance to follow rapid, wide modulation excursions. In your particular case, it is quite likely we are seeing a combination of the two factors.

The only thing which I can recommend, short of using another cartridge, is to check the stylus. If it is worn, this type of distortion will be all the more apparent.

Power Supply Hash

Q. *I am having trouble with a power supply. This seems to have caused a 5881 in my amplifier to burn out. There doesn't seem to be much hum in the power supply. Prior to connecting the scope to the power supply, the amplifier was disconnected and the power supply was properly loaded resistively, the value being such as to cause current to be drawn equal to that taken by the amplifier. The sensitivity of my scope is 25 millivolts. When I connect it directly to the cathode of the rectifier, I must set the sensitivity at ×100, and notice a normal full-wave pattern. Moving the scope connection to the junction of the two chokes, (the supply consists of a two-section LC filter), I then need, to increase the sensitivity to ×10, at which point I still see the normal full-wave pattern. But when I connect the scope lead to the output of the filter and increase the sensitivity to ×1, I note that the pattern does not remain stationary, but jumps up and down, sometimes going right off the screen. Could you please explain to me what might be happening? All power supply components have been thoroughly tested, and are of the highest quality. Charles L. Wilson, Kansas City, Mo.*

A. First, let me say that your power supply could not in any way be responsible for the 5881 blowing out. It was either defective to begin with or was burned out because the amplifier was oscillating or because of insufficient bias. You will be glad to learn that the pattern you have observed on your scope is not at all strange. Since your scope was set at maximum sensitivity, a change of only *25 thousandths of one volt* would cause a picture to deviate an inch. Assuming that the supply delivers 400 volts, a change in line voltage of approximately 6.5 millivolts, *6.5 thousandths of one volt*, would be sufficient to cause a trace to vary one inch. The line is constantly undergoing changes of at least that much, and of course they are very rapid. These changes will cause the filter capacitors to charge up to a slightly different value, which would cause some slight fluctuation in the output. Since these are not necessarily average d.c. changes but, rather, are instantaneous, they can be translated into a picture on the scope screen.

It should also be borne in mind that, because of the proximity of the last choke in the two-section filter to the power transformer, some 60 cycle hum voltage is induced in that choke. Some of this voltage can find its way through the filter and appear at the input terminals of the scope. To prove the existence of this hum voltage, disconnect the last choke, and connect the leads directly across the scope's input terminals. You will probably find quite a bit of voltage present.

These small fluctuations in power supply output are not at all harmful, and cannot even create hum in the output of an amplifier. This is so, since the output voltage and the minute changes in it form a large ratio. These changes are not so likely to occur with a power supply whose filter components are RC, rather than LC, which probably accounts for your being able to

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

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6 Self-Neutralizing Pull-Away Idler Wheel Mount: Keeps idler perfectly round and "true"... no thump . . . no rumble. Automatically disengages in any shut-off position.

7 45 RPM Adaptor: Rests on unit plate—ready for instant use.

8 Exclusive "Finger-Form" Star Switch: Convenient, instantaneous 4-speed selector.

9 Exclusive, Sensi-matic Trip: Permits perfect operation even with tone arm set at lowest tracking pressures. Safe, gentle, quiet and positive.

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11 Genuine Rubber Turntable Traction Mat: Special tread . . . no abrasive action on record grooves.

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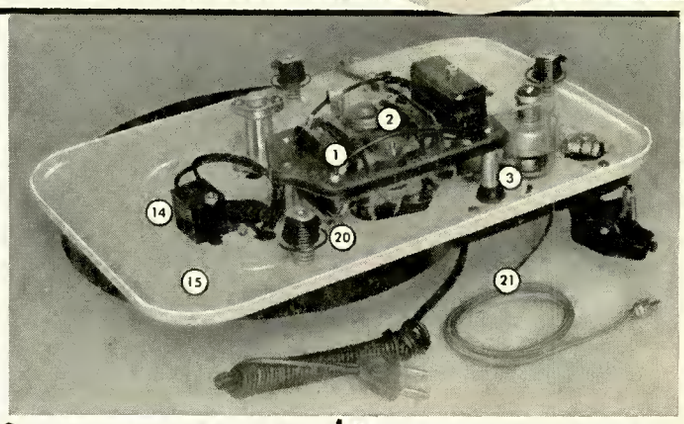
15 Heavy-Steel Unit Plate: A husky, rigid support for entire mechanism.

16 True-tangent Tone Arm of Aluminum: Provides rigidity with low mass and light weight. The finest material for this use . . . similar to professional arms. End socket pivots to permit perpendicular stylus alignment.

17 Convertible Tone Arm "Safti-Rest": Supports tone arm—ready for play . . . simple snap locks it for safety in carrying.

18 Interchangeable Plug-In Heads: Accommodate users' personal choice of magnetic, ceramic or crystal cartridges; turnover, twist or simple plug-in types.



19 Accessible Stylus Pressure Adjustment: Knurled knob on back of tone arm sets pressure instantly and maintains it . . . easy to use regardless of where player is situated in cabinet.

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Model T Mark II Manual Player $32.50

find one among all of your power supplies which does not exhibit this condition.

Head Alignment

Q. *How may I properly align the heads of my tape recorder? Nat Silvers, N.Y.C.*

A. If your machine is one of the small home models, it is likely that there is no adjustment for this, and hence nothing can be done. If the machine is one with one or two heads, proceed in the following manner. Try to secure a good alignment tape. (Do not be too surprised if you encounter two alignment tapes which yield differing results.) Run it through the machine, adjusting the alignment to obtain maximum output as noted on the machine's own VU meter, an output meter connected to the speaker terminals, or aurally as heard from a loudspeaker or headphones. If the machine is a single head model, you've done all you can, and the machine will automatically record tapes and play them back and they will be in alignment. The second head on the two-headed model is generally the erase head. The positioning of this head is not at all critical, and the chances are good that there isn't any provision for adjusting it. If poor erasure is observed, look for a worn head, or for a weak tube. If no alignment tape is available, use a high-grade recorded tape. If such a tape is used, do not align for maximum output but for maximum frequency response as noted aurally. To align a machine which has separate playback and record heads, proceed as follows: 1. Align the playback head as indicated in the section devoted to aligning single or two-head units. Make this adjustment as accurately as it can be determined. 2. Remove alignment tape and replace it with a reel of fresh tape or one whose contents are of no value. Set the machine to record, and feed in a test oscillator, tuned to 10 kc, setting the level at 15 db below zero VU. 3. Monitor the output of the playback amplifier with the machine's own VU meter, output meter or loudspeaker, and adjust *recording head* for maximum output.

If a test oscillator is not available, use the thermal noise of an FM tuner whose dial is set between stations. Proceed as above, but in this instance, listen to the output and adjust the *recording head* for maximum clarity of the hiss. Your machine is now aligned so that the recording and playback heads correspond to each other magnetically. If the playback head was not properly aligned, tapes recorded on more accurately aligned machines, when played back on yours, will sound muffled and lack sheen, the amount of degradation dependent upon the degree of misalignment of the playback head.

Table Rumble

Q. *On many records, especially when playing soft passages, I hear a sound which can be described only as a roaring. Could it be caused by voltages induced in the motor by the pickup? Would a rumble filter be of any help? Anyway, how can I fix it, since I'd rather listen to music than be roared at. Herebrt Muir, Waltham, Mass.*

A. The noise you encounter on some discs is probably caused by the cumulative effects of turntable rumble, hum pickup from the motor, and preamplifier hum, plus whatever rumble components impinged on the record at the time of recording. Your combination of components and discs would seem ideal for this. Starting with the records, I have observed hum on some recordings, low in amplitude to be sure, but can become annoying if the turntable rotates slightly slow or slightly fast. The hum on the disc will then form beatnotes with the hum which is always present in some preamplifiers. Further, some turntables are known to contain considerable rumble. From this distance it would seem that the hum picked up from the motor is probably the least serious obstacle to overcome, for, while there is little that can be done to shield the cartridge, it can be made to traverse an arc over which the hum will be at a low minimum.

Before resorting to a rumble filter, try cleaning up the hum in the preamplifier. This might be done by applying d.c. to the heaters of all tubes if they are now supplied with a.c., and by rearranging the a.c. lines and power supply components so that they are separated from the preamplifier proper. If these modifications should be of no avail, a rumble filter is the only thing left to try. These devices limit the low-frequency response of a sound system, and by so doing, reduce rumble. They are composed of RC or LC circuits, placed at the input to the preamplifier, or at some other convenient point, depending upon the manufacturer.

Reactance Formulas

Q. *What are the formulas for capacitive and inductive reactance? If you find this question suitable for use in your column, please do not use my name.*

A. The formula for inductive reactance is $X_L = 2\pi fL$, where X_L is the reactance of the coil, f is the frequency in cycles and L is the inductance in henrys. The reactance of a capacitor may be found by the formula $X_C = 1/2\pi fC$, where X_C is the reactance of a given capacitor, f is the frequency in cycles, and C is the capacitance in farads.

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ECC85/6AQ8—High-gain dual triode for FM tuners, with shield between sections for reducing oscillator radiation.

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EZ80/6V4—Indirectly heated, full-wave rectifier with 6.3 v, 0.6 amp heater, 90 ma output capacity and 9-pin miniature construction.

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GZ34/5AR4—Indirectly heated, full-wave rectifier with 5 v, 1.9 amp heater and 250 ma output capacity. Octal base. Replaces the 5U4G without circuit changes with the advantage of lower tube voltage drop because of the unipotential cathode.

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LETTERS

The Fourth Speed

SIR:

I should like to add a few (im)pertinent comments to your remarks about the fourth speed for records. I understand that the 45-rpm speed was arrived at by subtracting 33 from 78. By following this same logic (?) we could have:

33 from 45	12 rpm
12 from 33	21 rpm
21 from 78	57 rpm
33 from 57	24 rpm
etc, etc, etc.	

By following this system on out we could have an awful lot of new standard speeds —without bothering to work it out I'd say at least a dozen—and if each one could contribute as much to the standardization of the industry as RCA said the 45 speed did . . .

As you can see, in creating new standard speeds, this system is vastly more efficient than merely halving existing ones, since with the latter method we will quickly run out of speeds at which the quality of reproduction is acceptable, even when the discs are played on these new distortionless, super-fidelity reproducing systems. (Available for $19.95 and up at better gas stations and super-markets everywhere.)

I just can't understand where such an unscientific speed as 16⅔ ever came from.

PHIL PHILLIPS
228 S. Summit,
Iowa City, Iowa

"Judge for Yourself"

SIR:

If we adopt the attitude that all things are good, and (since each individual's opinion is subjective) that one evaluation of an experience or a product is as good as another, then all is lost. Competitive striving for perfection in any realm then becomes useless. For this reason I feel that a few more comments on this subject are in order.

The entire audio reproduction or hi-fi effort is directed to completely accurate reproduction of sound. That we are yet far from this unattainable, but approachable, goal is clear. However, the fact that some components and some systems closely approach this ideal while others fall far short is perhaps not sufficiently well known.

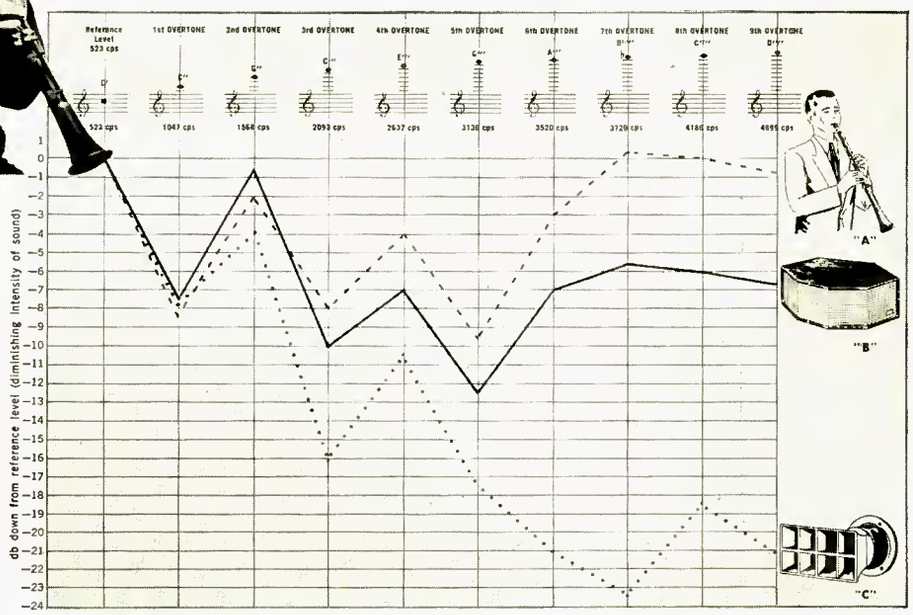
Insurance of accurate reproduction imposes a fantastically difficult set of requirements on each component of a system. Let us assume a perfect signal source—a tape or record or FM signal which contains sufficient totally accurate information to be identical to the original sounds. Then all that our reproducer must do is possess an infinite bandwidth with no phase shift, contain no harmonic or intermodulation distortion, have completely flat response over this infinite band, and produce wave configurations and apparent sound sources precisely duplicating the original.

Not all manufacturers of equipment currently meet these minimum specifications, and not all ears can define how closely these requirements are met. It is then necessary to appeal to instruments other than the ear for preliminary judgements. So intermodulation meters, calibrated microphone sets, and the like are invoked. Now, the degree of subjectivity of the opinion of a unit has been considerably lessened. After using such devices to obtain the best possible reproduction, then

(*Continued on page 78*)

First of a Series

CLARINETS, OVERTONES AND LOUDSPEAKERS



Leaving the adjectives to the people who need them to bolster an absence of facts, we have undertaken a test whereby the JansZen Electrostatic Speaker and one of the "best-sounding" Dynamic Speakers are allowed to "speak" for themselves. Here are the results of the test — simple, factual and conclusive.

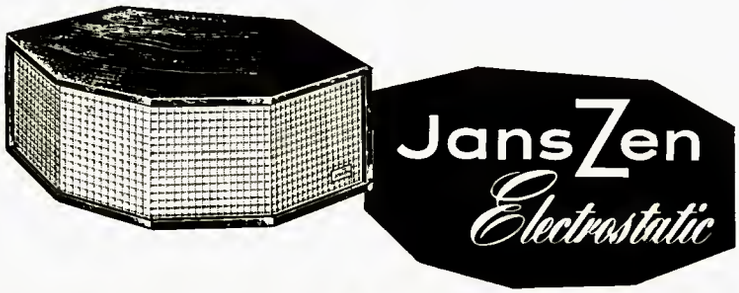
Robert McGinnis, Solo Clarinetist of the N. Y. Philharmonic, cooperated with us in the measurement of sounds of the clarinet. Actually, any one clarinet sound is a composite of over a dozen different tones, arranged in a natural acoustical progression. These are the ***overtones*** *— or harmonics.*

A "pure clarinet" tone, with its accompanying overtone series (represented by line "A"), was measured. We charted the intensities relative to the fundamental tone through the JansZen Electrostatic ("B") and the Dynamic Tweeter ("C"). This experiment was based on a "flat" system response right up to the speaker terminal. The results were illuminating. Study the chart, and note how closely the progression of tones through the JansZen parallels the live sound. Compare that with the distortions in the high range of the Dynamic speaker — *reaching as much as 18db of difference at 3729 cps!* This is a graphic portrayal of comparative frequency distortion.

While the basic electrostatic principle has been acknowledged superior to dynamic designs for upper octave sounds, it is in the JansZen, with its precision push-pull design, that this principle reaches its optimum performance. Because of this, the test must be considered not an analysis of electrostatic principle per se, but rather a specific comparison of the ***JansZen*** *Electrostatic with a good dynamic speaker.* ***While the JansZen does not produce absolutely identical reproduction of the live clarinet sound, it does come closer to the original than any other high frequency speaker made.***

Interestingly enough, women are more sensitive than men to overtones in the higher ranges. If your present installation includes a Dynamic Tweeter, the resultant distortion of these overtones may well be the cause of your wife's complaint about the "shrillness", or "loudness" of your sound system. She won't be bothered by this common ailment of high fidelity sound, with the JansZen — and neither will you. Because the JansZen gives you the closest thing to live sound — *by actual measurement!*

Send for complete literature on the JansZen 1-30 Electrostatic as well as the name of your nearest dealer.



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NEW LITERATURE

• **Triad Transformer Corporation,** 4055 Redwood Ave., Venice, Calif., announces the publication of its new 1957 General Catalog. Described and illustrated are more than 700 transformer types, of which 117 are new items. Among the new listings are toroids, pulse, transistor, geophysical, power, filament and audio transformers, also chokes and television components. Available from any Triad distributor or by writing direct and requesting Catalog TR-57. **E-1**

• **Hickok Electrical Instrument Company,** 10612 Dupont Ave., Cleveland 8, Ohio, lists 25 pieces of new test gear, including two color generators and the Cardmatic "automatic" tube tester, in an 8-page catalog which will be mailed upon request. This publication will be of distinct interest to professional engineers, laboratory technicians and electronic hobbyists. Requests should specify Form SM-30. **E-2**

• **Lafayette Radio,** 165-08 Liberty Ave., Jamaica 33 N. Y., is offering free a new 16-page high fidelity brochure. Included in the booklet is a wide selection of speaker systems, tuners, amplifiers, and record playing equipment. Profusely illustrated, Brochure HF-250 is an excellent directory of latest models made by leading manufacturers. Copy may be obtained at any of the six Lafayette hi-fi centers or upon written request. **E-3**

• **Livingston Audio Products Corporation,** Livingston, N. J., has just released a new comprehensive catalog of all recorded tapes available from the company's tape library. Containing more than 40 stereophonic and 160 monaural titles, the attractive 48-page booklet contains a great variety of music material ranging from classical to jazz. It also features such unusual items as a complete performance of a Shakespeare play by a name cast and a selection of satirical monologues by Henry Morgan. If you own a tape recorder, this catalog is a virtual necessity. Free upon written request. **E-4**

• **John F. Rider Publishers, Inc.,** 116 W. 14th St., New York 11, N. Y., announces the availability of a 32-page spring-summer 1957 catalog which describes the Rider publications. Covered are the contents of books presently in the Rider line as well as approximately 20 titles which will be released by June. A 4-page article titled "Why Read" stresses the fact that the printed word is one of the most effective methods of improving one's background in the field of professional activity. Copy will be mailed on request. **E-5**

• **Klipsch and Associates,** Hope, Ark., will mail free a listing of the titles included in the firm's new line of stereophonic recorded tapes. Developed to meet the demands of those who own high quality stereo playback equipment, Klipschtapes are recorded to be played at 15 ips. They are recorded under the direction of Paul W. Klipsch, designer of the well-known Klipschorn speaker system. All Klipschtapes are first generation copies of original master tapes, made directly from the master tapes at original recording speed. **E-6**

• **L.E.E. Incorporated,** 625 New York Ave., N.W., Washington 1, D. C., describes and illustrates its complete line of high fidelity speaker systems, including the well-known Catenoid model, in a 6-page 2-color folder which has just been released. Copy will be mailed upon written request. **E-7**

• **Shasta Division, Beckman Instruments, Inc.,** P.O. Box 296, Station A, Richmond, Calif., has performed a distinct public service in making available an 8-page 2-color brochure describing the function, applications, and recent improvements of the National Bureau of Standards radio stations WWV and WWVH. The publication also describes the new Shasta Model 905 WWV receiver which received its first public showing at the recent I.R.E. trade show in New York. When requesting your copy, specify Data File No. 10. **E-8**

COMING EVENTS

Apr. 28–May 3—81st Convention of the Society of Motion Picture and Television Engineers, Shoreham Hotel, Washington, D. C.

May 22–June 1—Scottish Radio Show, Kelvin Hall, Glasgow, Scotland.

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.

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

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

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

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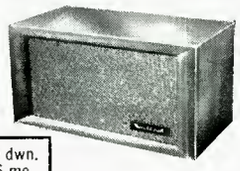
Heathkit Model SS-1 Speaker System Kit

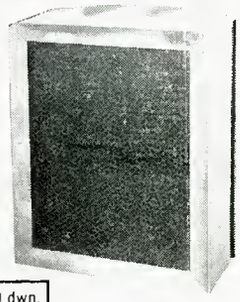
This high fidelity speaker system is designed to operate by itself, or with the range extending unit listed below. It covers the frequency range of 50 to 12,000 CPS within ± 5 db. Two high-quality Jensen speakers are employed. Impedance is 16 ohms, and power rating is 25 watts. Can be built in just one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



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HEATHKIT

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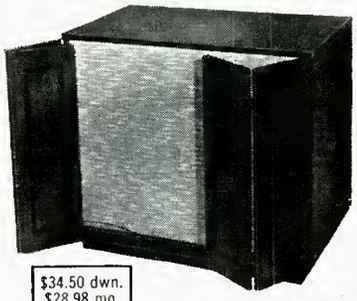
Months of painstaking engineering by Heath and Altec-Lansing engineers has culminated in the design of the Legato, featuring "CP" (critical phasing) and "LB" (level balance). The result is a *new kind* of high fidelity sound, to satisfy even the most critical audio requirements. Two high-quality 15" 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

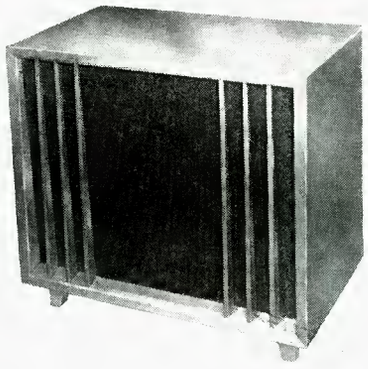
Styled in classic lines to blend with period furniture of all types. Doors attractively paneled. African mahogany for dark finishes unless you specify imported white birch for light finishes. Shpg. Wt. 246 lbs. **$345.00**



$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.

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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 pre-aligned. 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.

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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.

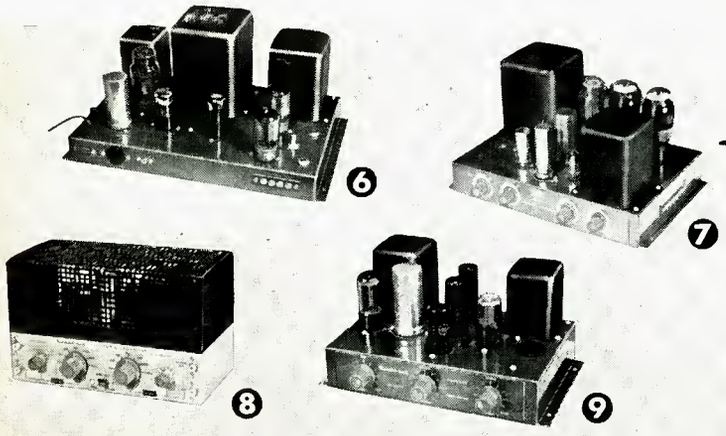
8 HEATHKIT ELECTRONIC CROSS-OVER KIT This device separates high and low frequencies electronically, so they may be fed through two separate amplifiers driving separate speakers. Eliminates the need for conventional cross-over. Selectable cross-over frequencies are 100, 200, 400, 700, 1200, 2000 and 3500 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.



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EDITOR'S REPORT

SO MUCH HAS BEEN SAID ON THE SUBJECT—

CONTEMPLATION ON THE SCIENCE of sound reproduction draws us repeatedly to that old saying which relates to the senior in college who expanded the freshman's "I don't know" to the more erudite "So much has been said on the subject and on the whole so well said that I do not feel that I can add anything further." In a sense, this is the way we feel about much of the published material concerning stereo and about sound reproduction as a whole.

So we went to Sound Headquarters—Bell Telephone Laboratories—and requested permission to bring to our readers some of the original technical papers covering many of the classic experiments and developments upon which our industry is founded. Permission has been granted and, beginning with the June issue, AUDIO will present as a monthly series these authoritative articles—complete and unabridged—from the pages of the *Bell Laboratories Record* and *The Bell System Technical Journal.*

The first article in the series is titled *The Reproduction of Orchestral Music in Auditory Perspective.* It covers that notable event of April 27, 1933, when a performance of the Philadelphia Orchestra was transmitted by wire from the Academy of Music in Philadelphia to Constitution Hall in Washington with a degree of effectiveness which would be impressive even by today's standards. Later articles will include such classics as *Technical Problems of Stereophonic Reproduction* by a group of BTL engineers, and *Loudness, Its Definition, Measurement and Calculation* by Harvey Fletcher and W. A. Munson.

It goes without saying that our gratitude to Bell Telephone Laboratories for this generous gesture is both deep and sincere. And we are certain that our satisfaction in being able to publish these articles will be matched by the interest with which they are accepted by our readers.

STACKED vs. STAGGERED

This is a subject which has been handled with kid gloves for too long, yet it is one which affects everyone who is either a user or a potential user of recorded stereo tapes. 'Way back in the 20's we had two different types of phonograph records—vertical cut, as represented by Edison and one or two others, and lateral cut, as represented by Columbia Gramophone, Victor Talking Machine Co. and others. There was a time when it was necessary to have a "turnover" sound box if one were to play both. Finally, the Edison-type gave way completely, and the lateral phonograph record became the standard. As we all know too well now, we were far from standardized as to recording characteristics, but before electrical recording and reproduction it didn't make too much difference.

Records improved considerably over the next ten-year period, and we resorted to tone controls to make any final adjustments. With the advent of the LP, along with high quality magnetic pickups, minor differences in recording characteristics became really important, and anyone who has followed hi-fi since LP's were introduced knows how long it was until we had even a fair amount of standardization. Now, of course, practically any current record will play well with RIAA equalization.

Up to now, it seems as though we are likely to have a similar problem with tape—particularly stereo tapes. It is bad enough that the equalization characteristics of the various machines are not uniform, but part of that can be attributed to differences in tastes among those who have the responsibility of passing on the prototypes before they go into production. A much more important variance from good engineering practice is the existence of two types of stereo tapes—stacked and staggered.

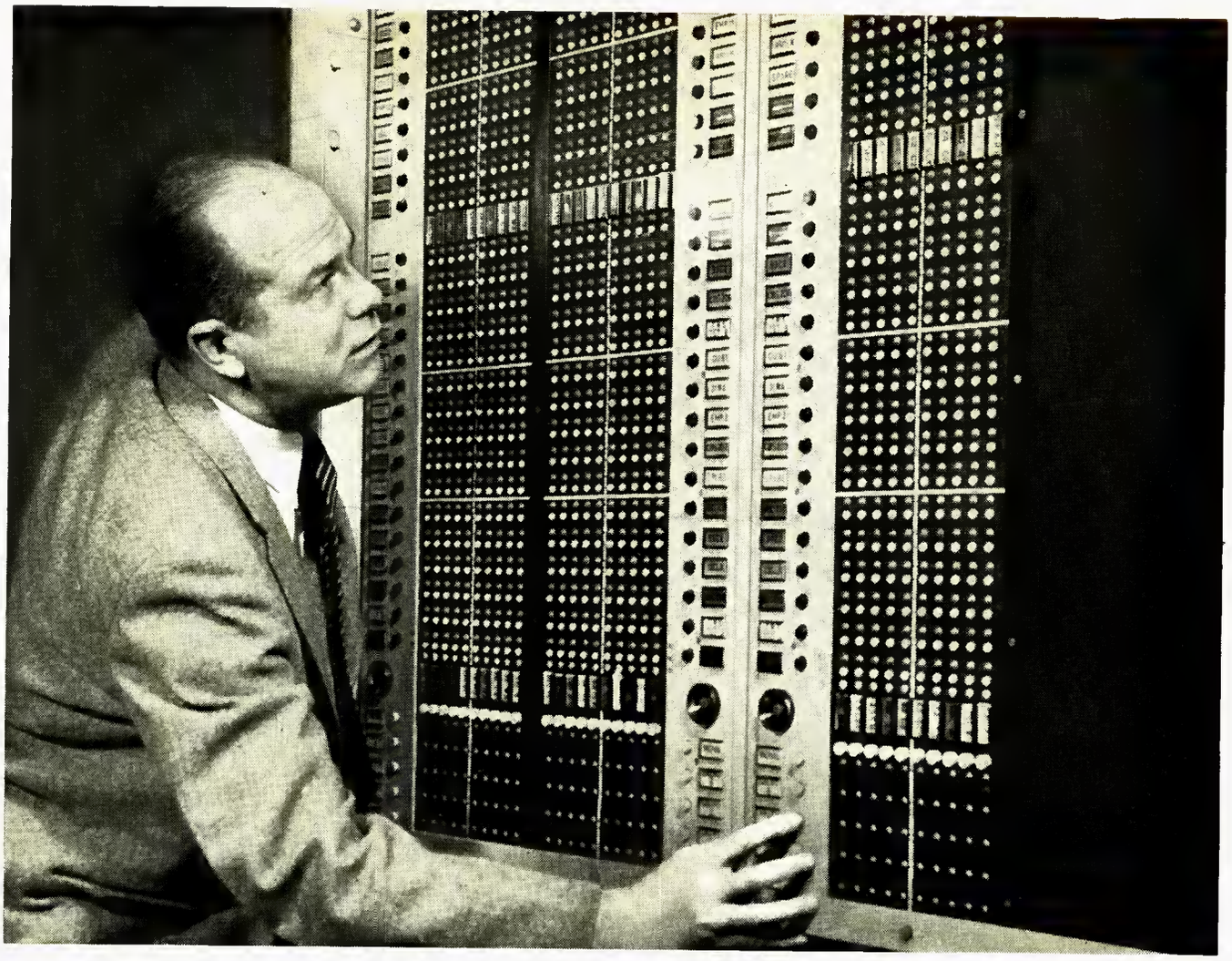
Throughout the industry it is recognized that the original stereo recorder resulted from the idea that a machine made for two-channel instrumentation could also be used for music. Trial proved that it could, and since the machines were available it was natural that this use would be publicized. And with a rapidly developing market, what was more natural than the introduction of recorded stereo tapes?

Most instrumentation applications demand a very high degree of isolation between the two (or more) channels, and it is most easily obtained by the use of completely separate heads. Thus the two recording or reproducing gaps had to be spaced, and a distance in the vicinity of 1¼ in. became standard. However, with the staggered tracks, it is practically impossible to do a proper job of editing. Furthermore, it seems doubtful if completely accurate spacing can be maintained in production of the machines. Anyhow, stereo tracks do not need a high degree of isolation, because the material on one track is so very similar to that on the other, and after all, *both* ears hear *both* tracks at the same time.

With a more realistic approach, another company brought out the stacked-head machine. The tapes are easier to edit, and the phase relation of the two tracks remains absolutely constant. But with two "standards," recorded-tape companies almost had to provide tapes for both, which doubles their inventory and it doubles the inventory of the retail dealer.

At this moment, however, it looks as though the stacked head will be the winner in the long run. According to *Retailing Daily* (now *Home Furnishings Daily*) for March 29, RCA has discontinued the manufacture of recorded tape for staggered-head machines, two manufacturers of staggered recorders are ready with kits to convert the machines to stacked-head models and a third is considering the change, and there are no signs of the reverse of this trend. Naturally we are in favor of this move, and hope it will soon become universal.

One tape and recorder retailer recently sent out an open letter to the industry with a strong plea for standardization on stacked heads, and they back up their opinion by refusing to handle staggered machines and tapes because they "like to keep their customers happy." We believe they are right, and trust that more will follow in their lead. There is certainly no room for both systems.



Bell Laboratories engineer Cyril A. Collins, B.S. in E.E., University of Washington, demonstrates new TV switching control panel for black and white or color. Complex switching connections are set up in advance; in a split-second a master button speeds dozens of programs to their destinations all over the nation. Special constant-impedance technique permits interconnection of any number of broadband circuits without picture impairment.

Telephone science speeds TV enjoyment

Telephone science plays a crucial part in your TV entertainment. An interesting example—one of many—is the latest TV switching center developed at Bell Telephone Laboratories.

Switching centers control the transmission of programs which come to your local TV station over Bell System facilities. To be available exactly on cue, programs must be switched at high speed and with very great accuracy.

To create the new switching center Bell Laboratories engineers borrowed from the switching control art which handles your dial telephone calls. They developed a special control panel which puts complex switching patterns within the easy grasp of one man. By pushing buttons, he sets up—and double-checks—forthcoming network changes far ahead of time. On cue he presses a master button which sends the programs racing to their respective destinations around the nation.

To connect the broadband circuits, the Laboratories engineers developed a new video switch which operates on a constant-impedance principle. The new switch permits the interconnection of any number of circuits, without the slightest impairment of transmission quality.

Thus the technology which serves your telephone also works for your TV enjoyment.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

Above All, The Ear

JENNIS A. NUNLEY*

A light in the darkness anent the mysteries of hi-fi as practiced by the cultists. This author, with his feet on the ground, wraps a strong lesson up in a bit of humor which may tend to mislead, but, if we may resort to a colloquialism—he's got a point there.

Marry, this is yet but young, and may be left
To some ears unrecounted.
Shakespeare.

BACK IN 1946, when high fidelity first started to roll again, I was working in the office of an oil firm and of about 300 office workers, there were only two of us who had any knowledge of what hi-fi meant. The other fellow, Jack, was a good deal more active than I, being on a higher salary (hi-fi was somewhat more expensive then than it is today). Jack used to take great pleasure in regaling me with recounts of his experiences over the weekends, which he devoted entirely to experimentation. At that time, the triode was the thing, and Jack had been building up an amplifier with transformer-coupled triodes, using expensive imported "pots" (his word for the transformers), which came from England.

One Monday morning, Jack came bursting into the office, wild-eyed and lacking for sleep. "The doggone thing will pass a square wave!" he announced triumphantly. I was positively struck dumb.

Jack's announcement had been made in a loud voice and I became aware of irritated looks from the clerks around me, and a particularly malignant one from the section boss, who had been hearing too much lately of decibels, frequency response, and waves. To avoid antagonizing my associates, I hurried Jack off downstairs for a cup of coffee.

In the coffee shop, Jack breathlessly told me of his completing the amplifier and of the various tests he had made on it. All of the tests had indicated results far exceeding his expectations and he was completely jubilant. The fact that the amplifier had succeeded in reproducing a square wave with only a small amount of deformation was the crowning achievement and, in 1946, that did represent a fair accomplishment.

Although this has nothing to do with the main subject of this piece, with your indulgence I will digress a moment to describe briefly the state of high fidelity in 1946, for the newcomers and for those who have forgotten. This is best presented by a copy of Allied Radio Corp. catalog number 112, dated 1947 (actually published in 1946) which I have carefully preserved. In this catalog, there are about four pages devoted to things which were then termed high fidelity (versus over 60 pages in the Allied 1957 catalog). The most choice amplifier offered then was the Altec A-323, a 15-watt job. This boasted the phenomenal response of 20-20,000 cps. within plus or minus 1 decibel. The unit had 2 percent harmonic and 8 percent IM distortion at rated output and sold for $118.00. This was hot stuff. Allied's own Knight hi-fi amplifier was somewhat less expensive at $59.95 and carried these words in the specifications list: *"Frequency Response.* High-fidelity frequency response—flat within plus or minus 2 db, from 30 to 12,000 cps. Extremely wide coverage." The unit included variable automatic volume expansion, a feature which I would like to see incorporated more extensively in present amplifiers. Altogether, we felt, the Knight was not a bad amplifier. Another statement extracted from the specifications list of the Knight seems a trifle naive today but is a splendid indication of the almost natal state of hi-fi in 1946: *"Inverse Feedback.* Imparts triode qualities to the 6L6G beam-power output stage and yet preserves the well-known efficiency of the 6L6G tubes; improves tone quality and reduces hum and noise. An important engineering feature."

Proof of the . . .

Getting back to Jack and his all-triode, transformer-coupled amplifier. Finally, after a couple of weeks of ironing out bugs (mostly hum and noise), he invited me around to listen to his rig. The first part of the "audition" consisted of peering at a 3-inch oscilloscope screen while the amplifier "passed" square waves, and then observing the needle of an a.c. meter while Jack fed various signals to the input of the amplifier. At last, Jack got around to connecting the amplifier to a pickup and to a pretty decent Altec 12-in. coaxial in a conventional bass-reflex cabinet. He put on a couple of his better 78's (no LP's in 1946) and I sat back to listen. This part obviously made Jack nervous; he much preferred the oscilloscope and meter tests to the rather mundane act of *just listening.*

The listening test was quite satisfying to me, especially since Jack had put on one of my favorite recordings. The latter fact, of course, I would not dare mention to Jack, in fear of revealing to him my incredible naivété in considering the music itself *almost* as important as the electrical characteristics of the reproducing system. Actually, with no vanity involved, I secretly did not think that Jack's system *sounded* much better than my commercially built combination, which Jack had degraded violently, refused to consider as a serious sound reproducer, and would not condescend to listen to.

To some, Jack may sound like an intolerant, disagreeable person, but, on the contrary, he was pleasant, enthusiastic, and a nice person to know. He was infected, however, with a condition that has grown right along with high fidelity and is part and parcel of a great many audiofans today. This condition consists of being too much intrigued with electrical matters rather than with the product of these elaborate electrical schemes, and with being too much impressed by more or less abstract electrical tests and data. Jack, being one of the *avant garde,* was perhaps more radically inclined toward this condition than most; happily, many audiofans strike a good balance between listener and electrician. The two roles are intertwined and complement each other perfectly, if allowed to do so.

In the November 1953 issue of *Radio and Television News,* Alva R. Wilson describes an amplifier of his own design (the merits of which will not be discussed here), and in the second paragraph makes this statement: "Just to be different, therefore, we are going to describe an amplifier whose audio curve is far from flat. We have designed an amplifier to please the human ear and not an oscilloscope." This paragraph startled me somewhat, and I can imagine the knowing smiles and disgusted sneers it must have evoked among hi-fi people all over the country. What startled me was not the unspeakable idea expressed in the paragraph but that Mr. Wilson should have the courage to allow his name to appear in connection with such a statement in a serious, widely-read magazine. To publicly blaspheme against the response curve and the hallowed oscilloscope in connection with audio seemed so alien as to smack of extreme liberalism, or communism, or *something.*

* *225 "J" St., Salt Lake City 3, Utah.*

The Ear's the Thing

So here we have a man who designed an amplifier to please the human ear! I'm almost as dumbfounded as I was when Jack first told me that his rig would pass a square wave. And now I'm going to jump right into the pool of sharks with Mr. Wilson and confess that I, too, feel that the human ear, not an oscilloscope or an a.c. meter, should be the ultimate test for any music system. In the following paragraphs, I am going to go as far as to let a little of my blood into the water, just to infuriate the sharks, and see if I can come out without being chewed up. In other words, I will attempt to justify, or at least to rationalize my stand.

I am going to take the liberty of referring occasionally to that great and amusing oracle, Mr. G. A. Briggs, using as a source his book, *Sound Reproduction* (3rd Edition), which is published by the Wharfedale Wireless Works of England, and purveyed in this country by British Industries Corporation.

I will start by making a direct quotation from Mr. Briggs' chapter on *The Ear,* which will lead toward certain observations: "It is often stated that distortion is produced in the ear at low frequencies by the non-linear lever action of the bones of the middle ear, but I am inclined to think that this statement should be accepted with reserve." Mr. Briggs is certainly correct in accepting the statement with reserve but should the statement be accepted at all, with or without reserve? There are, no doubt, some people who would like to be able to wire the output of an amplifier directly to the brain (with appropriate matching transformer), thus avoiding the clumsy exchange of sound impressions from speaker to air to ear to brain. The ear, being composed of spontaneously formed protoplasm, is not subject to redesign and therefore must frustrate many experimenters who see a number of flaws in its construction.

We must consider, however, whether or not the ear is capable of imperfection or of introducing distortion, within the limits of the definition of the term "distortion" as applied to audio matters. Distortion, as we all know, is any deviation in reproduction from the original sound *as perceived by the human ear,* be it spurious harmonics, unequal reproduction at different frequencies, or any of the other improper variations which beset the reproducing system. This definition obviates the possibility of the ear being responsible for real distortion, barring actual physiological change in the ear between the time of hearing the original sound and hearing its reproduced replica. If there is "distortion" in the ear at a given frequency, then this "distortion" is generated as the original sound is heard and identically generated as the reproduced sound is heard. The "distortion" becomes a real part of the sound to the individual listener and to him is the natural and true sound; thus, in actuality, there is no real distortion present. We must concede that all true reception of sound begins at the ear shell. From there through the various bones, liquids, membranes, and nerves, there is, by definition, no distortion possible. The "response" of the ear is *perfect* to the individual to whom the ear belongs; it is the instrument which has acquainted him with the world of sound since birth and it is the instrument which brings it to him today, and *he has no other.* (*Look around the other side of his head,* Ed.)

If there were some way of improving hearing, say by increasing the high-frequency hearing of one whose ear naturally and inherently does not perceive the high frequencies, the result would not be pleasing. The individual would, until sufficient time had elapsed for him to become accustomed to the change, complain unnaturalness in sound, and possibly he would develop a dislike for the piccolo. Similar results would be obtained if the lever which is presumably responsible for low frequency "distortion" in the ear were remodeled in conformance with *good audio practice.* We may fiddle with amplifiers, design new speakers and enclosures, even control the temperature and humidity of the air that surrounds the ear, but once the vibrations have reached the ear, then the matter is beyond our purview.

Use of Instruments

Outside the ear, then, we have the various tests, the IM figures, the curves, the scope tracings, and so on, which (don't mistake me) are of great value, but they are of value only in helping the ear to find out *why* it is *not* pleased, never to *tell* the ear *when* it is pleased or when it is not pleased. If distortion is heard in the playback of a recording, or if it sounds flat or unnatural, it is quite proper that assistance from instruments more precise and discriminating than the ear should be sought in order to determine why the reproduction was not pleasing. But picture the predicament of the fool whose instruments, by all the established rules, indicate that he should have good reproduction but whose ears find the final result unpleasing. ("Oh, but that is impossible," you may say.) Is he to ignore the evidence of his ears and conclude that the reproduction *is* good because the instruments tell him so? His diametric opposite is the man (like Mr. Wilson) whose amplifier tests poorly but renders sounds that are almost indistinguishable from the original. Of these two, who is the happier? Well, if we must make a choice, I will be found in the camp of the man whose rig *sounds* good, for (am I a freak?) I can sooner forget a poor scope trace than a tortured chord assailing my ears.

But, alas, you are going to win over me to an extent, for I am forced to make a rather large concession (and here the shark gets a bite of me): a reproducing system which *tests* good almost invariably *sounds* good. With eyes downcast, I also concede that this is one of the major reasons why tests are used so extensively in connection with audio equipment. Another reason, however, is that a battery of test equipment can remarkably transform an amateur into a professional, at least in the eyes of another amateur, and nothing can hide the shortcomings of a reproducing system quite so well as a cluster of data and a lengthy demonstration of characteristics on the faces of meters and scope screens. It might be pointed out that Mr. Briggs relies heavily on oscillograms in his research, but it is also evident that he takes a distinct pride in his ability to hear, without the aid of instruments, what is best in reproducers.

It has occurred to me that absolutely precise measurements of sound (as differentiated from electrical voltages or currents) are impossible. We most certainly may say that a reproducing system has definite electrical characteristics; each component may be measured electrically with results as precise as the measurer has time, money, skill, and patience to make them. A magnetic pickup delivers exactly so many volts at such and such a current at a given excitation (the record grove); an amplifier delivers constant-wattage output at a given excitation and this can be compared with the level of excitation to produce very exact and useful results. We may then use this precisely known energy to excite a loudspeaker cone and we may measure the excursions of the cone for each given excitation, again with exact results. If we assume blindly that the cone excursions represent an exactly proportional amount of actual sound, then we know how much sound has been reproduced. But we can make no such assumption without actually measuring the intensity and volume of sound and comparing them with the excitation and cone excursions. This is where the impossible is introduced, for *there is no known method of measuring sound exactly.*

If that last sentence has taken your breath away, I will wait calmly while you recover, then listen patiently while you gasp, "But, my dear sir, all that is necessary is to place a microphone in front of the speaker and measure the electrical output of the microphone." You are right, but to a limited extent. In such a measuring set-up, we must take into account the sound-to-electrical-out-

(*Continued on page 73*)

The Role of Printed Wiring in High Fidelity

NORMAN H. CROWHURST*

While there is often an advantage in cost with this new technique, its principal advantage is in the improvement in performance, particularly when applied to tuner and audio amplifier circuits.

WE OFTEN READ announcements of a "revolutionizing" development. So often that thoughtful people, and engineers in particular, are apt to think "wait and see," whenever a reporter writes, "I venture to predict that the present system will be entirely obsolete in 5 years from now." The advent and development of printed wiring, or printed circuitry, has been followed with considerable interest by manufacturers of high fidelity equipment, waiting to see what someone else would do. This is understandable in view of the investment involved.

About 18 months or so ago, Harman-Kardon undertook this very bold step—and they are still very much in business! Now that they have this experience behind them, I decided to investigate their conclusions on the subject: whether they had found a productive field or whether they may be thinking of abandoning it as a rather expensive experiment. Over at the Harman-Kardon plant I found a very interesting story.

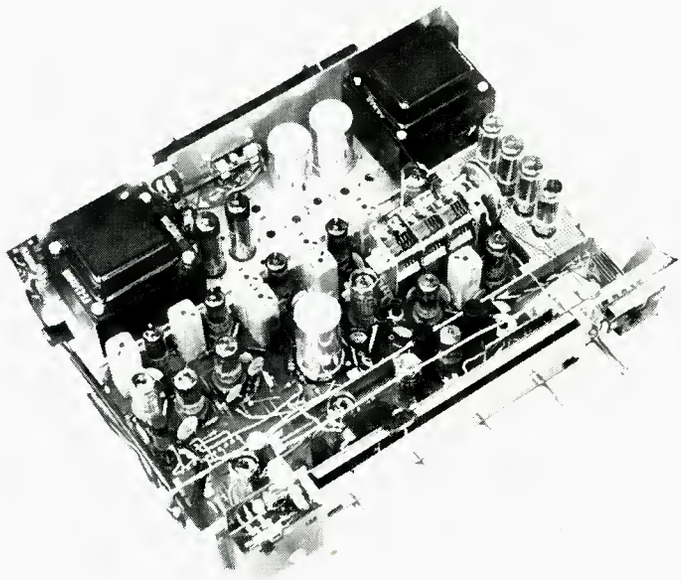


Fig. 1. Harman-Kardon receiver chassis constructed with the printed-wiring techniques described. Performance is held to extremely close limits.

What are its Potential Advantages?

Probably most readers would expect the principal advantage of the new process to be reduced production costs. This is the big point in its use for television production and consequently is probably its best known advantage.

What seems to be less known is the advantage it achieves in precision construction and the consistency of the resulting product. This fact is exemplified in the use of printed wiring technique for all items of computer and guided missile equipment. There it is not used primarily because of reduced production cost, which is not usually a factor, but because it gives greater reliability and product consistency.

Not only are lead dress, and similar features of a product, identical from unit to unit along an indefinitely long production run, but quality control is much simplified by the very fact that the entire circuit is readily visible. It is much easier to look for defective wiring simply by inspecting a printed board. A dry joint is at once visible. The "quality" of the wiring can be reduced to a matter of tolerances the same as the value of a resistor or a capacitor—something that was never possible using the old method of wiring.

In the audio field a continuation of expenditure on engineering time, after a product has gone into production, has come to be expected. Companies regularly allocate engineering time to production follow-through for years—in fact, indefinitely—because little bugs keep cropping up in the production line, long after the prototype circuit has been "finalized" (a word that seems to have lost its meaning!). It seems as if engineering is only finished when a product line becomes obsolete. This has always been a considerable drag on high fidelity engineering departments. They never seem to be entirely free to give undivided attention to the development of new products. Always they have to be taking time out to re-work production items.

The printed wiring technique has brought in sight the end of this never-finished-engineering aspect. The engineering department, having put a design "to bed" so the production department can go on making it, can turn their attention wholeheartedly to the development and design of another new product.

But enough of this generalizing. Let's examine some of the things that Harman-Kardon found in their change-over from the old fashioned method of wiring to the printed wiring technique. Originally they laid down equipment to convert their existing product lines to printed wiring production. Then, having found this successful, they went further. Engineering went to work on new designs. So they are now manufacturing product lines that were exclusively designed for production by printed wiring technique, as well as printed wiring versions of their original products. This says the experiment was successful.

Fundamental Differences

They had to learn, in applying the process to high fidelity equipment, that this is a different field from either television or computer and guided missile type equipment. The main purpose here never was production in vast quantities at much lower cost, as in the television

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Fig. 2. Method of making mock-up drawing which serves as master for production of printed-wiring panel. Pressure sensitive tape is used for laying out "wires" between connection points.

industry. The high fidelity consumer wants a better product for his money and, as a secondary interest, he would like to get it for less money too.

In the television industry, the printed boards are made up in individual units, of which there are quite a number to a complete TV set. In the high fidelity amplifier the better approach is to get as much as possible on one board. This gives a maximum consistency in the finished results, because as much as possible of the wiring is fixed by the printing and as little as possible is left to the variation in routing of connecting leads.

For achieving the maximum cost reduction (as in TV manufacture) a fully automatic assembly line is desirable. But in the high fidelity approach, because the quantities involved are not large enough to warrant the terrific expenditure on fully automatic equipment, and also because "larger and fewer" is the desirable trend in printed boards, the technique is developed in more of a semi-automatic fashion.

The machines for inserting resistors are set up quite quickly to each position on the board and a number of boards run through, inserting the same resistor in each board. A quick change of the positioning tool, and reloading with a different resistor value and the boards have a second resistor inserted in all of them. Capacitors and other components are inserted in the board virtually by hand, but using a production line method whereby each operator inserts the same components in successive boards.

One problem in laying out a printed wiring arrangement is how to make one connection cross another (corresponding with "loop-overs" in a schematic). This is inevitable in any electronic circuit. The original approach was to print some of the circuit on each side of the board and make through connections from the part on one side to that on the other. This involves twice the printing cost, because there has to be art work and a printing operation for each side of the board.

But the serious problem is getting a satisfactory connection between the two sides of the board. One way to do this is to plate through the hole that joins the two sides. This is an extremely fragile method, because the plating is only about .002 in. thick and the sharp corners where it joins the etched metal on each face of the board are weak points where it can easily crack and break the connection.

Another possibility is the use of a connecting lead from a resistor or capacitor inserted in this position, relying on the solder to flow through from one to the other and make a successful joint with the metal on both sides of the board. This too can prove quite unsatisfactory because it is so easy for a contaminant to get on the resistor lead that may obstruct the flow of solder from one side to the other. Using an extra long period or a higher temperature in the solder to overcome this can result in the solder flowing too far up so as to damage some of the components, especially switches, volume controls and similar items.

The best solution seems to be to design the board around a circuit that prints on one side only. Actually a laminate is used and the part of the copper surface not wanted for the circuit is etched away. The etched copper is on one side of the board and the resistors and other components have their leads pushed through from the other side. Loop-overs from one connection to another are achieved by jumpers of tinned copper wire, inserted by the same machine that inserts the resistors. Holes are made in the "wiring" of the etched metal in the right place to accommodate these jumpers and the inserting machine bends them to standard dimensions, just the same as for inserting resistors.

This method makes a good reliable

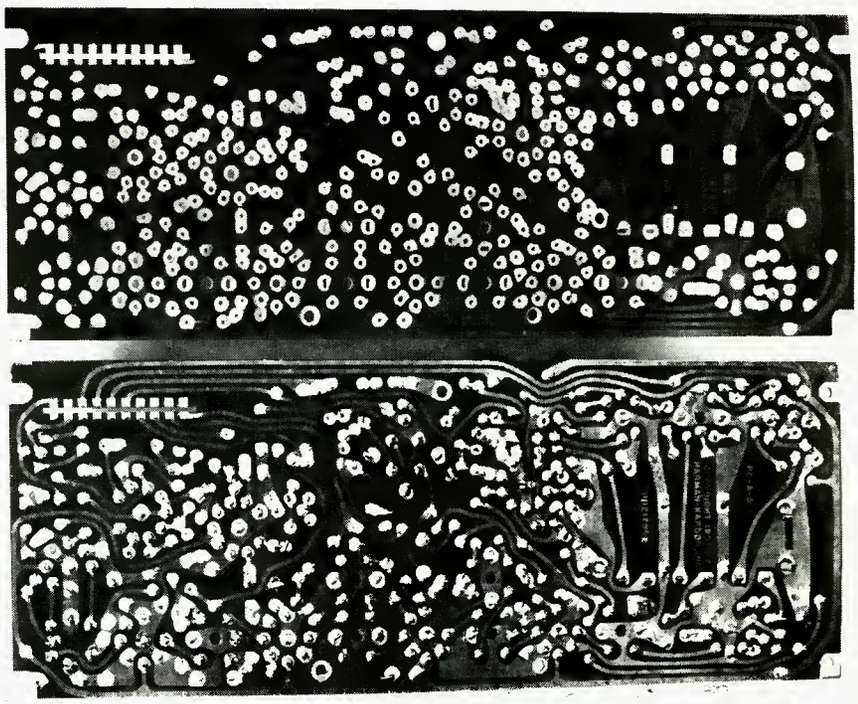


Fig. 3. Printed board with solder mask is shown at top before insertion of components; same board is shown at bottom after components are dip-soldered in place.

connection and avoids the cost of printing on both sides of the board and the problem of satisfactory connecting between sides. The path followed by the jumper is standardized to just the same extent as the printed wiring, because the ends are located by the holes into which they are inserted and these are fixed by the original tooling. The path followed is straight and standard because it is fixed by the inserting machine, the same as for resistors and other components. Thus the end product is a circuit in which not only the components can be to specified tolerances, but also the exact positioning of every wire.

While the objective in applying the printed wiring technique for high fidelity is to put as much as possible onto one board, not everything is put on the board. The supply filter capacitors and rectifiers are usually mounted separately on the chassis. This part of the circuit is not usually critical as to lead dress. It is the circuit internal to the amplifier and carrying audio signals that is critical as to placement of wiring. All of this is printed and thus standardized.

For high fidelity application standard resistors and other components are used. Capacitors are standard, except for the use of a type, developed for application with printed wiring, having the leads at one end. They are standard foil capacitors in a suitable casing. Printed resistors, capacitors, coils and other circuit components are not recommended for high fidelity application. The technique is, for the present at any rate, restricted to the use of printed *wiring,* into which standard resistors, capacitors and other components are connected.

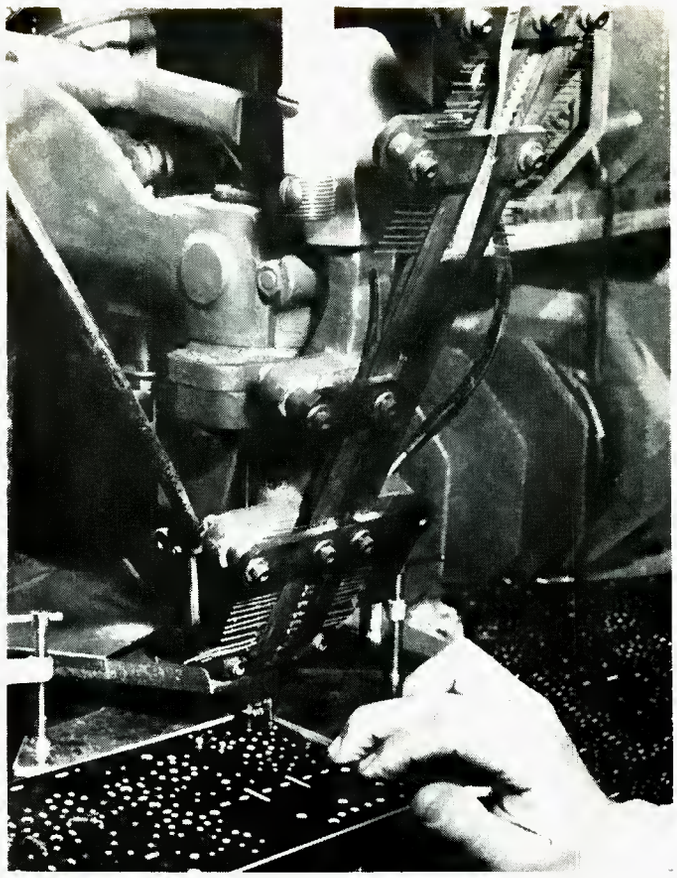


Fig. 4. Resistor-inserting machine in action. Circuit board is positioned by guide clamped to work table and one resistor is inserted in same position in each board of entire run. Clamp is then moved to guide board for a second resistor, and so on.

Process Problems

Next we come to the soldering process itself, where the biggest saving in time and cost occurs. Here it is important to use a skilled operator for the actual dipping. Various companies have tried skillfully designed machines to do the dipping, but there seems to be as yet no satisfactory substitute for the "touch" that a skilled operator can acquire. It does not take too long to learn to do a good job but this is essential to a satisfactory operation.

It is very similar to the ordinary soldering operation. There is no ready substitute for knowing how to solder by applying the iron and the cored solder to the joint for just the required amount of time, feeling or seeing when the solder runs into the joint, and removing heat from the joint as soon as it does, so it will "freeze" without becoming a dry joint. The man who does the dipping has to acquire a similar technique applied to the many joints that are made on the one board.

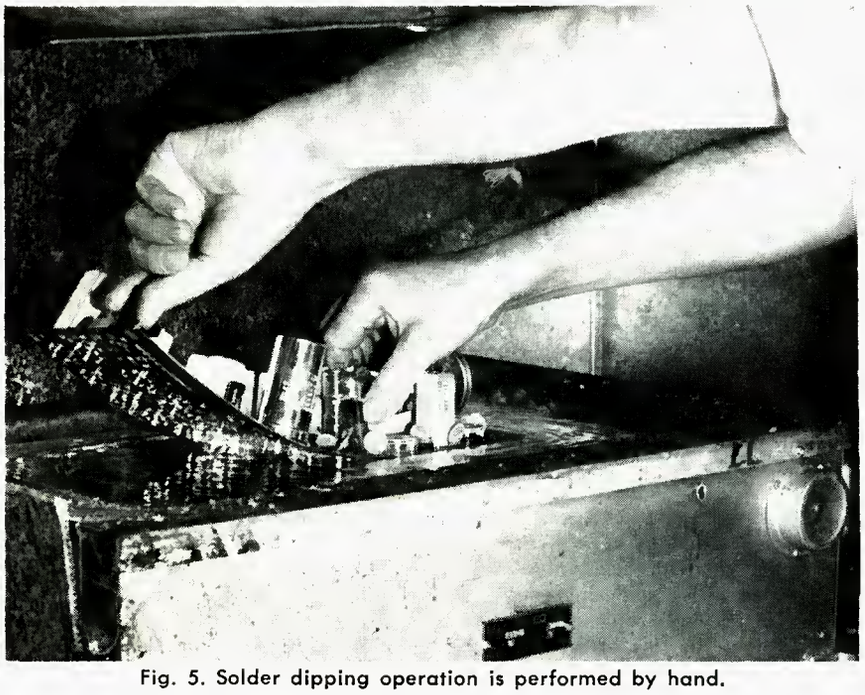


Fig. 5. Solder dipping operation is performed by hand.

An important factor is the control of the solder composition. This is apt to deteriorate over a period of time. For one thing, tin being lighter than lead, the tin is apt to rise to the top, especially when the bath is switched off and allowed to cool and then heated up again. Even with agitation to get the mixture well homogenized a certain amount of separation occurs which means the bath needs replenishing with tin.

Also, contaminants from the board can slowly but surely reduce the effectiveness of the solder composition. To take care of this a procedure of careful analysis with critical standards has to be established so the solder is maintained in good condition. This is not a serious disadvantage to the process, because the rejected bath of solder is not wasted. When it has become too contaminated it is returned to the manufacturer for recovery and the bath is filled with fresh good solder.

An aid, particularly in the inspection department, is the use of the solder mask. This is a further printing, on top

Fig. 6. Comparison between older type tube socket, left, and newer type, right, giving increased serviceability.

of the etched circuit, that prevents solder from "taking" on all the wiring, so solder only adheres to the points where joints need to be made. This makes all the joints stand out visually in a different color from the rest of the "wiring" so the operator concerned with quality control can much more easily inspect all the joints at a glance, to find any that may not have taken, or are dry.

Effect on Production

There are many more details that Harman-Kardon have found out about the process that enable it to be more effective. These are some of the main ones. The general effect is that the material costs rather more than in a unit of conventional construction (using the same circuit, anyway). At present capacitors, for example, cost a little more than those with conventional lead-outs for normal circuits.

On the other side of the "bill," however, labor costs come down considerably so the over-all cost of the unit is still well below that using conventional wiring methods. But the company have not cut back on their employment because of reduced labor cost *per unit*. Their wage bill is probably a little higher, but their production has increased *very much more*. While a fewer number of people would theoretically be required to produce the same output, what is more to the point is that the same number of people can produce a much bigger output.

A greater degree of skill is required for most of the work. In this connection, a surprising thing is the relation between the number of people working on *production*, making the unit, and those whose job is to *inspect* and *test* it at various stages. Because the actual production takes so much less time and labor, it is possible to devote considerably more effort and attention to test and inspection and still produce the product at a cost below that of the conventional method. Not that printed wiring *needs* more inspection and test. But the method enables comparatively minor defects to be eliminated, that would never have been economic with the old method. The product can now go out essentially *perfect* at a cost hitherto impossible.

The fact that a larger proportion of the labor is now spent in test and inspection means a higher degree of skill is needed. In the author's opinion this fact is to be commended on sociological grounds. Much of the modern trend has been away from skilled or craftsman-like labor, toward unskilled. It is good to see this process reversed, so the worker can feel he is really putting a personal contribution to the quality of the finished product. Also it means his work is worth more and hence his pay improved.

The components for printed wiring have developed rapidly in the past 18 months. As with any other new types, they have had their "teething" troubles and were not at first as reliable as components which have had the test of time. Component manufacturers have given excellent cooperation, as a result of which these troubles are now a thing of the past. Improved design from the viewpoint of handling and service has also evolved.

For example, the earlier type of tube sockets which solder solidly into the board were difficult to remove if they should be defective. The newer improved type of socket stands up on pins so it is possible, if it develops a defect, to clip the pins around and then remove them one at a time with a soldering iron. This makes tube socket replacement quite simple without the risk of wrecking the printed board in the process.

Effect on Design

The printed board manufacturers have improved their service in providing sample boards—almost over night. The quick technique of drawing the boards has been developed using adhesive tape on a four times full size paper version. This can be done much more quickly than using pencil or ink. Prints of this mockup drawing can then quickly be rushed to the sample board manufacturer and a printed board is back with a minimum delay enabling the circuit to be made up and tested at quite a reasonable cost before investing in all the tooling. Of course, these sample printed boards are not cheap in comparison with a bread board for conventional experimental work, but they are well worth their cost in expedited development.

Care is necessary in the arrangement of the boards to keep any of the heavier components in positions where they are not likely to wreck the printed board in transit, due to stresses placed on it. This should go without saying, but it needs a little more attention than the conventional construction.

The advantages of improved precision in production were evident in several ways. Taking the company's tuners as an example, a single stage limiter is used, with a sensitivity comparable with two-stage limiters of conventional design, and it is quite consistent in its performance. It gives, in fact, better performance than many two-stage limiters.

The fact that the circuit wiring is so consistent and uniform enables pretuned i.f. cans to be used with an absolute minimum of post-assembly alignment. With the conventional construction, the degree of adjustment necessary in alignment means the performance of the finished unit is far from uniform, either in bandwidth or sensitivity. The close consistency possible in the tuner construction means the performance of any unit taken from the production line will be quite uniform.

The increased gain from a single stage is possible because controlled regeneration can be used. With a conventional design this would need extremely careful attention to lead dress, and a jar in transit might well make the unit unusable. The use of printed wiring makes it possible to design a "hot" circuit with a closely controlled amount of regeneration. Of course it cannot be made too "hot," otherwise variation in tube tolerances would render it unstable in some circumstances. But it is possible to design a circuit much hotter than a conventional type can be made and still achieve a more consistent performance than was previously possible with "cooler" circuits.

It is fairly obvious that this advantage applies to tuner construction. What is

(*Continued on page 75*)

AUDIO *is* 10

Presenting some of the facts about the oldest magazine in hi-fi and the people who put it together. The history of AUDIO and of the high fidelity industry are so closely intertwined as to be almost inseparable so that even the well informed audiofan is never quite sure which came first. Actually, of course, there was no recognized hi-fi industry in 1947, but AUDIO ENGINEERING was aimed in that direction from the first issue.

Ten years is not a long time to an octagenarian, but to a newborn babe it could seem like forever. And when the "babe" wasn't born until three years after its strongest booster started, we get into the realm of infinity squared or light years or something equally hard to comprehend.

The "babe" is, of course, the high fidelity industry, which wasn't thought of when the planning commenced for the first issue of Audio Engineering. The time was January, 1947; place, New York City; occasion, the need for a new type of magazine which would cater to the professional sound engineer and which—it said in small print—would bring together those who followed hi-fi as a hobby.

It was for these people that Audio Engineering first offered a means of exchanging ideas, and as they were gradually drawn together they began to show a purchasing power, and more and more products became available to them, so that by 1950 a small but steady demand for hi-fi equipment was apparent. From then on, the growth of the high fidelity industry has continued to surprise practically everybody—even those who are in it—every year.

Originally, Audio Engineering was a professional sound engineer's magazine, but just as the growth of hi-fi pushed the magazine in the direction of specialization in home equipment, so also did the growth of television push advances in the professional field into the background. Radio stations and networks didn't have the money for improved audio facilities when every cent was needed to expand into television, and the novelty of the convex white screen held the eyes of the country while the ears were assailed by 4-inch speakers squirting out the sides or tops of millions of thin-walled, open-backed cabinets. Sound was definitely in second place. But as the novelty wore off, the tide turned toward music and with the coming of the Vinylite LP the corner was turned.

The first few years of Audio Engineering saw the interest rising in better amplifiers and in better speaker enclosures; as new and better equipment was described—usually as the product of a serious home experimenter—modifications of these designs began to be available commercially. For example, the first big swing toward the Williamson-type amplifier followed the publication in November, 1949, of the story about the "Musician's Amplifier." The corner speaker cabinet which incorporated both front and rear radiation was first described in Audio Engineering in 1949, and many variations began to show up in the stores. As early as 1948 there was published in Æ an article on the loudness control; the one described then has become practically a "contour control" while a modification described in 1949 has been simplified to the extent that about half of the amplifiers on the market today incorporate a loudness control.

The trend of the market made it advisable to change the name of Audio Engineering magazine in 1954, and while the newly-named Audio continued to include serious articles, the predominance of editorial material was in the realm of the home system. And that readers like the magazine's policy seems to be attested by a list of over 700 Life Subscribers and a renewal rate that is unusual in the magazine industry.

Audio does not have a big staff. Since a large percentage of its editorial material is submitted by outside contributors who are deeply interested in the subjects they write about—there are a few people who are involved with every issue. On the following pages will be found photographs and specifications of those whose work is related to the production and distribution of your monthly copy of Audio. There are a few others whose work is equally important, but it doesn't bring them into contact with the reader—in fact, he may never hear of them. Audio, on its tenth anniversary, salutes those who make it possible: first, the reader, without whom there would be no advantage to the advertisers; second, the advertisers who have their own messages to get across to the readers; and its staff—who, on the whole, have a pretty good time at producing *your favorite magazine*.

C. G. McPROUD

Editor and Publisher

Engineer, writer, editor, publisher, C. G. McProud has worked in audio for twenty eight years. A graduate mechanical engineer, his first few working years were spent in civil engineering. He joined Paramount Pictures in the early days of sound pictures, and was employed in the same studio for thirteen years. Working with audio all day, he followed it as a hobby in spare time, and designed and installed high fidelity systems in the homes of many movie greats.

During the war, he worked at design, development, and installation of underwater sound equipment; he was later assigned by the Navy to help in preparing a series of Maintenance Manuals on the same equipment. Following the war, he entered the magazine field, did free lance writing, and finally planned the editorial policy for AUDIO ENGINEERING in January, 1947, leading up to its first issue in May of that year. He was the magazine's managing editor until the death of John H. Potts—its co-founder, editor, and publisher—in 1949, at which time he became editor. Duties of publisher were added in 1952.

Mr. McProud was among the original group which founded the Audio Engineering Society and was president of this organization during the year 1951–52. He is a charter member of the AES, and received the Society's award in 1952 as the person who did the most for the advancement of the Society. He is also a member of the Institute of Radio Engineers and of the Acoustical Society of America, and an associate member of the SMPTE.

Often called "Mr. Audio," he is credited with conceiving and naming the Audio Fair—forerunner of the current high fidelity shows.

HENRY A. SCHOBER

President

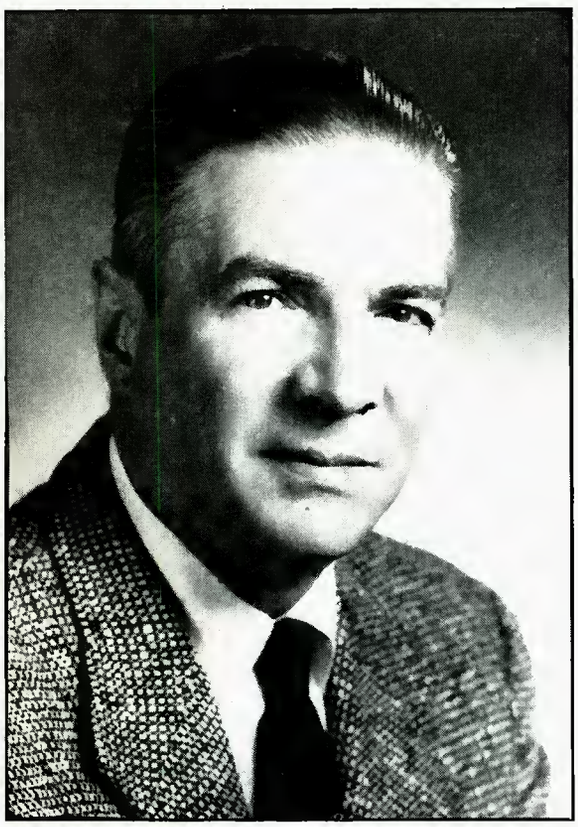
Born in the Bronx, Henry A. Schober is a member of ANNY, considered by its members to be the most select fraternity on the Manhattan professional scene. Surrounded by Kansans, Oklahomans, New Jerseyites and other westerners, he takes just pride in being A Native New Yorker.

Educated in New York public schools, he began work in 1927 as office boy for Arbuckle Brothers, Inc., wholesale food merchants. Sixteen years later, after working his way up to the position of assistant comptroller, he resigned to enlist as an infantry private in the U.S. Army. During his tour of duty he was promoted to master sergeant and was assigned to civil affairs and finance and property control divisions of military government. After serving overseas for approximately three years he received his honorable discharge and returned to civilian activity.

In February, 1946, he joined Radio Magazines, Inc., as comptroller. At the time, RMI published CQ, a "ham" magazine and AUDIO ENGINEERING, forerunner to AUDIO. After a realignment of corporate structure which was culminated in April, 1952, he became president of the company, in which he and C. G. McProud are sole stockholders. Since then its entire activity has been in the field of audio publications—both magazines and books.

Mr. Schober is married, and his principal hobby is romping with his two sons—Steve, 7, and Wayne, 5.

Among Mr. Schober's academic tributes is the W. Keith Reid Accounting Award, presented each year as a mark of merit "for excellence in accounting and good citizenship." His principal hobby is people *per se,* and a great portion of his outside-the-office time is devoted to an informal study of what makes them tick.



HARRIE K. RICHARDSON
Associate Editor

Harrie K. Richardson made his first impression on the audio world in Pauls Valley, Okla. According to the graybeards who were present, it was the first time 100 per cent fidelity and 100 per cent distortion had been achieved with the same transducer.

After education in Oklahoma public schools he joined the staff of *The Daily Oklahoman*, the state's largest newspaper, as Radio Editor.

In 1929 he became chief announcer of Station KVOO in Tulsa where, after some months, he was named assistant manager, which position he occupied for the following three years. During these same years his hobby was electronics in a general sense, with specific interest in audio.

In 1931 he appeared on the Hollywood broadcast scene and for three years worked with all networks as producer, announcer and/or writer for many national programs. He was one of three persons engaged in the opening of NBC's first Hollywood studio.

Leaving Hollywood he returned to the Midwest and was located in Chicago until 1944, except for 1938 when he was manager of station WNAX in Yankton, S.D. While in Chicago he held a number of executive positions in the radio advertising field. Among his ad agency affiliations were the firms of Needham, Louis & Brorby, Inc., Roche, Williams & Cunnyngham, Inc., and H. W. Kastor & Sons, Inc.

In the fall of 1944 he withdrew from commercial activity to join the Office of Scientific Research and Development in New York as editor of Sonar instruction manuals published for the U.S. Navy. It was during this chore that he first worked with C. G. McProud.

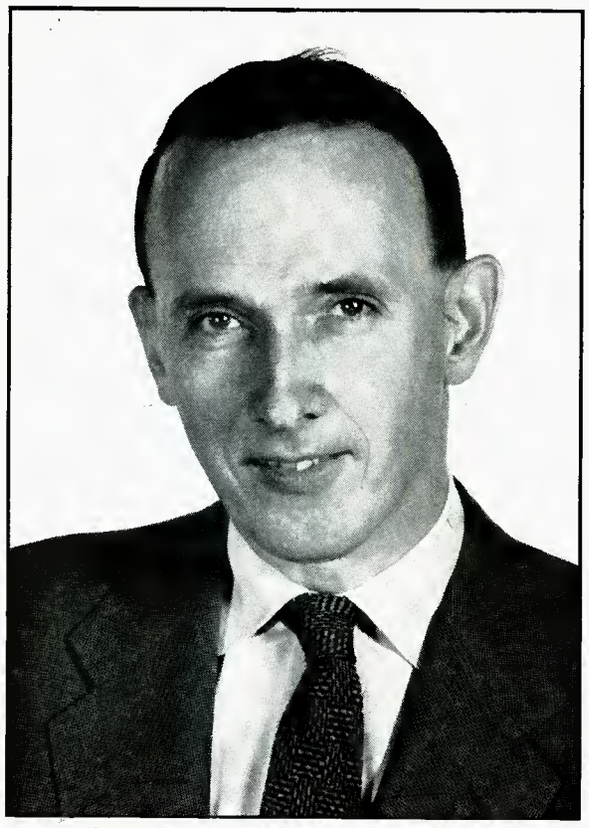
His name appeared on the masthead of AUDIO in June, 1951, and has remained there without interruption since that time.

EDGAR E. NEWMAN
Circulation Director

Edgar E. Newman was born in Boonton, New Jersey, and is now married and has three children—Geoffrey, Douglas, and Lorie Jean. In the interval between, he pursued the usual preparatory studies, attended the American Institute of Banking, Naval Radio Communication Schools, and Melville Radio Institute. He joined Radio Magazines in April, 1947, as an editorial assistant, and a month later assumed duties as Circulation Manager for both AUDIO ENGINEERING and CQ in addition to his editorial duties. He became Circulation Director in June, 1952, and when the Book Division was formed in September of that year he became its manager. He became Managing Editor of LECTRODEX (formerly *Radiofile*), which is also published by Radio Magazines, Inc., in January, 1957. In addition to these duties, he is also Circulation Director of THE TIBIA. Furthermore, he was draftsman for AUDIO ENGINEERING for a number of years, but as might be expected from the list of his present duties, the days were just not long enough.

The importance of the Circulation Director in a publishing company is one which cannot be overemphasized, since he is likely to be the first point of contact between the reader and the organization, and it is from him that readers are most likely to form their impression of the magazine. It is a position that requires patience, skill, and tact, yet all the while it is made up of thousands of small operations—any one of which can win or lose a friend for the organization.

How well Mr. Newman meets these requirements of a difficult assignment is attested by the many friends he has among our readers. Aside from his family, he receives his greatest pleasure in receiving subscriptions to AUDIO.



EDWARD TATNALL CANBY

A simple listing of Edward Tatnall Canby's activities since 1927 would more than fill this page. He attended both Yale and Harvard, earning AB and MA degrees in music at the latter, and during the summers he went to Concord Summer School of Music. He was Instructor in Music at Princeton for three years and at Finch College for four, and was Visiting Professor of Music at Washington University for one year. In addition, he has done private teaching of harmony and musical analysis.

Mr. Canby has been the mainstay of the record review and music sections of AUDIO ever since the first issue in 1947, and is considered by many as the most reliable record reviewer in the country. He has an intense interest in records and in their proper reproduction, and while he approaches hi-fi equipment from the viewpoint of the novice, his analysis of its performance is usually well-founded and in many cases has been of considerable assistance to manufacturers. His AUDIO ETC column is devoted largely to observations on equipment and to the musical scene at large, and is invariably entertaining. He also reviews records for *Harpers, The Review of Recorded Music,* and *Musical Courier,* and has appeared in many other publications. He is the author of "Home Music Systems" (Harper & Bros.) and with C. G. Burke and Irving Kolodin co-authored "The Saturday Review Home Book of Recorded Music."

He is a member of the Audio Engineering Society and of the American Musicological Society, and is on the Committee on Recordings of the National Council of Teachers of English. He has appeared continuously on radio station WNYC in New York since 1947 (where AUDIO first heard him) and has his own program throughout the United States and Canada on transcription and tape.

CHARLES A. ROBERTSON

Mr. Robertson tells us that his collection of records was started in the late thirties, after he attended Columbia College and found out that it was practically impossible to replace those he had enjoyed there and later given away. His tastes extend to a goodly portion of recorded literature—jazz, oddities, and classical—but he confines his comments in AUDIO to the first two categories. Many of the finest performances of jazz were recorded in the 20's and 30's, and in those later years it was still possible to find some rare items in stores and junkshops. Mr. Robertson was fortunate enough to concentrate on them. Two rich lodes were in export companies gathering discs for shipment to South America, and in return for going through stacks of records and salvaging those still saleable, he could keep those he wanted at only one cent each.

He ended this era with two years in the Air Force as a tail gunner on a B-24 in England, and upon returning he found that the old shellacs had been reclaimed to make the evil-sounding wartime product, so he bought only those he could not resist.

His hi-fi components were put together just as the Korean War began to make them scarce, and he went back to buying as many records as three growing children allowed. Strangely enough, Mr. Robertson is a working newspaperman—and has been for 22 years—and when not hunting records (which his night beat gives him daytime "leisure" for) he gardens and collects books. He has been with AUDIO for a relatively short time, but his reviews on jazz and variety items are sound and are couched in ordinary English—a rarity in the jazz reviewing field where one is assumed to be an *aficionado* if he reads jazz reviews at all, with its attendant phraseology which is lucid only to the cats.

HAROLD LAWRENCE

Without some knowledge of the material we use in our music systems for just listening, we would most certainly derive much less enjoyment therefrom. And it is in this realm that Harold Lawrence helps us all out with his regular feature, ABOUT MUSIC. He is a native New Yorker, and has studied piano and composition both here and in Paris. He has written extensively on music for the *New York Times* Book Review and Music sections, the *Saturday Review*, the *Reporter*, and other publications. He has also lectured on musical subjects of the School of General Studies of Brooklyn College as well as for the *New York Times* and the New York Board of Education.

He managed the Imported Records Department at Liberty Music, Inc.—one of New York's largest music and record stores—in the late forties; was director of recorded music at WQXR from 1950 to 1956, and is presently music director of the classical division of Mercury Record Corporation. His first column appeared in AUDIO in April, 1954, and he has been in every issue since.

AUDIO believes that most people who are interested in high-quality sound reproduction have that interest because they like music, yet the average person has not had the opportunity of acquiring a musical education along with the other skills he must have to make a living unless, of course, he makes that living from music. Mr. Lawrence approaches music with a practical viewpoint and never becomes stuffy or pedantic—largely because he has a sense of humor. His material is not intended to be weighty or profound, but only to give us an insight into the general subject of music, and particularly into the methods of approach employed by composers and the performers of their music. We like to think of ABOUT MUSIC as "painless education."

JOSEPH GIOVANELLI

It was in April, 1929, when the light of day first saw Joseph Giovanelli. During his childhood it seemed that his natural bent would lead him to be a watch repairman (or, to describe it more correctly, *breakman*), but eventually his inclination turned to breaking radios instead, which developed finally into a serious interest in electronics. He studied the basics of electronics in high school at the New York Institute for the Education of the Blind, and during the same period he became a radio amateur and later got his first class radio telephone (commercial) license.

He obtained much practical experience in sound reproduction during his four-year stint at Syracuse University, from which he graduated *cum laude*, where he made many location recordings of symphony concerts and concert band performances as well as shows, singing groups, and, in short, almost any kind of recording. To round out his knowledge and to get a fuller appreciation of the problems of the sound engineer he studied musicology, acoustics, radio writing, radio production, and radio advertising, and he worked in the school radio station.

He now has his own recording studio, designs and builds specialized meters and other types of equipment, and builds and sells a custom speaker of his own design incorporating ideas he first had as a grammar school student. This speaker is included in any of the custom hi-fi installations which he makes in his spare time. He has been a regular contributor to AUDIO since November, 1955, and his department—AUDIOCLINIC—draws more correspondence than any other. In this issue, Mr. Giovanelli proposes an extension of the question-and-answer technique to include "answers" provided by readers—the new department to be known as AUDIO TECHNIQUES.

Hi-Fi Salesman—Friend or Foe

Reflections of a hi-fi salesman on the whys and wherefores which govern the intelligent buying of sound equipment. Watch out for the well-meaning friend.

MARCO KARPODINES*

THE PURCHASE of a home music system is an important event, akin in many respects to the purchase of a new car. First, it is a major acquisition, often an expensive one. Second, it provides pleasure rather than just filling a need. Third, it requires proper advice, and there the similarity ends.

In buying a new car you shop around, decide on a make you like, and then buy it—as is. The salesman does his part by pointing out the virtues of the particular car he represents in the light of your own needs, and once he does that his job is over. The audio salesman, however, is a different breed from our auto salesman in many ways. First of all, he carries many different brands of merchandise. His shelves contain innumerable tuners and amplifiers, many speaker systems, not to mention turntables, cartridges, enclosures and various accessories. A formidable array. However, he is not interested in any one particular item as such, but rather in your own personal requirements.

Price is often the most important consideration. So, although a first glance at all the equipment on display may leave you confused, your budget will eliminate many items. Limited space, possession of certain still-usable components, the desire to modernize or purchase in steps rather than all at once, possible custom or inbuilt installations; all these factors also tend to narrow down your ultimate selection. Thus, although there may be many systems available, there is only one that best meets your own individual requirements.

The audio salesman should have some technical background. He is constantly asked technical questions concerning equipment, and your money is riding on the accuracy of his answers. Obviously, you want to feel that you are making a proper purchase, and the only way to insure this is to make certain that the person advising you is technically qualified.

The Well-Meaning Friend

Friends always stand ready to advise you—both before and after you have bought your hi-fi system. But keep the following in mind. Although advice may be given freely, if the results are not satisfactory, it is the salesman who must be prepared to rectify mistakes. Your dealer stands to lose or gain on the basis of your purchase. If you are pleased with the sound and operation of your equipment, he has made his profit, you have purchased wisely, and all is well. If you are not satisfied and return for either adjustment or replacement, he has lost money. He holds himself responsible to you and he bases this responsibility on the soundness and experience of his salesmen.

On the other hand, a friend who ill advises is not liable to answer for the results obtained, either good or bad. Why should such emphasis be placed on this point? *Simply because the greatest cause of mis-matched or un-hi-fi systems is the well-meaning friend.* He has a particular cartridge with a particular speaker in his home so he feels it is best for you. It may be the most unhappy combination for your installation because of the difference in acoustic conditions which prevail in your home and his. But room acoustics are often neglected in his consideration. Only a properly qualified sales technician should advise you on your installation.

This attitude is backed by the growing sale of used high fidelity equipment. Much of this equipment is sold or traded-in within one year of purchase, but not because it is defective. In fact, most of it is in perfect condition. It is unsatisfactory because it just does not sound right in the listener's home. Admittedly there are exceptions, but this is generally the case, since some of the best known components in the high fidelity field simply do not work well with one another. This fact has been proved in the most practical audio testing lab ever devised—the sound sales demonstration room.

Demonstration Technique

More frequently than not the determining factor in the final choice of a component or a complete system is the demonstration. It is true, although hard to believe, that the average person, in an initial A-B test, will generally prefer the poorer sounding of two speakers. But poorer sounding to whose ears? The customer's ears—but only before he has been shown or taught what to listen for and how. Let me explain.

The loudspeaker is possibly the most difficult-to-choose single component in any home music system, and is the one item which should be selected on the basis of a subjective listening test. This does not minimize the importance of a tuner or amplifier. The problem is attributed to the fact that, whereas distortion measurements and specifications have been standardized in the case of amplifiers, for example, practically speaking, loudspeaker measurements do not lend themselves to the same degree of mathematical analysis.

Speaker selection poses an additional problem in that the average person exposed to extended-range sound for the first time will perhaps find the higher frequencies objectionable. It then becomes the job of the audio salesman not only to demonstrate but to explain and teach. The listener must be shown that the offending highs are actually the top sheen of the violin or the overtones of the trumpet—sound he may not have heard live in a long while. Once this type of customer appreciates these basic sounds, his final decision is readily reached.

It is the approach to this realization that sometimes makes the audio salesman's job a difficult one. Most customers want to be shown why they should invest more in a better speaker. But before they can detect the difference between speakers they must be taught what to listen for and how. In other words, a good audio salesman must be a good teacher as well as a handy man with the records.

All too often, demonstrations are allowed to deteriorate into a hodge-podge ABCD listening test which proves nothing in particular. The true A-B test should be of extremely short duration, since if extended past a reasonable five-to-ten-minute time limit, it generally tires and produces confusion. In an A-B comparison, more than two speakers should not be demonstrated at the same time. The customer's decision should be made between two speakers. Then a third speaker can be introduced and compared with the preferred one of the two he has already judged.

Although demonstration technique is of prime importance, the effectiveness of any demonstration is determined by the appreciation of the salesman for the customer's individual needs. In no other industry must the salesman so thoroughly shoulder the responsibility of his recommendations.

If for no other reason, the sound salesman must, literally, always be on the customer's side. Remember this when you shop for high fidelity equipment. Profit by the salesman's technical background, take advantage of his experience in planning home music systems, and above all, accept him as one who gains only if you are thoroughly satisfied with the equipment you purchase.

He is the well-meaning friend we mentioned earlier with one exception—*his opinions are backed by sound judgement.*

* *1510 Elm Ave., Brooklyn 30, N. Y.*

Pharaoh had the words for it!*

Photos courtesy of the Metropolitan Museum of Art

*hearken

ye

it is
indeed
that

the voice of

Unibrsity

(symbol for
loudspeaker)

(is) good

more than
anything

The pyramid builders had no high fidelity loudspeakers, but their ancient language had the "words" for this ultra-modern development . . . as demonstrated by this translation into hieroglyphics of University Loudspeakers' slogan.

It's a slogan University proudly introduced to the high fidelity field because it summarizes our aim: *to provide you with truly better listening.*

Words can try to describe this superior sound . . . but the rich tonal pleasure offered by these loudspeakers is experienced only when you *hear* them.

So whether in hieroglyphics . . . or in Chinese, Arabic, Greek, Sanskrit or Hindustani used in other University advertisements . . . this slogan conveys our sincere invitation to visit your dealer and . . .

LISTEN *University sounds better*® HIGH FIDELITY

Translation into Early New Kingdom monumental type hieroglyphics by Cyril Aldred, associate curator of the Department of Egyptian Arts, the Metropolitan Museum of Art, N.Y.C.

"Listen, University Sounds Better" posed novel difficulties to Egyptologists when translated to hieroglyphics. For example, the simple English request, *listen,* became *hearken ye, it is indeed that.* There was no Egyptian verb for *to sound,* so *the voice of* was substituted. And since the Ancient Egyptians used no comparative forms of adjectives or adverbs, they had no word for *better;* instead, the labored construction *good, more than anything* was substituted.

For *University* the "easy" symbol of *school for scribes* could not be used, since the name refers here to a manufacturer. *A brand new "high fidelity" hieroglyphic was developed* by "vocalizing"—phonetically spelling out—University as *unibrsity* (there was no "v" in Ancient Egyptian). Then, just as the Egyptians did when inventing a hieroglyphic for an object, a picture of the loudspeaker was added . . . thus bringing a 4,000-year-old form of picture writing up to date on 20th century high fidelity sound!

Ford Memorial Auditorium Exemplifies Sound Redesign

BERT ENNIS*

Photos by Ed Sullivan, Paramount Staff Photographer

While many public buildings are outfitted with "commercial" quality public address and sound reinforcement systems, the newest trend is to employ broadcast-quality equipment in professional circuitry.

If the wraith of the man who gave the world the T Model Ford were to visit the Henry and Edsel Ford Memorial Auditorium, Detroit, in the 1957 version of his original car creation, his reaction to the advances engineering has made in the areas of acoustics and automotives might be well worth recording.

And oddly enough, as is the case sometimes in the automobile field, the remarkable sound reinforcement system which serves the magnificent, ultra-modern structure dedicated to the memory of the Fords, father and son, on the banks of the Detroit River, came about through the art of redesign; sound system redesign, that is.

When Detroit's city fathers decided a few years back that drastic face-lifting operations must accommodate the mammoth Lawrence Seaway project, the Ford Foundation—together with Lincoln and Mercury dealers in the area—came into the picture. In company with a Veteran's Building, new Convention Hall, County and City Buildings, plans were drawn for the erection of the Henry and Edsel Ford Memorial Auditorium. Toward an over-all expenditure of five million dollars for this building, the Ford Foundation donated one million, the aforesaid car dealers contributed another million and a half, with the city of Detroit picking up the tab for the balance. Completed late in 1956, the Auditorium is the third of the numerous structures comprising the Civic Center now rising along the shore of the rehabilitated Detroit waterfront.

An enormous array of architects, contractors, engineers submitted plans and specifications, including those of Harlan Electric Company, electrical contractors, involving a sound reinforcement system calculated to serve an auditorium project of this magnitude properly. For this project embraced a huge stage, lower floor and balcony seating 3000, rehearsal halls, dressing rooms, a 100-member orchestra pit, a Social Room accommodating 500, with its own stage.

Into this multimillion dollar maze of construction and plans came late, but decisively, a man named Alan Roseberry.

Fig. 1. The magnificent structure known as the Henry & Edsel Ford Memorial Auditorium, located on the Detroit River along the redeveloped waterfront of the city of Detroit, is equipped with one of the most elaborate and comprehensive sound systems in the country.

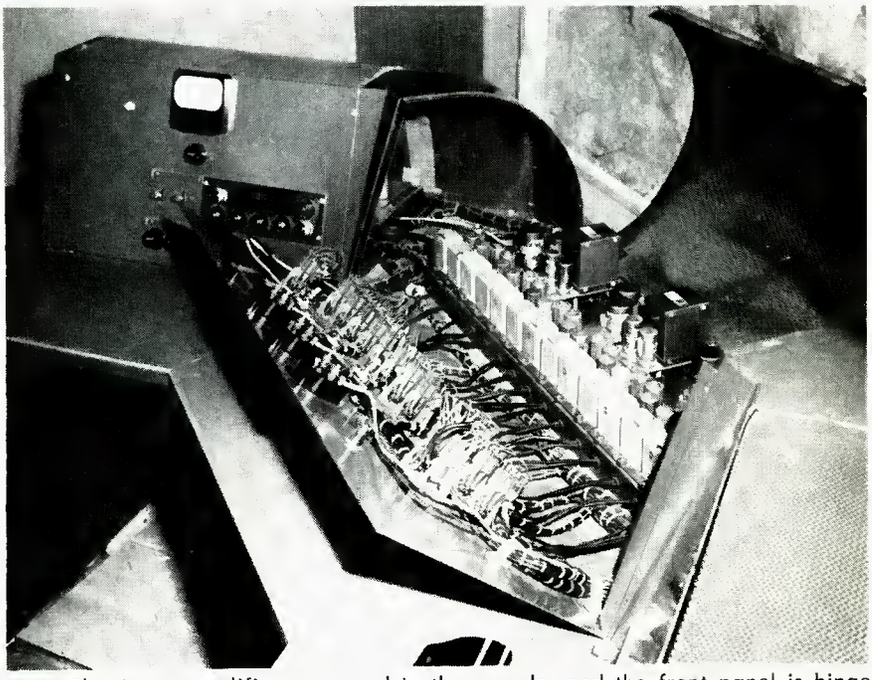


Fig. 2. Plug-in preamplifiers are used in the console, and the front panel is hinged to permit fast and easy access for inspection and service.

* *Altec Lansing Corporation.*

Modern High Fidelity by Pilot

Born of 37 Years of Electronic Experience

CHOOSING YOUR AMPLIFIER

Power Output, Frequency Response and Distortion

The most flaunted amplifier features in the world—*high power output, wide frequency response, low distortion*—are virtually meaningless terms unless they are interrelated. Specifications that fail to show this relation, say nothing, and can be quite deceptive.

An amplifier that claims "*20 watts of audio power—20 to 20,000-cycle frequency response—and less than 1% harmonic distortion*" may have them all. But, there is nothing to indicate any relationship among them. The distortion may be "less than 1%" ...at 2 watts, and only between 50 and 8000 cycles, beyond and below which the distortion may rise appreciably. At 20 watts the distortion may be as high as 10%. Who knows? The 'facts' are not facts.

Here for example, are the vital specifications of two new Pilot amplifiers with built-in preamps. Note how they are stated. There isn't the slightest chance for misunderstanding.

Both amplifiers have built-in preamps with equalization for tape-head playback as well as for records. Other features include: variable phono input impedance, independent bass and treble tone controls, rumble and scratch filters, separate loudness and volume controls, tape recorder output and use of hum-free dc on tube heaters.

	AA-903B (illustrated)	AA-920
Power Output	14 watts	20 watts
Total Harmonic Distortion at Rated Output	less than 1%	less than 1%
Intermodulation Distortion at Rated Output	1.5%	1.5%
Frequency Response at Rated Output	20-20,000 cycles ±1db	20-20,000 cycles ±1db
Price	$79.95	$99.50

prices slightly higher west of Rockies

There is a promise of performance in these statements upon which you can really rely in choosing your amplifier—a promise that will be fulfilled the very moment the amplifier is turned on in your high fidelity system.

And, as an added reward for your choice of Pilot, you will enjoy styling that will always bring admiring comment when shown off in your home—handsome metal enclosures finished in contrasting burgundy and burnished brass. A Pilot Amplifier alongside a Pilot Tuner make an attractive pair on an open shelf or table.

At your hi-fi dealer, or write for complete specifications to Dept. FE-1.

Pilot **RADIO CORPORATION** 37-06 36th Street, Long Island City 1, N. Y.

IN CANADA: Atlas Radio Corp., 50 Wingold Avenue, Toronto 10, Ontario

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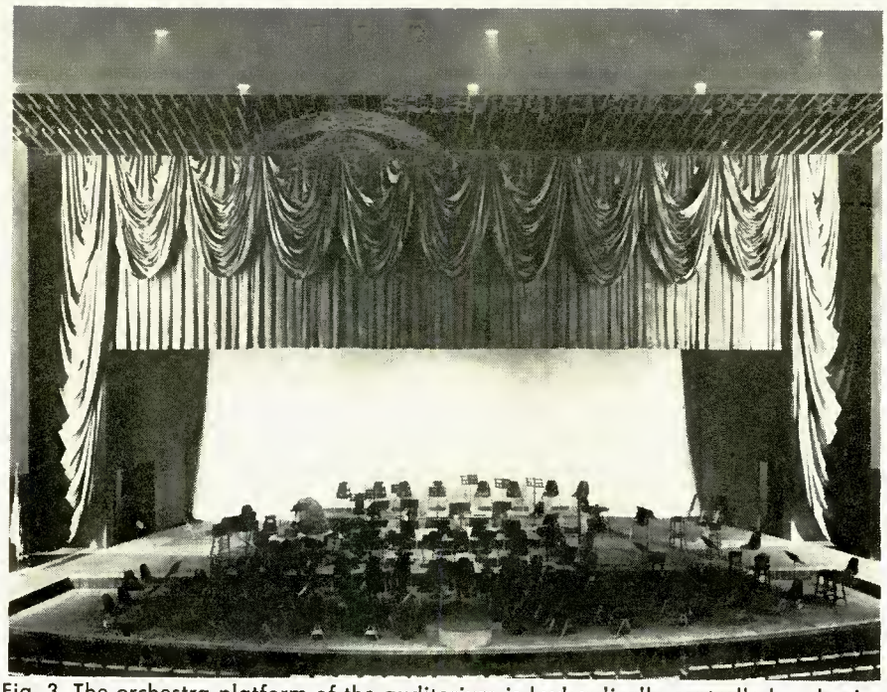

Fig. 3. The orchestra platform of the auditorium is hydraulically controlled and raises up to the level of the stage. Three "Voice of the Theatre" systems are installed in the grille above the curtain to provide three-channel stereophonic sound.

Fig. 4. The control room is provided with Rek-O-Kut turntable, three-channel Ampex recording and playback mechanism, two Altec FM-AM tuners, and four power amplifiers in addition to complete control console.

Head of the firm of Roseberry & Son, Detroit sound-engineering dealer, he secured from Harlan Electric Company an order to install a specified sound system. Poring over these specifications, Roseberry noted they called for a miscellany of public-address equipment, an imported line of intercommunication telephones, with public-address equipment for the Social Room differing in make from that chosen for the auditorium.

Satisfied that the specifications would not provide a sound system worthy of the project, Roseberry sought and obtained permission from the electrical contractors to redesign a system around a complete line of Altec equipment. For a period of weeks he and his son took upon themselves the task of building in their studio the exact systems called for in the original specifications, using the equipment designated. They then put together an alternate system comprised of Altec components.

Fig. 5. Above the unique murals on the walls, the ceiling of the auditorium rotunda is equipped with five 8-inch speakers in Lowell baffles.

When this man-sized chore of redesign had been completed Roseberry invited an audience of architects, contracting engineers, Detroit city engineers and officials of the various Ford organizations involved to attend a comparison demonstration. Employing identical music and voice sources on both the original and alternate system, Roseberry left the decision to this critical jury. The verdict was unanimous. The Detroit sound expert was given the go-ahead to install a complete Altec system. Matters of price differential concerning a cost rise of approximately $12,000 were ironed out. Approval of the $40,000 eventual price tag on the work and equipment involved in the redesign project was manifest by the comments of officials during a trial run prior to official opening of the Ford Auditorium. Patron reaction since the system has

What Price High Fidelity?

If you're a musically literate audiophile—rather than just a hobbyist with sound—you're more concerned with high fidelity performance than you are with electronics.

You want predictable results—and know you must pay for professional audio engineering to get them. You'd rather leave the uncertainties—together with the expense—to the hobbyist.

You're no doubt pretty wary of advertising claims—and weary of listening to pseudo information and double talk by salesmen hot after a sale. You're lucky. Or wise. Or both.

Too many "Do-it-Yourself" schemes to make things "easy" for the uninitiated are all too often unsatisfactory . . . costly.

Who, but professional engineers, are qualified first to select—then precisely to integrate and balance the many components of a high fidelity system? Who, but experienced engineers, are equal to the exacting demands of designing and constructing horn enclosures? Who, but technically competent people—supplied with all the elaborate equipment necessary—can measure the performance characteristics of a sound system, account for its mechanical operation, see to its unimpaired functioning? All you need do *yourself* is listen.

And who, but you, can judge whether or not a sound system fits your ear . . . your recordings . . . the individual acoustical requirements of your home? There are a few superior sound systems. AMI has made one of them. It will never be "sold" to you—but you may buy it . . . *after* you've decided that it's for you. Six different models.

Write now for the name of a dealer nearest you. Illustrated literature and performance data will be forwarded to you.

The Precision Instruments of High Fidelity

AMI

1500 Union Avenue, S. E.
Grand Rapids 2, Michigan

Engineers, Designers and Manufacturers of Professional and Commercial Sound Systems Since 1909.

EXCLUSIVE THREE-CHANNEL FRONT-LOADED EXPONENTIAL HORN SYSTEM: Below 45 cps to above upper limits of audibility. Exceptional transient response. Three-way frequency-dividing network with cross-over at 550 cps and 4,000 cps. High output 22 watt amplifier with preamp for 20 to 20,000 cps range. Less than 2% IM distortion (60 cps and 7,000 cps; 4::1 ratio signal). Precision calibrated bass and treble tone controls for definite steps in cut and boost; separate continuously variable volume control: professional three-step loudness control: 12 db/octave high frequency roll-off control (scratch filter); equalization controls. "Tuner," "Mic," "Tape," TV input and "Mag Tape" output. AM-FM tuner with AFC: 4-speed precision intermix changer of advanced design; G-E variable reluctance cartridge with 1 mil diamond and 3 mil sapphire styli.

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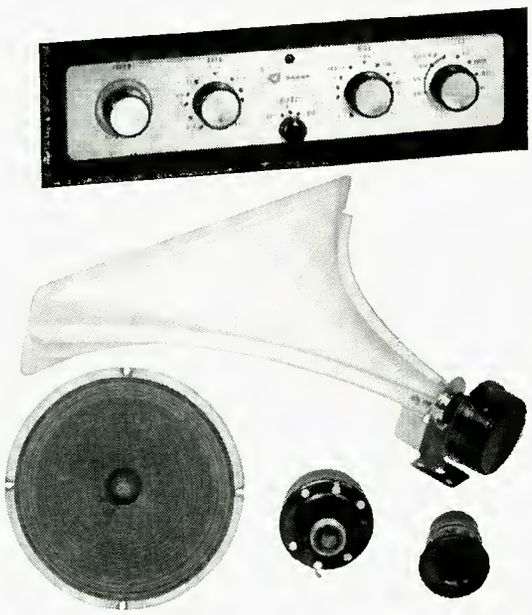

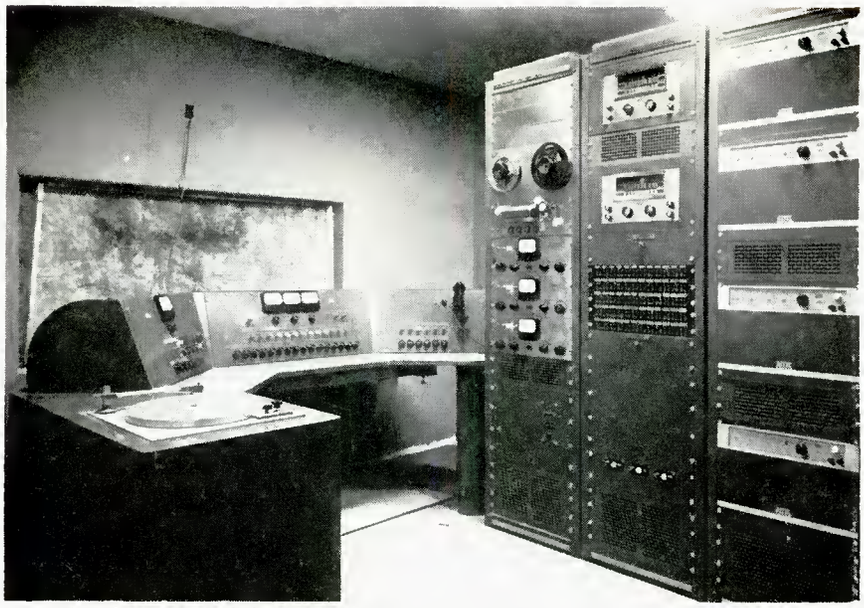

Fig. 6. Another view of the main equipment racks which are located to the right of the control console. System is engineered to serve as feed for radio broadcast or TV audio pickup when required, as well as to provide sound reinforcement.

Fig. 7. Tom Roseberry, of Roseberry & Son, points out some of the features of the control console. Telephone communication is provided throughout the building from the control room, linking all production and operating facilities.

been in regular operation has confirmed this judgment.

System Requirements

A highlight of the system is the employment of three channel stereophonic sound in the main auditorium. Originally, the design provided for only 35 watts of power feeding a speaker array with a frequency response of only 80 to 7500 cps. This was proved to be inadequate. Redesign permitted the 75-watt output recommended by the Research Council of the Academy of Motion Picture Arts and Sciences to serve an auditorium of this size properly. Additionally, the speaker array was redesigned to accommodate this increase in power, and to afford a more realistic frequency response of 30 to 22,000 cps. Low-frequency horns and high-frequency multicellular horns were installed in the proscenium arch to accomplish these desirable and necessary ends.

Ample microphone inputs, 31 in all, were installed throughout the entire area. Magnetic loops, placed in the floor of the auditorium, were a proper concession to the future application of the presently experimental audio-frequency wireless microphone. Four of the microphone locations on the stage, capable of handling any type of production in point of magnitude, utilize automatic microphone stands. Controlled from the stage switchboard, these stands are electrically driven to permit elevation from below stage level, through automatic doors, to a height six feet above stage level.

Installed in the unusually large control room strategically located in the rear of the main auditorium is a functionally-designed, compact control console. This instrument accommodates a professional-type turntable, and a transcription pickup arm. Here again, the art of proper redesign entered the picture, as the original plans provided a turntable of a type usually found in an inexpensive portable phonograph. *Figure* 8 is a simplified block schematic of the entire installation.

The left turret of the console contains the phono volume and tone controls, talkback microphone controls, tape-recorder remote controls, and the "All-Bridge control." The center turret holds the stage microphone controls, master volume controls, speech-music filter, and VU meters. In the right turret are installed the controls for audience microphones.

The "All-Bridge control" governs the circuit which bridges each of the three channels, combining these into a monaural feed which may be used to feed radio and TV, as well as the other systems throughout the auditorium. The speech-music filter is employed to increase the intelligibility of vocal performance.

If at any time conditions warrant the use of either a single- or a two-channel system, provision has been so made. A

"You'll Have The Best in Hi-Fi Sound with a Jensen Speaker System!"

ADD YOUR OWN TOUCH TO HI-FI...and SAVE!

You'll enjoy hi-fi music doubly when you put together your own easy-to-assemble Jensen speaker kit . . . and you don't need a work shop. The acoustically correct Jensen-designed Cabinart enclosure kit and the famous Jensen loudspeaker kit can be assembled right in your living room without any messy woodworking or wood finishing. Everything is accurately pre-cut and *pre-finished* with a professional furniture finish in your choice of mahogany or korina blonde. You'll have the same fine matched speaker components used in Jensen's factory assembled complete high fidelity reproducers—and at far less cost, too!

Send 50¢ for your copy of Manual 1060 for full information about selecting and building Jensen speaker systems.

System Type	"Woofer" Size	Equivalent Jensen Reproducer	Jensen Speaker Kit		Cabinart Cabinet Kits				
			Model	Price	Type	Basic Cabinet Kit	Price	Dress Kit‡	Price
3-Way	15"	Imperial	KT-31	$184.50	Corner* Horn	K-101	$89.00	P-201	$54.00
3-Way	15"	Triplex	KT-32	169.50	Corner* Bass-Ultraflex	K-103	48.00	P-203	39.00
3-Way	15"	Triplex	KT-32	169.50	Low Boy Bass-Ultraflex	K-105	48.00	P-205	39.00
2-Way†	15"	——	KT-21	99.50	Corner* Bass-Ultraflex	K-103	48.00	P-203	39.00
2-Way†	15"	——	KT-21	99.50	Low Boy Bass-Ultraflex	K-105	48.00	P-205	39.00
2-Way†	12"	Concerto	KT-22	73.00	Corner* Bass-Ultraflex	K-107	39.00	P-207	36.00
2-Way†	12"	Concerto	KT-22	73.00	Low Boy Bass-Ultraflex	K-109	39.00	P-209	36.00
2-Way†	8"	Contemporary	KDU-10	24.75	Corner* Bass-Ultraflex	K-111	23.00	P-211	25.00
2-Way	8"	Duette Treasure Chest	KDU-10	24.75	Duette	K-113	18.00	P-213	21.00

* Gives excellent results against sidewall. Bass-Ultraflex is a Jensen trademark.
† Cabinet provides for expansion to 3-way system at any time with Jensen KTX-1 Range Extender Supertweeter Kit, price $43.75.
‡ Available in Mahogany or Korina Blonde.

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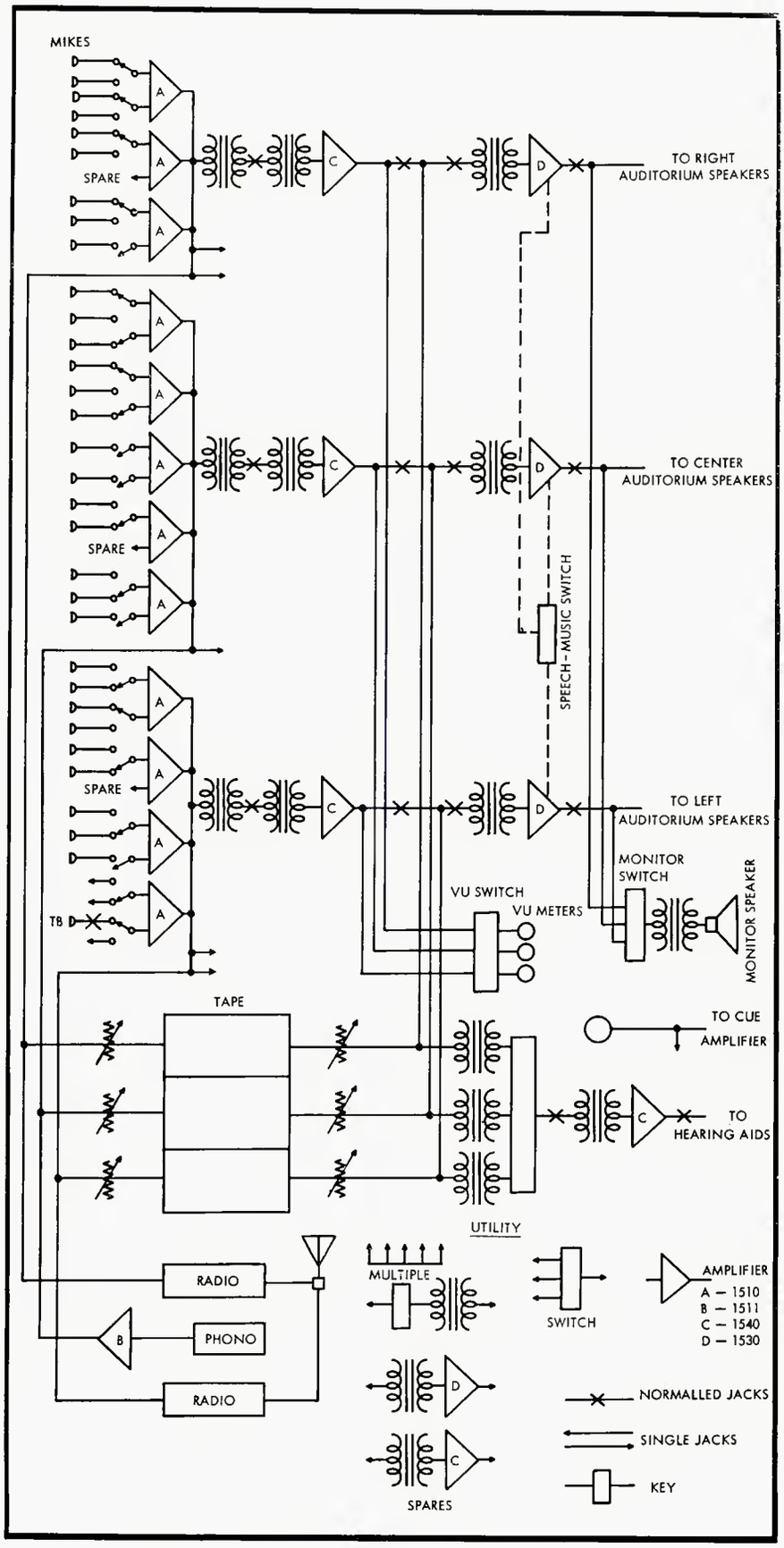


Fig. 8. Simplified block schematic of entire auditorium system.

patch panel has also been provided to offer more flexibility to the system. So that two-channel stereo programs may be received and played to auditorium patrons, two AM-FM tuners are available. A three-channel stereophonic tape recorder is part of the comprehensive control-room equipment. Operation of the three channels is entirely independent, except for the main a.c. supply. Steps have been taken to make sure the Henry and Edsel Ford Memorial Auditorium will always be certain of sound. Should one channel fail, the control engineer has only to patch the system into either a two-channel or single-channel setup, thus assuring continuance of the performance. During intermission, he may patch the faulty amplifier out, and patch in a replacement.

Another outstanding feature of the Ford Auditorium system is the telephone hook-up that ties the various operating points together, employing a common talking, selective ringing Western Electric phone system. Thus, during a performance, the stage manager has ready contact with spotlight men, projectionists, orchestra conductor, sound engineer, and all other vital locations.

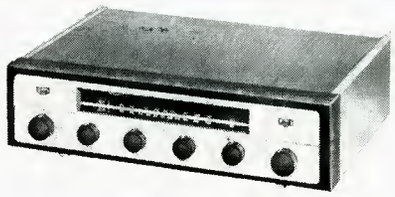
Backstage dressing rooms are completely covered by a cue system which permits the house manager or stage manager to page backstage, and to feed the performance to the dressing rooms by bridging the "All-Bridge Buss." He may also page the lobby, the large social room adjacent to the lobby, or he may permit the lobby system to be fed backstage.

The lobby system was specifically designed for the convenience and use of the chief usher. He can reach those in the lobby and social room, and when occasion demands, feed the stage performance to overflow crowds in these two locations. The system in the social room may be employed independently of the lobby equipment to reinforce the sound for small groups. Projector sound may also be fed through this setup.

Throughout this entire elaborate installation, 1500-series Altec amplifiers are used exclusively, with a variety of microphones of the same manufacture.

Through the process of redesign employed by H. A. Roseberry and Son, the quality of sound provided is such that various Ford Auditorium patrons are unaware that sound reinforcement is employed for a variety of stage attractions. As a fitting comment, it would seem proper to add that this monument of steel and stone to the Detroit automotive pioneer boasts of a decor equal in modernity to the sound installation. Magnificent murals and gleaming bas-relief figures employing gold-like metals provide an architectural beauty richly complementing the acoustic wonders of the Henry and Edsel Ford Memorial Auditorium.

THE BEST SEAT IN THE CONCERT HALL



It may be a difficult notion to accept at first, but most seats in a concert hall provide the listener with a compromised performance. For one seat, the violin is muffled; for another, a flute passage is lost. Even excellent halls suffer from unwanted reverberations and reflections, and frequently you must listen at a sound level substantially above or below that at which you listen best.

Were you free to shift from seat to seat in the concert hall, you would finally arrive at the one, uniquely best for you—the seat in which you could hear the music as the composer would wish you to.

Although it isn't practical to play concert hall "musical chairs", you can now effect that one best seat *in your own home* with Harman-Kardon high fidelity instruments. There, free of the acoustic limitations of the concert hall, untroubled by audience noise and the accident of seating location, you and the music meet under ideal conditions.

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The two high fidelity instruments seated atop the cabinets in our illustration are The Rondo AM-FM tuner, model T-120, and The Melody amplifier, model A-120. Each is only 12½" wide by 3¼" high by 7½" deep. A total of seven operating controls and two slide switches provide: magnificent Armstrong FM with Automatic Frequency Control to insure accurate tuning *automatically;* sensitive AM with built-in whistle filter; dynamic loudness contour control to provide precise balance for your own hearing characteristics; separate bass and treble tone controls; record and FM rumble filters; built-in record equalization; remote speaker selector switch; and 20 watts of distortion-free, hum-free power output.

The Rondo tuner and Melody amplifier each sell for $95.00.

The Recital, model TA-120 (silhouetted above), priced at $175.00, combines all the features of the Rondo and Melody in one compact, handsome unit only 14¾" wide by 3⅝" high by 10-15/16" deep. Simply plug in a suitable loudspeaker and record player, and a high fidelity system of incomparable performance and unique good looks is yours.

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A Single-Channel Transistorized Remote Amplifier

Built to broadcast standards yet miniaturized as completely as a pocket radio set, this unit provides the necessary amplification to feed a line at normal levels. The circuitry and techniques are worth a thorough study by the experimenter.

JOHN K. BIRCH*

ONE METHOD OF CLASSIFYING the wide variety of remote broadcast amplifiers that have appeared over the years is according to the method by which power is obtained. Although a.c. equipment is the most straightforward, battery operation has always been extremely desirable, as anyone will agree who has tried to stretch a 300-foot extension cord to the field house 400 feet away at an unfamiliar athletic field. But all battery powered amplifiers have two things in common—they are heavy, and they defy any reliable estimate of useful activity remaining in their power plants. This uncertainty plus the factor of shelf deterioration result in a considerable economic problem where extensive portable operation is planned. To the designer of remote equipment, then, transistors supplied the means to build a unit with battery life far in excess of anything else available; in fact, one that would carry the broadcaster through an entire season on only one set of batteries. A discussion of the design considerations for such a unit should be of value to anyone interested in the portability and high-quality audio performance obtainable by the use of transistors.

At the outset of the development of this new remote amplifier, five design goals were listed which it was felt must be included at any cost. These will be described briefly.

Design Features

1. The complete assembly must be as small as possible to provide maximum mobility. Only one microphone input channel would be provided, adequate for a large variety of programs such as sports, interviews, and church pickups.

Size reduction had reached a stalemate in vacuum tube equipment not only because of the tubes themselves, but also due to the volume taken up by the power supply and transformers. Transistor circuitry permits the elimination of the microphone input transformer due to the inherently low input impedance of the common emitter amplifier. Working a 150-ohm microphone into a typical input impedance of 2000 ohms results in only a slight reduction in gain and signal-to-noise ratio, more than compensated for by the removal of the transformer. Omission of the "A" battery is one of the biggest factors in designing for compactness, and the VU meter can be considered unnecessary in a single-microphone set-up.

Fig. 1. The single-channel remote amplifier in its carrying case.

2. Frequency response and distortion must be held close to ratings for previous equipment. Transformer size and power output are the critical factors here and these must be equated with unit size, battery drain and typical program material to arrive at specifications which are not better than the service requires, nor below customary broadcast standards. A frequency response of ±2 db from 70 to 10,000 cps was decided upon, with harmonic distortion under 2 per cent at full output. Low-frequency response comes dearly with miniature transformers carrying d.c. in their windings, as will be described later. Response at the high end is dictated principally by the alpha cut-off frequencies of the four cascaded transistors, and here any inclination toward improvement is tempered by the hard facts of remote line performance.

3. An adequate overload factor must be provided. By this it is meant that if +4 U is to be the normal output level with program material, all specifications must hold for test with a sine wave signal 10 db higher, or +14 dbm. This is standard broadcast procedure, and it insures that the entire amplifier is able to handle peaks 10 db higher than normal without overloading—especially important here since no level-indicating device is provided.

4. A line-isolation pad must be included, of sufficient attenuation to reduce the effects of variation in line impedance to a negligible amount. This is one of the more unpleasant aspects of remote amplifier design since it appears wasteful of hard-earned output milliwatts, but its value is proven by a few actual measurements.

A remote line one or two miles in length will measure quite close to 600 ohms when it is terminated at the console by a repeat coil and a 600-ohm attenuator. A longer line, or the presence of numerous stubs, may present an entirely different impedance. Response of the amplifier under discussion was measured at the line terminals when connected to a telephone line ten miles long. The following table shows the effects of the line isolation pad:

PAD	60 cps	10,000 cps
None	+ 4	− 13
2 db	+ 0.7	− 8
4 db	+ 0.5	− 6

* *Gates Radio Company, Quincy, Illinois.*

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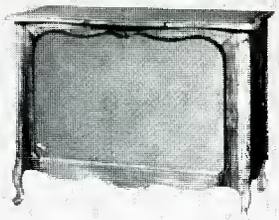

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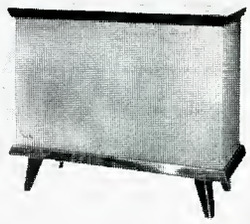

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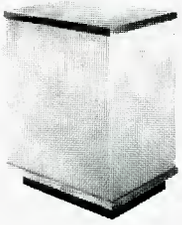

The B-302A Gem
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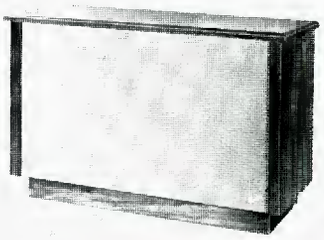

The Distinguished B-400
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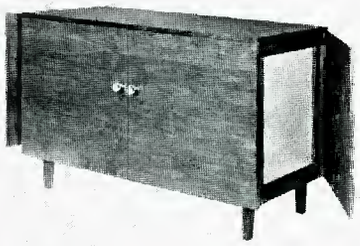

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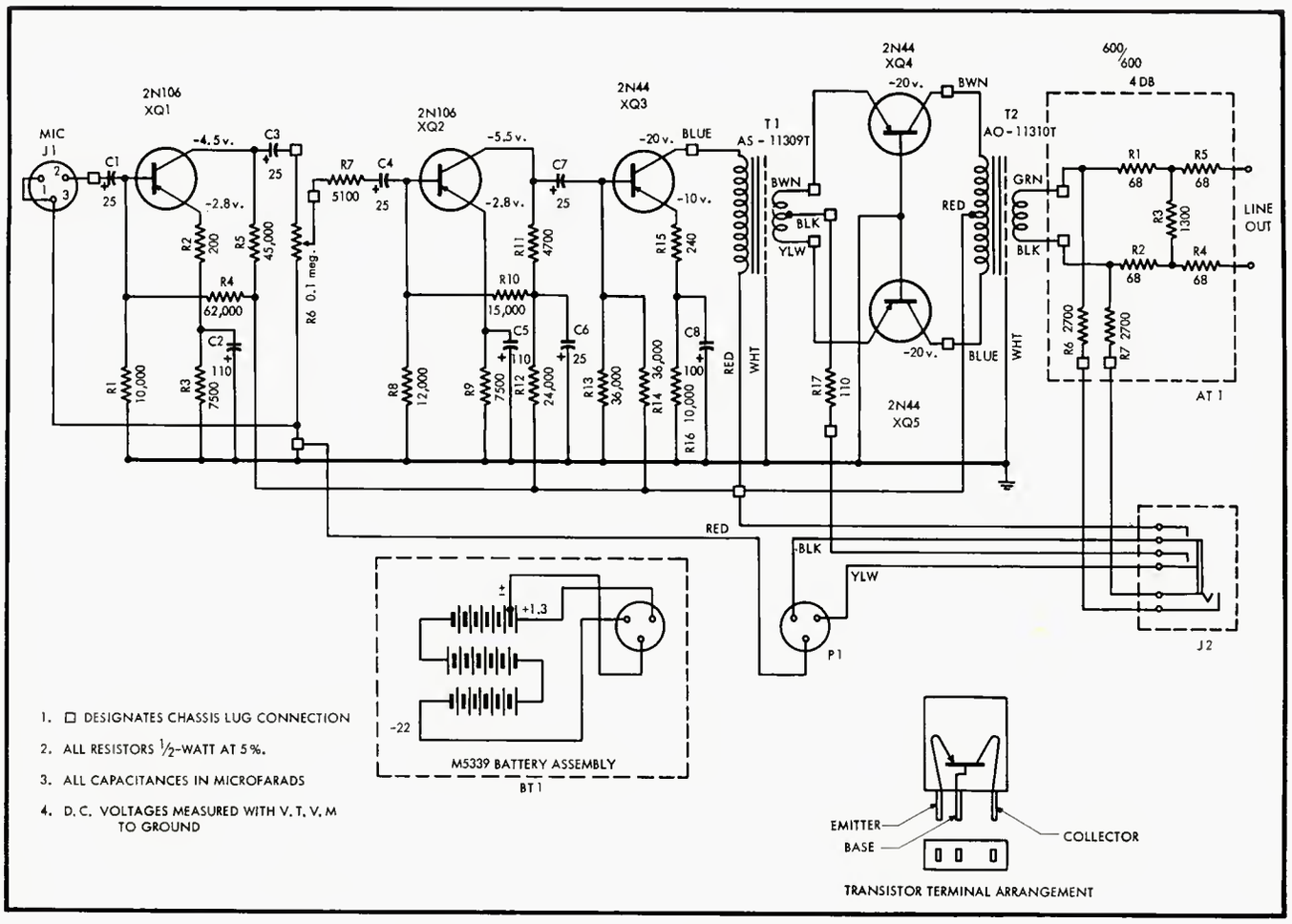


Fig. 2. Over-all schematic of the remote amplifier.

Effect of the line pad on decrease in output level when line impedance is reduced from 600 ohms to 150 ohms is as follows:

PAD	DECREASE
None	11 db
2 db	6 db
4 db	3.5 db

Decrease does not include loss in the pad. Note that the advantage gained by isolation more than compensates for the pad insertion loss; this would not be true, however, of pads larger than 4 db in this case.

5. Noise must be as low as is measured in similar vacuum-tube equipment, requiring an equivalent input noise figure of from −115 to −120 dbm. A brief discussion of equivalent input noise might be of interest, since it illustrates an important phase of amplifier design.

Visualize a two-stage amplifier having a volume control between stages. With the control open, a signal of −50 dbm (50 db below a reference of 1 milliwatt in 600 ohms) is fed to the input, and a level of 0 dbm is measured at the output. When the signal is removed the noise present at the output terminals is found to be 60 db below the output level. We would then say that this amplifier has a signal-to-noise ratio of 60 db. Increasing the input signal by 10 db to −40 dbm will make it necessary to turn down the volume control until it produces 10 db of attenuation to obtain 0 dbm out. Now when the signal is removed, the noise will measure 70 db below the signal because the control is attenuating 10 db of the noise originating in the first stage. We could now say that the amplifier had a signal-to-noise ratio of 70 db, but since it is the same amplifier as before we must resist the temptation and look for a more accurate method of describing noise.

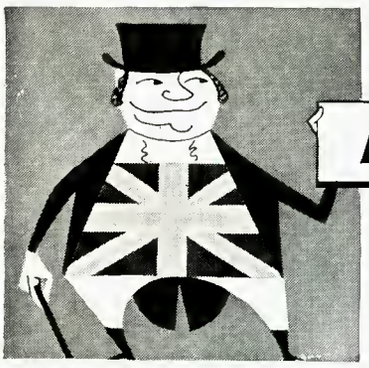
It is best done by relating noise to the input signal, because by doing so attention is focused on the principal source of noise—the input circuit, and it can be seen at a glance what is the lowest level the amplifier can accommodate and still produce the desired output noise level. Equivalent input noise is obtained by adding the output signal-to-noise ratio to the input signal level, and it may be thought of as being the output level of a hypothetical noise generator connected to the amplifier input. In the two examples given, the equivalent input noise level would be −110 dbm. It can readily be seen that this figure is not affected by the setting of the volume control. The foregoing example, in which the signal-to-noise ratio improved for a constant output as the input level is raised, illustrates the advantage of placing the attenuator *after* the input stage in a line or monitor amplifier, and employing high-level mixing in a multichannel amplifier.

An important point here is that the interstage volume control must not be turned down to the point where the input to the second stage falls below the input to the first stage. If this occurs, the signal-to-noise ratio will be decreased by the amount of the difference between input levels. Also, where the two levels are nearly the same, the second stage must have as low a noise figure as the first.

These features have been included in the amplifier pictured in *Fig.* 1 and shown schematically in *Fig.* 2, but only after overcoming a number of problems that are peculiar to transistor circuitry. One of these—temperature stabilization—has been so thoroughly covered before[1] that the method used here will be recognized as quite conventional. The rest are concentrated in the input and output circuits.

The Preamplifier

As mentioned previously, noise in the preamplifier is of utmost importance,



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Max. plate dissipation	12W
Max. screen voltage	300V
Max. screen dissipation (max. signal)	4W
Max. cathode current	65mA

Base

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British high fidelity experts know that for medium powered equipment there is no finer tube than the EL84. A pair of these tubes provide a power output of 10W at a distortion level of less than 1% while their transconductance value of 11,300 μmhos results in exceptional sensitivity. The EL84 may also be used for higher powers. For example, two tubes in push-pull will provide outputs of up to 17W at an overall distortion of 4%.

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Supplies of the EL84 for replacement in British equipments are available from the companies listed.

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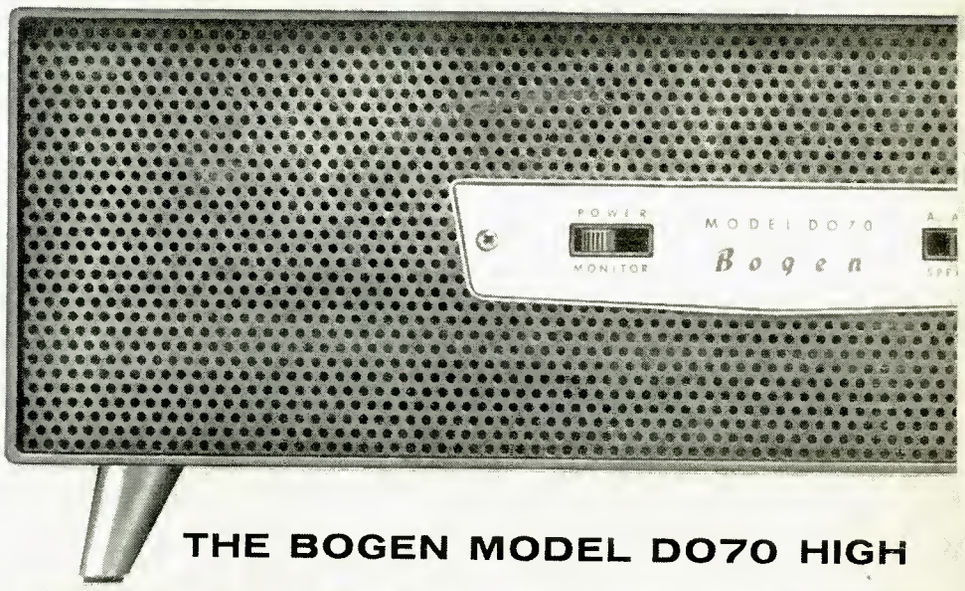

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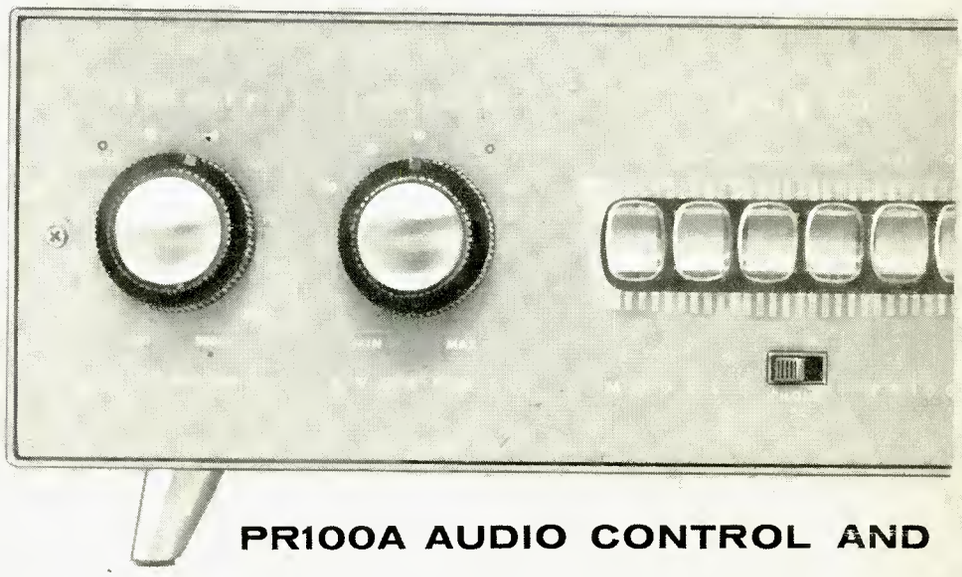

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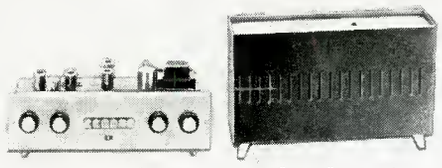

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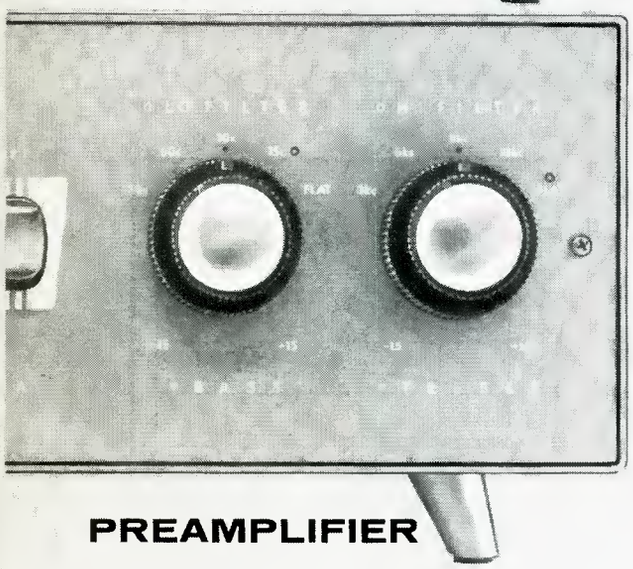

PREAMPLIFIER

THE D070—POWER OUTPUT: 70 WATTS; TONE BURST PEAK POWER: 300 WATTS; DISTORTION: 1.0% AT 80 WATTS, 0.5% AT 70 WATTS; 0.125% AT 10 WATTS; FREQUENCY RESPONSE: 5 TO 100,000 CPS, WITHIN 0.5 DB; SENSITIVITY: 1 VOLT INPUT FOR 70 WATTS; GAIN: 76 DB; HUM AND NOISE: 100 DB BELOW RATED OUTPUT; DAMPING FACTOR: VARIABLE FROM 0.1 THROUGH ∞ TO −1.5. BUILT IN 2 POS SPEAKER-SELECTOR SWITCH WITH BLONDE- OR MAHOGANY FINISHED METAL ENCLOSURE: $129.50.

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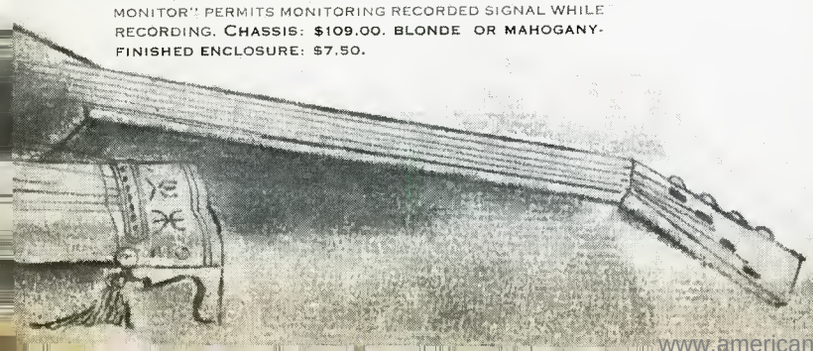

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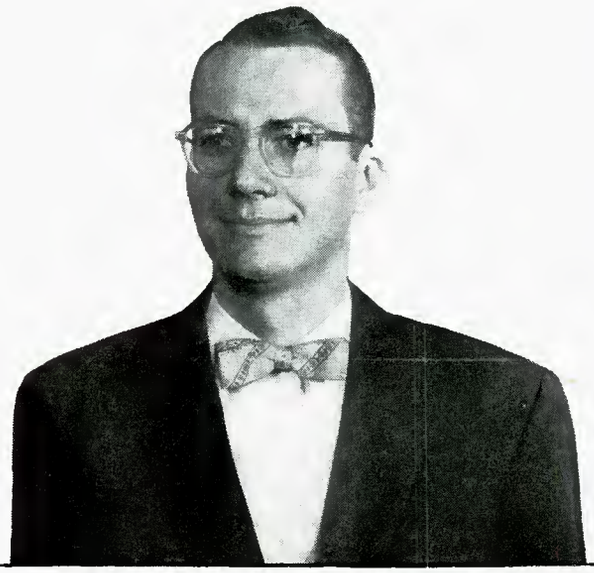
Richard B. Roetter, Newark Electric Company, Chicago, Illinois. (Dick is widely known among Chicago-area audiophiles as one of the mid-West's leading hi-fi consultants.)



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but a few calculations will show how it may be reduced below the amount tolerated by our specifications. R. F. Shea[2] has related the published transistor noise figure to equivalent input noise power by the formula

$$P_{ni} = .9 \times 10^{-17} \; F_o \; \log \; (f_2/f_1)$$

Where P_{ni} is the equivalent noise power in watts at room temperature, F_o is the noise figure converted from db to a power ratio, and f_1 and f_2 are the lower and upper frequency limits. The microphone in this case is effectively unloaded, and the open circuit output voltage of a 150-ohm microphone whose output is rated at 60 db below 1 mw/10 dynes/cm² is 7.8×10^{-4} volts. This produces 30×10^{-11} watts in the 2000-ohm base circuit. P_{ni} must be 55 db below this, or 9.5×10^{-16} watts. With a frequency range of 50 to 10,000 cps, and solving for f_o, we obtain

$$f_o = 46, \text{ or } 16.6 \text{ db.}$$

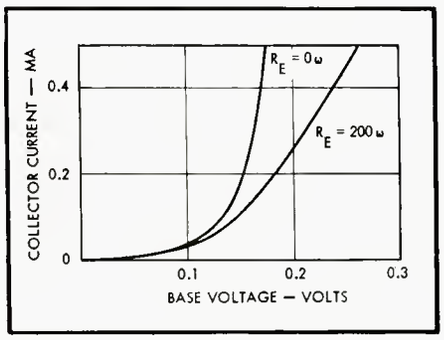

Fig. 3. Effect of external resistance on linearity of emitter-base diode.

Transistors having a maximum noise figure of 16 db or lower will be satisfactory—two popular types are the Raytheon 2N106 and the RCA 2N104. A low-noise transistor is also used in the second stage for the reasons mentioned, since transistors not designed especially for low-noise service are apt to have a wide noise figure spread.

With noise under control, we can turn our attention to an important but frequently ignored aspect of transistor circuit design—the dynamic range of the input circuit. Unless the preamplifier is able to handle any input level that is likely to be encountered, restrictions must be placed on the use of the remote equipment and it can no longer be considered an all-purpose unit. A representative broadcast microphone has a rated output of −55 dbm in a pressure field of 10 dynes per square cm. From figures available for the average and peak sound pressures of a number of sources at different distances,[3] some typical levels are obtained:

Source	Average Level	Peak Level
Male voice—12 in.	−73 dbm	−57 dbm
Piano—10 ft.	−67	−46
15 piece orch.—10 ft.	−57	−42

The inability of the transistor voltage amplifier to handle anything but extremely small signals is the result not only of the high load impedance which is required for adequate amplification, but also of the inherent non-linearity of the emitter-base diode shown by the $R_e = 0$ curve in *Fig.* 3. A simple method of improving linearity is to add a resistance in series with the diode, either at the base or at the emitter. The effect of adding a 200-ohm resistor in the emitter circuit is shown on the same graph.

This procedure results in degenerative current feedback, which reduces even harmonic distortion in the same manner as cathode degeneration in vacuum tube amplifiers. Degeneration also has a valuable side effect, in almost completely equalizing the gain figure for transistors of any one type and providing good predictability for the over-all gain of the amplifier.

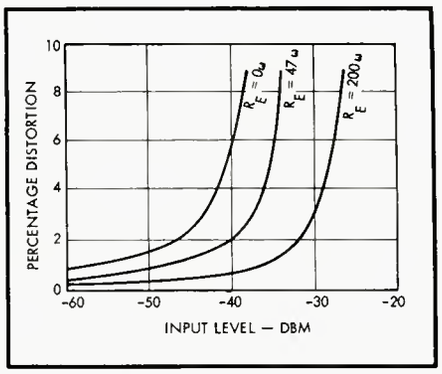

Fig. 4. Effect of external emitter resistance on maximum input signal.

The effect of improving input linearity on the signal-handling capability of the preamplifier is shown in *Fig.* 4. Harmonic distortion is plotted against input level in dbm for unbypassed emitter resistances of zero, 47, and 200 ohms. Note that 1 per cent distortion occurs for an input level of −57 dbm for $R_e = 0$ and −35 dbm for $R_e = 200$ ohms. The sharp upswing in each curve occurs when the clipping point of the transistor is reached. This is a function of collector-to-emitter voltage, which is kept low in the low level stages to minimize noise.

This type of degeneration is also useful in transistorized phonograph preamplifiers, where the peak output level of a cartridge may reach −30 dbm or more.

The Output Stage

In the foregoing discussion of design principles, it was seen that the output level to the line must be +14 dbm. The 4-db isolation pad plus 1 db for a production safety factor and as a margin for battery aging, make it necessary to provide +19 dbm (80 mw) at the output transformer. Design of a circuit capable of delivering this power centers around two choices: between Class A and Class B operation, and between the common base and common emitter configurations.

Class B operation is attractive because of its offer of high power output and a low quiescent current, qualities that have made it imperative for portable-radio and hearing-aid circuits. On the other hand, it is difficult to obtain very low distortion with Class B. Biasing is critical and subject to shifting with temperature changes unless elaborate precautions are taken. Distortion occurs due to the notch effect, and it is especially serious at high frequencies where variations in current gain and phase shift between transistors cause unbalance. Push-pull Class A operation is the logical choice where distortion must be kept low, at the price of higher battery drain.

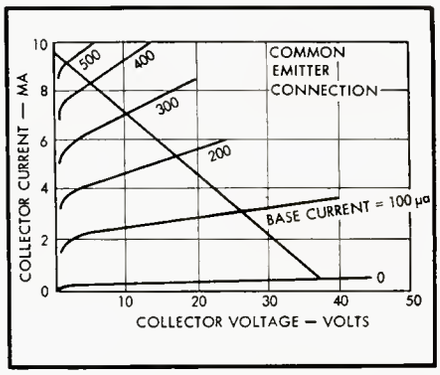

Fig. 5. Collector characteristics for 2N44 in the common emitter connection, illustrating crowding at high collector currents.

With this as a start, it is possible to select a suitable transistor type. With an output power of 45 mw (for one) the transistor should have a collector dissipation of about 100 mw for Class A. Allowance must be made for derating for temperature increase, so a dissipation of around 150 mw would be required. The G.E. 2N44 is so rated, and is used in this amplifier for both the driver and push-pull output stages.

Distortion in the power stage is due to two factors: non-linearity of the collector family curves, and non-linearity of the emitter-base diode. The latter was described in the preamplifier section,

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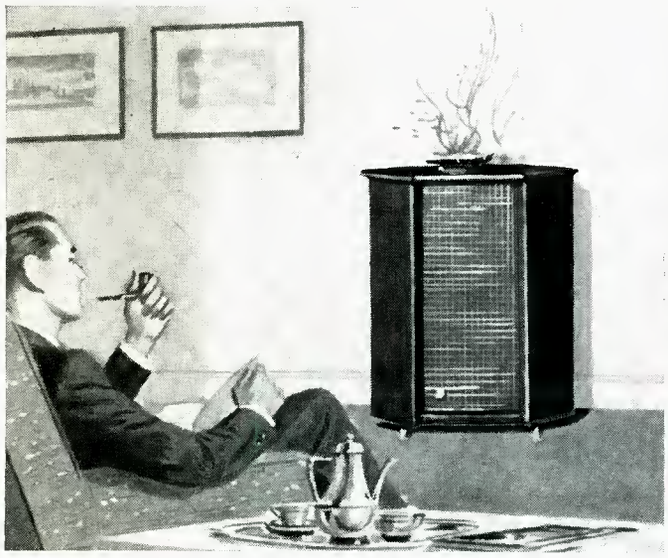

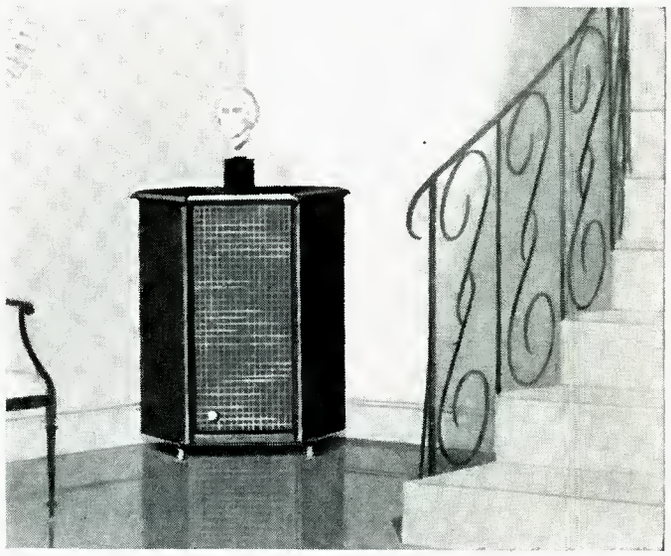

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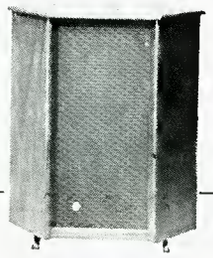

reinforcements and wood-screw clamping. For 12-inch speakers.

Suggested User Price (optional) 300W1 Cherry **$69.95**, 301W1 Blonde **$74.50**

301X1 Adapter Panel—converts 12-inch enclosures for use with 8-inch speakers.

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and it was found that performance was improved when the input circuit was isolated from the source—approaching a constant-current condition. The same effect can be obtained by driving the output stage from a transformer having a higher impedance than the input impedance. *Figs.* 5 and 6 show the curves for collector current as a function of collector voltage for the common-emitter and common-base configurations, and a load line for 4000 ohms has been superimposed on each. The crowding at the high current end for the common emitter indicates a source of distortion for operation at maximum output, which in this case is about 43 mw. Maximum output for the common base circuit is 45 mw. Measurements made on a push-pull amplifier at 2 per cent distortion using 2N44's show maximum output for the common emitter to be +15 dbm; for the common base, +19 dbm, or more than twice as much power. The input impedance of the common base circuit is about 40 ohms. With a source impedance of 50 ohms, the distortion at +18 dbm is 3 per cent; for 150 ohms, 1.5 per cent; and for 600 ohms, 1.2 per cent. Since the loss in gain is 3 db at 150 ohms and 8 db at 600 ohms, the 150-ohm driving impedance is chosen as the best compromise between high gain and low distortion. The primary impedances of the driver and output transformers are 20,000 ohms and 8,000 ohms, respectively.

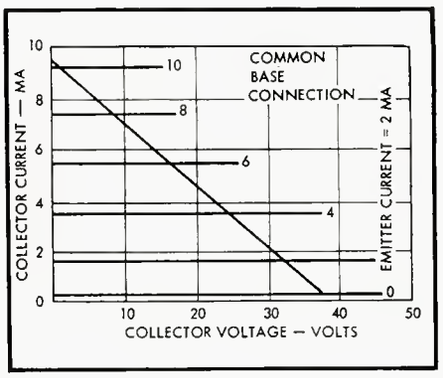

Fig. 6. Collector characteristics for 2N44 in the common base connection, illustrating even spacing.

Transformers

At this point, it should be emphasized that transformers are the most critical factor in high-quality transistor amplifier design, and the most serious obstacle to miniaturization. Although many extremely small transformers are available, they are not usable below about 200 cps for the equipment under consideration.

Reducing the size of audio transformers usually will involve use of one of the nickel alloy core materials, which have very high permeabilities at low flux densities. These materials are, however, very sensitive to even a small amount of d.c. flux and most of the gain involved in their use is eliminated by even a few milliamperes of d.c. The design process settles down to a juggling process between core materials, d.c. in windings and efficiency to determine the optimum combination for the size allowable.

Normally with transistors a small amount of d.c. is present, so that nickel alloys may be used, but not at maximum permeability. Resistance of the windings must be kept at a minimum by crowding all possible copper into the window. Shielding may be provided by a mu-metal case. Transformers used in this amplifier are specially made by the Triad Transformer Corp.

Batteries

Three outstanding features of mercury batteries make them a natural for use in this equipment: they maintain a nearly constant load voltage over their entire life, their total life is the same whether the equipment is operated continuously or intermittently, and they exhibit an extremely long shelf life.

The first is important in the design of a low-distortion amplifier, since it guarantees that there will be no deterioration of the original specifications. A decrease in voltage of 10 per cent was measured over the specified useful life in this amplifier. The second feature is due to the fact that mercury cells require no rejuvenation period, and it makes possible an accurate estimate of the time when the pack must be replaced. To simplify this, a chart is attached to the underside of the case on which program time may be recorded. The third feature is important economically, allowing a minimum of spares to be stocked.

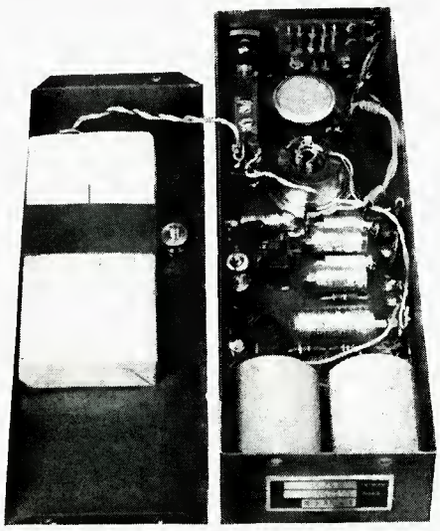

Fig. 7. Internal view showing printed chassis for amplifier and line pad.

Since the drain of a pilot lamp could not be tolerated, the problem arose of how to insure that the power would not be left on accidentally. A simple solution was found by breaking the battery leads with a set of contacts on the headphone jack. When the headphones are plugged in, power is applied, and the top flap of the carrying case cannot be closed until the plug is removed. In the event that headphones are not used, a plastic dummy plug is carried in a clip at one end of the case.

Final Design

Figure 2 is the over-all schematic. Emitter degeneration is provided in the preamplifier by R_2 and in the driver by R_{15}. Because of the high signal level and low collector voltage at the booster, Q_2, degeneration is not practical because it would cause the output impedance to be too high. Thus the linearity resistor, R_7, is placed in the base circuit, and the collector voltage is reduced by the bypassed resistor R_{12}. Temperature stabilization is provided for the push-pull output stage by supplying the emitter bias from one cell in the battery pack. R_{17} fixes the total collector current at 10 ma. The temperature stabilizing networks shown insure low-distortion operation up to 140° F.

The internal view of *Fig.* 7 shows that both the amplifier proper and the line isolation pad have been assembled on printed wiring boards. The driver and output transformers are at the lower end of the case, and the battery pack is mounted under a clamp on the cover—connected to the amplifier through a plug at the upper end. The small size of the complete unit—9 × 2 × 3 in. and weighing only 3 lbs.—suggested its use in the leather carrying case in which it is pictured in *Fig.* 1. It may be operated in a number of ways: suspended from the shoulder with a short mike cord attached; serving as a base for a microphone that has been modified by the connection of a male plug to its swivel; placed inconspicuously in a church, auditorium, or office; and many others.

This amplifier illustrates one of the most appropriate uses at present for transistors in broadcast equipment. It provides the closest approach yet to perfect portability, benefiting station and listener alike.

References

[1] Paul Penfield, Jr., "Transistor bias stabilization," Audio, May and July, 1956.
[2] R. F. Shea, "*Transistor Audio Amplifiers*," P. 127, John Wiley, New York, 1955.
[3] H. F. Olsen, "*Musical Engineering*," P. 206, McGraw-Hill, New York, 1952.

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EVERY ELECTRONICS WORKER or hobbyist in the audio field is continually confronted with the problems of signal level and impedance matching. He must be careful not to cause distortion in an audio system by feeding into it a signal of such magnitude as to result in overloading of the input circuit, while at the same time providing correct impedance matching. For a single, fixed circuit, this condition may be easily satisfied. But, in experimentation, a means for varying both impedance and attenuation is desirable.

The device described in this article may be used for all impedances and attenuations normally encountered in audio frequency work. Simple resistive networks can be employed which will work between equal or unequal impedances and provide a wide variety of attenuations. The combinations that can be designed are practically unlimited.

For purposes of analysis let us consider the circuit of (*A*) in *Fig.* 1. Here we have an "H" type of attenuation network, also referred to as a pad. R_1 and R_2 are the series arms of the network and R_3, the shunt arm. The input and output impedances are equal, that is $Z_1 = Z_2$. (B) of *Fig.* 1 shows a "T" type pad. In calculating for impedances and losses of the "T" pad we find that the results are the same except that the values for the series legs are twice that of the "H" pad.

In designing these pads it will be found that over a certain range of losses the resistive values of R_1 and R_2 vary only a small amount. For instance, consider the circuit of the 50 ohm "H" pad of (*C*) in *Fig.* 1. Here, $Z_1 = Z_2 = 50$ ohms. For 20 db loss, R_1 and R_2 are 20.5 ohms each, and R_3 is 10.1 ohms. For the same attenuator with 30 db loss, R_1 and R_2 are 23.5 ohms each, and $R_3 = 3.1$ ohms, while with 40 db loss, R_1 and R_2 are 24.5 ohms each, and R_3 is 1 ohm. Thus it can be seen from this data that R_1 and R_2 change very little, whereas R_3 changes as much as 10 to 1. It seems reasonable, therefore, for all practical purposes, in this attenuation range, to vary only the shunt arm, R_3, and select an intermediate resistive value for R_1 and R_2. This is shown in *Fig.* 2. Here, R_1 and R_2 are given as 22 ohms, while R_3 may be 10, 3, or 1 ohm, selected as required by a switch, and corresponding to 20, 30, and 40 db of attenuations. Any mismatch of impedances or inaccuracies in losses would be negligible under usual circumstances.

* 3917 Madison St., Hyattsville, Md.

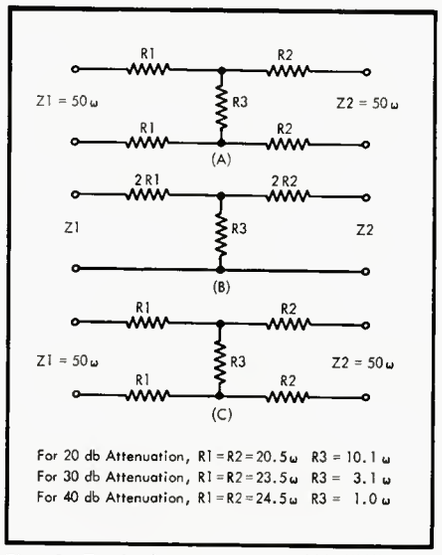

Fig. 1. Typical attenuators. (A) "H" configuration; (B) "T" configuration; (C) "H" configuration with values for attenuations of 20, 30, and 40 db in a 50-ohm circuit.

We may build up a matching impedance, variable attenuator around this idea with plug-in networks using the same series resistors for several different losses and switching in various shunt resistors. In addition, plug-in networks may be designed specifically for a single attenuation value, for equal or unequal input and output impedances, and used in the attenuator box. Plug-in networks avoid complicated, costly switching design. They have the further advantage that the constructor may design pads of any desirable impedances and losses as needed simply by wiring in the required resistors into additional plugs, using switch Sw_1 to select the shunt leg.

Practical Unit

The unit shown in the picture is built into a 4×4×2 inch metal box, *Fig.* 3. An octal socket for plugging in the different pads is fitted to the top. Input and output binding posts are mounted on the sides. Switching is accomplished with a wafer type switch. A dial is used to indicate loss in db (decibels), for the different switch positions. It is set up for a range from 5 to 45 db in 5 db steps.

Pads of any of the losses given on the dial and all useful impedances can be easily made and used in the box. It is, of course, beyond the scope of this article to present the innumerable combinations that are possible. Only the values (*Fig.* 2) for a 50/50 ohm, 20 = 30 = 40 = db network are given. When this particular network is plugged in, the dial would be set to 20, 30 or 40 db according to the loss desired. If a suitable dial is not available these indications may be placed on the panel with decals. The plugs are very inexpensive, if purchased, or may be octal bases from old tubes. All resistors are of the ½-watt size.

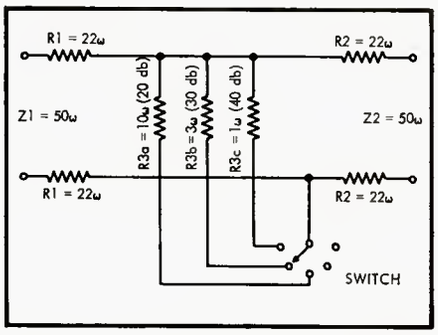

Fig. 2. By compromising the values of the series legs of the H-pad as shown here, three different values of attenuation may be obtained simply by changing the shunt resistor, which may be done by means of a switch.

Wiring of the plug-in unit, socket, and switch is given in *Fig.* 4. The impedances and loss values of each network should be marked on each plug-in unit with white ink. The impedances indicate the values which will be available at the input and output binding posts when a certain plug-in unit is inserted in the socket, and the loss values will be obtained when the switch, Sw_1, is set to the indicated loss on the dial

(*Continued on page 74*)

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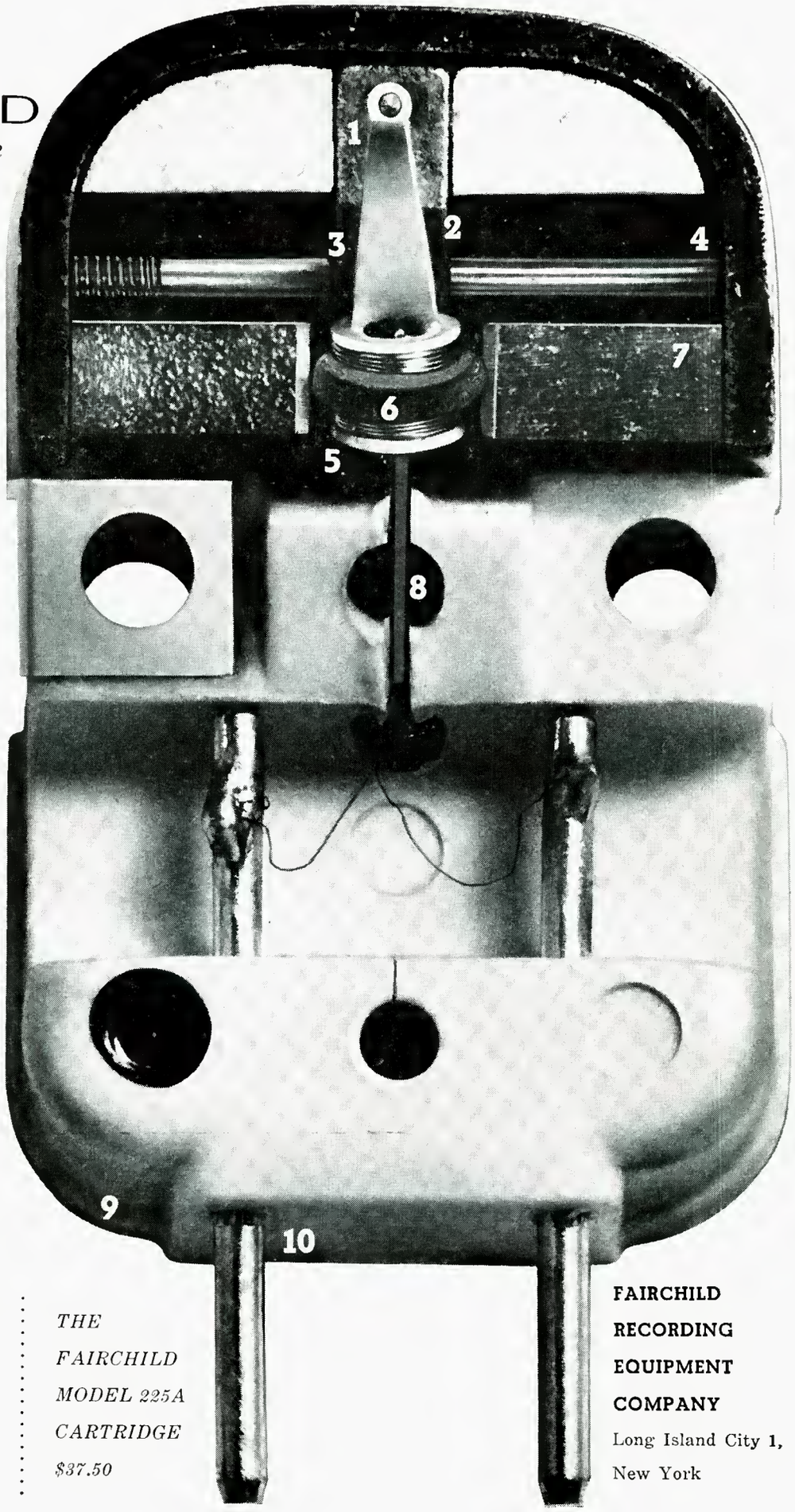

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Equipment Report

Shure Brothers' new "Dynetic" phono reproducer and arm

To design a phonograph pickup that was different in operating principles from any other on the market would appear to be an almost insurmountable problem, but that is apparently what Benjamin B. Bauer did with the new Shure Brothers' "Dynetic" reproducer, even though that may not necessarily have been one of the original requirements.

The operating principle of the new pickup is similar *in effect* to most other variable reluctance pickups—a variation in the magnetic flux through the coils being caused by the motion of the stylus. In this unit, however, the movable portion of the magnetic circuit is the magnet itself, shown in *Fig.* 1, which rotates on its own axis as the stylus follows the groove in the record. The stylus proper is mounted in a shoe which is made of magnesium to reduce mass as much as possible, and the natural flexing of the shoe gives adequate vertical compliance. As can be seen in *Fig.* 1, the over-all size of the moving part of the pickup is relatively small, and the effective mass is claimed to be somewhat under 1.5 milligrams. The magnet itself—approximately $\frac{1}{32}$ in. square and $\frac{3}{8}$ in. long—is simply inserted in a square opening in the damping material and seated in another similar opening at the top of the pickup. Thus the armature is flexibly mounted, and the damping material is sufficiently soft that the compliance is equal to or greater than 7×10^{-6} cm/dyne, making it possible to track at very low stylus forces. The housing for the pickup is a molded plastic, and the unit is fitted with a small coaxial plug (see *Fig.* 2) which mates with a receptacle in the arm.

Because of the high compliance and the desire for a minimal tracking force, the Shure pickup is designed to work in its own arm, *Fig.* 3. The horizontal axis of the pickup assembly is supported by watch-type synthetic ruby jewel bearings. As shown in *Fig.* 4, each of these bearings consists of a sleeve jewel and a cap jewel, providing greater reliability than would needle-point bearings—a necessity because when inserting or removing the pickup the entire strain is carried by the jewels. A counterweight permits adjustment of stylus force between one and two grams. The arm itself—made in a tapered channel form—is statically and dynamically balanced and moves only in the horizontal plane, being supported by a jeweled thrust bearing. The height of the arm is readily adjustable so as to accommodate any type of turntable. A plastic lift button actuates a spring which engages the rear of the threaded rod on which the counterweight is screwed, and when the button is depressed the pickup is raised. The arm-rest magnet holds the arm against a simple vertical post.

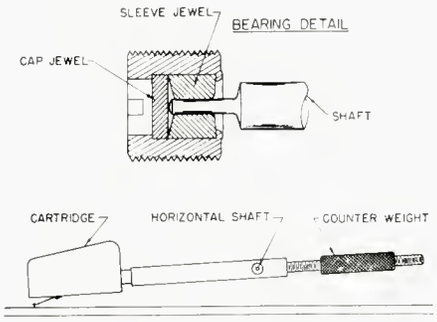


Fig. 4. Detail showing bearing detail and arrangement of cartridge mounting.

One unique feature of the arm is in the damping of the counterweight to eliminate the effect of arm resonance. The counterweight is attached to the arm by a flat spring which is surrounded by an elastic polymer. The effect of this "dynamic damping" is to eliminate the peak in response (which usually occurs below 15 cps). Without the damping material, the arm resonates with one peak if the counterweight is blocked, and with two peaks when it is allowed to swing freely. With a proper choice of the damping, the response rolls off smoothly below about 20 cps. Elimination of the low-frequency resonance record wear which can be severe in the case of a pronounced peak.

Figure 5 shows the response measured from a Cook Series 10 (78 rpm) test record without low-frequency equalization,

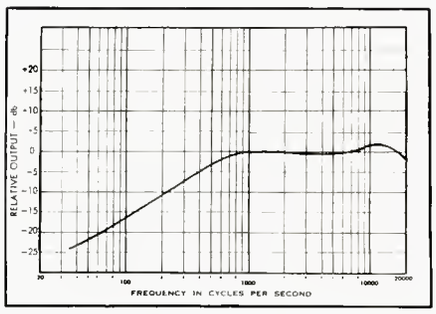


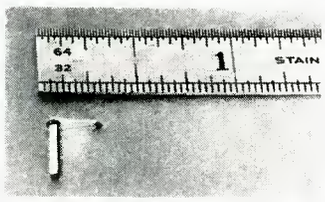
Fig. 5. Response curve from Cook Series 10 (78 rpm) test record.

and thus showing the rolloff at the low end. Note that the response is quite smooth, with only a 2-db peak at around 12,000 cps. This measurement was made with a tracking force of 1.5 grams, although the pickup will track satisfactorily as low as 1 gram. Because of the balancing of the arm, the turntable may be played at an angle of 45 deg. from the horizontal so turntable levelling is not a requisite.

The Shure pickup is normally furnished with a 0.7-mil stylus for LP use, which is an innovation in the standard stylus, although 0.5-mil styli may be had on some other types. The main advantage of the smaller radius of the stylus tip shows up when playing the inner grooves of a fully modulated record. In many instances, a definite degradation of quality is observed toward the center, and in direct comparison between 1.0- and 0.7-mil styli, it has been conclusively observed that considerably better quality is obtained with the smaller stylus. This is true consistently with newer records, although not nearly so noticeable with some of the early LP's.

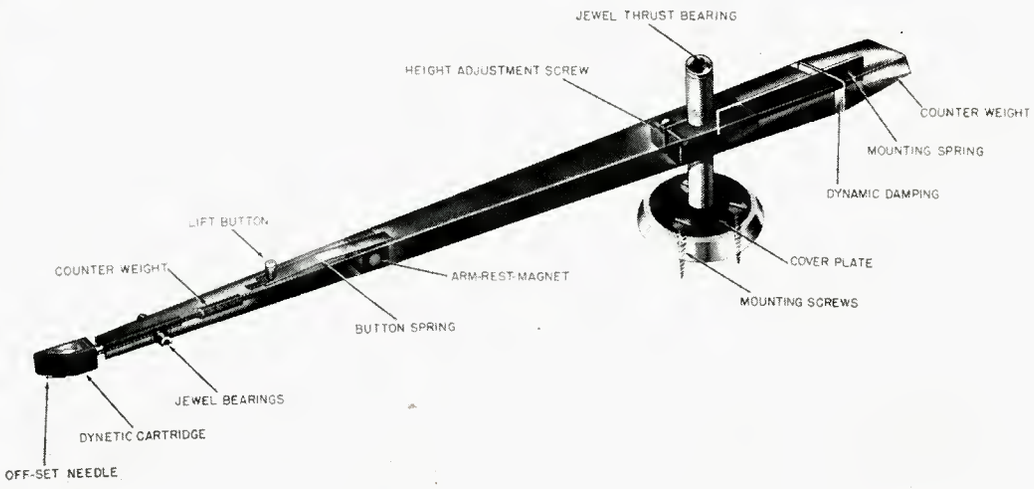
On paper, the new Shure pickup would appear to be "loaded" with desirable features, and the listening tests bear out the success of the design objectives. We would describe the quality of reproduction as extremely good and on that basis alone it should be well accepted. Coupled with that are the low stylus force and a high degree of freedom from the effects of floor vibration, in addition to a very low hum pickup—a result of the balanced coil construction.

The output from the pickup is 15 mv for a groove velocity of 10 cm/sec, and the unit is designed to feed into a load of 27,000 ohms (used for the curve of *Fig.* 5).



Actual sizes of stylus and magnet (above, Fig. 1) and of complete pickup (below, Fig. 2).

Fig. 3. Phantom view of Shure "Dynetic" reproducer and arm.



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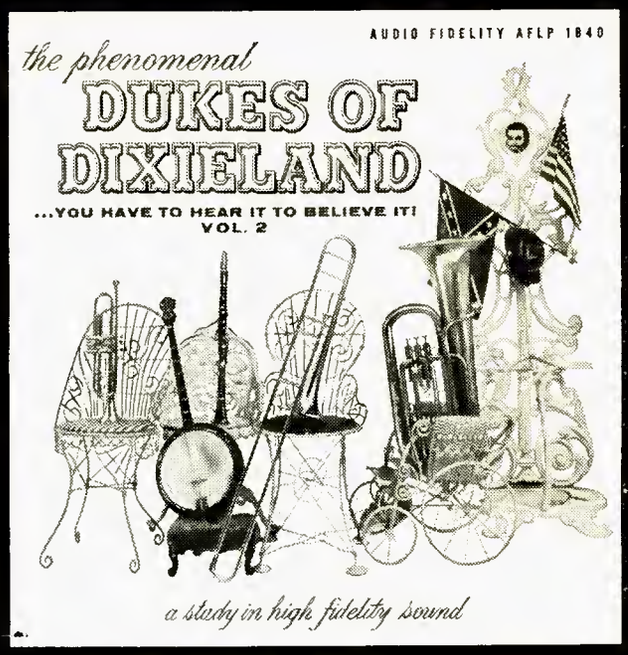

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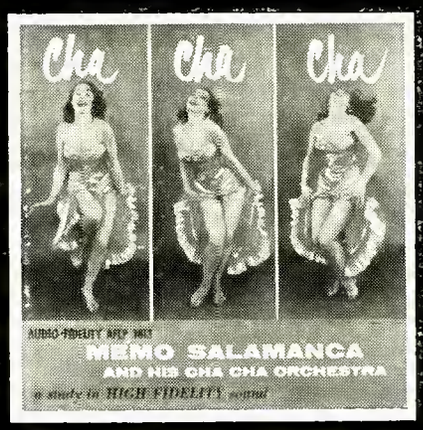

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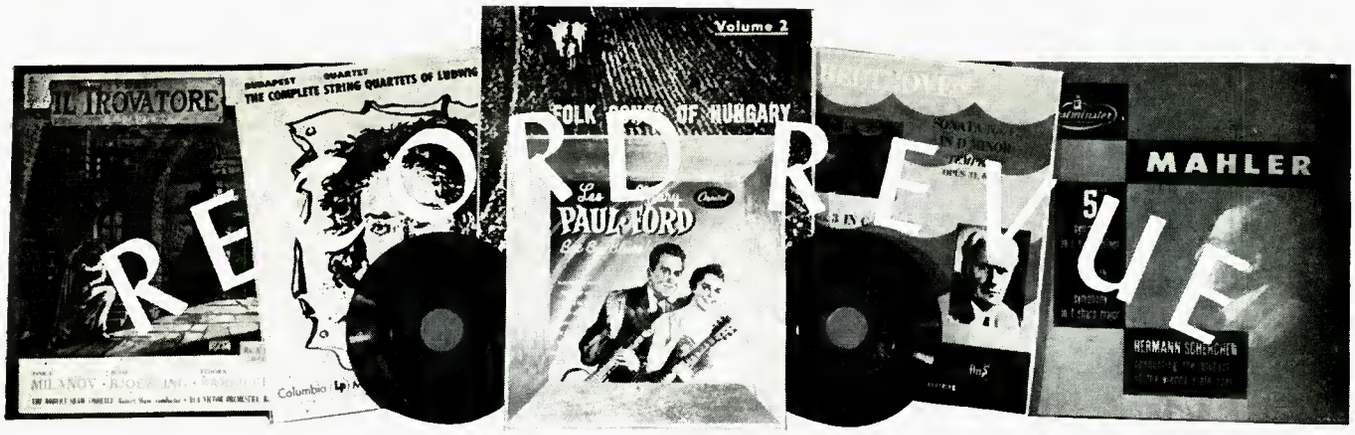

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Hovhaness: Saint Vartan Symphony, Op. 80 (1950). M-G-M Chamber Orch., Surinach. **M-G-M E 3453**

This is an extraordinary record, one that will quickly appeal to almost any ear that enjoys sensuous musical tone, whether understood or not.

Hovhaness is the half-Armenian who, after a conventional conservatory education in Boston and a thousand-odd compositions which he destroyed almost completely (including two big symphonies, several full operas) turned to a unique new style of music, Eastern-influenced to a degree so far unknown in recent Western music, yet built upon Western standards with a mostly conventional modern Western orchestra. It's astonishing stuff and, to tell the truth, can't really be judged by the normal canons of Western taste and style.

Hovhaness' music stands still—like a stageful of ballet dancers weaving an intricately dynamic pattern of immoveability. (Beethoven's music runs; it is always going somewhere, rounding out a vast architectural form.) Nothing happens, yet everything is alive, brilliant, colorful The "movements" don't begin and they don't end—they just exist, for awhile—then suddenly stop as though a switch had been turned off.

Strange, brassy combinations of tone color, exotic yet utterly transparent, complex standing rhythms (like standing waves . . .) that overlap each other in irregular, asymmetric patterns, elaborate canons that look fantastic on paper but simply stand still and produce lovely tone clusters in the listening—these are some of the means which Hovhaness uses.

This "symphony," in honor of an Armenian saint 1500 years old, is a "mosaic in tone," 24 short sections grouped in five big parts, like so many mosaic clusters of limpid tone; there is unity, you will discover, in similar motives and patterns that return, but none of the soaring architecture of the West's big pieces. The music, though technically polytonal (many-keyed), stays put, mostly scintillating about a single scale or chord; the dissonances are colorful rather than harsh. . . .

Enough said—but go out and get this disc quickly, if you want the latest hi-fi novelty. Superb recording, in spite of a rumble pattern on the disc (it doesn't sound noticeably) and reversed labels in my copy. (The *second* side should begin with a saxophone solo, unaccompanied.)

Panorama of Musique Concrète. (Works by Henry, Schaeffer, Arthuys.) **London Duc.-Thompson DTL 93090**

This, it would seem, is primarily a historical survey; for the taped and disced "music" dates mostly from before 1950—some of it, incredibly, assembled before tape editing was available, from numerous disc fragments. Musique Concrète, in case you didn't know, is (French term) music made from "concrete" sounds as opposed to abstract or purely musical sounds. Anything goes and in this you will hear locomotives and the like, as well as, of all things, phonograph records, these last in bits and pieces, a couple of notes repeated again and again.

I've heard some snide remarks anent this disc and there is no doubt of its ultra-ultra-serious dedication. If you go to "avante garde" cinema, you'll instantly be reminded of the rolling disembodied eyes, the strange shapes, the double exposures and the general air of dedicated surrealism! You'll also hear, if you're in on the recording biz, some too-obvious stunts that quickly pall, such as the inevitable tape echo (multiple heads) and the tired slowing down of an uncoupled phono motor. Art—even this art—is not served by obviousness; but these were pioneer experiments, I suppose.

I'd suggest that as of now, Musique Concrète is generally pretty zany and of the lunatic fringe, artistically speaking. But I think it ought to be said, too, that most new movements begin, and must begin, among the dedicated radicals. Nobody else has the one-track approach necessary to break the new ground. It takes work, remember. Would *you* sit around editing tape 12 hours a day year in and year out for such sounds as this?

When the fanatical pioneers have done their stuff, others will step in and profit, more constructively and conservatively. And there is no doubt at all that "organized sound," as Edgard Varèse calls his work, is a vast field and ripe for purely artistic experiment. We're at the dead, zero beginning-point now, but maybe there'll be a Bach or a Michelangelo of this art, in times to come. No reason why not—if people keep working.

Stravinsky: The Soldier's Tale (L'Histoire du Soldat). Robert Helpmann, Terence Longdon, Anthony Nicholls; Glyndebourne Opera Co. **RCA Victor LM 2079**

Here is Stravinsky's little whimsy once more—it seems to be recorded every other week nowadays, after many a long year of obscurity. (I have the earliest job, on 78's, done by Stravinsky in the very early 1930's.) This version is the complete one, with the story narration; here it is in British English, whereas the recording on Vox of the same presents it in the original French.

All other versions are of the Suite—the bulk of the music, minus commentary.

As always, I find it quite delightful. The translation preserves the jaunty, semi-slang, semi-fairy-tale feeling of the French, and that odd trick of saying the words in time to the music. The little soldier is bedeviled by the Devil in various guises—the fiend gets his fiddle away from him and enslaves him with a magic book. The fiddle, we can assume, is the soldier's soul, in the classic devil tradition, but it appears very violinistically in the music itself from beginning to end.

A bit wordy, to tell the truth (the original stage pantomime, ballet style, helps keep things interesting), but the story hits a nice stride and manages to get over its folk-like, legendary sense along with the slang. Good entertainment and beautifully recorded—well played, too.

Milhaud: Suite Provencale (1936); Saudades do Brasil (1920). Concert Arts Orch., Milhaud. **Capitol P 8358**

What with the rage for Latin-American rhythms, few of us today will have the slightest trouble thoroughly enjoying Milhaud's little suite of Brazilian rhythms, an outlandishly modern piece back in 1920. It hums along sweetly in the familiar way and indeed, except for a sharper, harder, firmer outline, it might well pass as one of the more exotic of today's juke box items. Very nice for hi-fi, too.

The later opus, *Suite Provencale*, is based on music by an obscure early 18th century composer of Milhaud's birthplace in French Provence. The tunes are sturdy 18th century in outline, the Milhaud harmony breezily polytonal, the orchestra rather loud and noisy to boot. But I like this composer's version a lot better than an earlier 78 recording that, as I remember, took the whole suite dreadfully seriously and heavily. Not so here—it lilts along quite crashingly.

2. MORE VARIETY

Campaign Fifty-Six: Sounds of an Election Year Campaign. Ed. Profs. H. Lamar, C. Blitzer, Yale Univ. (1779 Yale Sta., New Haven, Ct.)

The pattern for this very interesting disc has been well set by the CBC documentaries of the past done by the now famous Murrow-Friendly team. The technique of narration with edited tape-clips fading in and out is sure-fire and, in this case, is very well managed. You hear major excerpts from big campaign moments beginning far back in the preceding years and highlighting the two conventions, principally the Democratic one since that was, in this last campaign, the most crucial.

The importance of the University background here is simply that the non-political, objective approach is more easily maintained, both because of excellent background, via two professors, History and Political Science, and because of the safely non-controversial aura of University patronage. Considering what was at stake, these editors do a royally impartial job. Net result, be you Republican or Democratic, you'll think they're on *your* side.

Right now, the disc already sounds significant—you can hear the clear difference in approach between Eisenhower and Stevenson, one preaching plenty of prosperity, the other talking doom. (Maybe that was the editor's intention.) In a few years, of course, the whole thing will take on that air of unreality that old political speeches always have—so go out and "collect" this item quick, while the getting's good. A fine job. (Address above: priced at $3.98.)

Jean Ritchie Field Trip. Collector 1201. (Collector Lim. Eds., 43 W. 46th St., New York 19.)

My favorite gal has done it again. Jean Ritchie is a folk singer, a real one in that she comes from a "singin'" Kentucky family and

780 Greenwich St., New York 14, N. Y.

has learned most of her songs there or in her own region from actual listening. She is also a top-notch musician with a beautifully true voice and a fine sense of style—her own. She does her own things to her music, too, and this is within the folk tradition; for folk music grows as each transmitter-personality adds his own wrinkles and twists.

Jean now lives in New York and she's plenty educated. But instead of "spoiling" her, this has turned her interest towards learning more about the antecedents of the songs she knows. The present disc is part-product of a year in England, Scotland, Ireland, where she traded her own American mountain music for songs on the same subjects still sung in the old places. She took a Magnecorder with her, but she also took her own growing knowledge of the music itself, and the trade, judging from examples here, was a fair one.

The record juxtaposes rather loosely some of Jean Ritchie's own songs and the similar ones she found in the old country. The scholarship is casual, the music comes first. For those who love real folk music there are superb things here, including many delightful touches—bits of speech and comment left in where they give us a flash of character or a bit of background, old voices, childs' voices, hearty ones and frail ones.

The fresh Kentucky sound of Jean's own singing, between the others, makes for a fine variety and continuity of interest. My only complaint is that there is no word sheet included. There should be (and may be by the time you get your copy). Address above.

Adventure in Time. Sauter-Finegan Orchestra, et al. **RCA Victor LPM 1240**

Well, I honestly don't know what one is supposed to make of this . . . in particular whether it's funny or deadly serious. S-F is a band known for relatively progressive experimenting (if you can use that word) and what's significant here, I guess, is simply the nature of the weirdies they've gone to such trouble to wax, in super-hi-fi.

Couple of items are just jazz—pardon me, pops. I honestly like 'em best, especially those which play a simple bit of a musical figure, in a musical sort of way. But then you get into "E = MC²," a piece for percussion that bangs and whangs but doesn't hold a candle to its forerunners composed by such as Edgar Varèse (beginning in 1925!). "The Minute," a poem by Karl Shapiro, is read ultra-seriously in a half whisper, to odds and ends of semi-percussion sound, by Ruth Yorke. Then there's a little item in which a lot of people scream ungodly murder, off in the synthetic echo. "Whoo doo Voodoo" by name but it sounds to me like Sauter-Finegan acting just too, too sophisticated.

Then there are pieces that seem mighty like old 12-tone Schoenberg at his most unlubricated. (He squeaks and scrapes and scratches.) Not exactly popular-style, these. An item "painted on the piano" is a very serious-minded solo. "World Without Time" is a classic-style modern trio, flute piano and percussion, and could have bounced right out of any concert hall, more or less. Then there's "Swingcussion," in which a dedicated young man loudly announces he likes Swingcussion—at close range—and is echoed by other dedicated souls in the background.

Quite eerie, the whole thing, and it must be, as they say, "a phenomenon of our age." You know, I have a dreadful feeling maybe it *is* serious, all of it. On the other hand . . . maybe they're kidding us around. Or they're taking RCA Victor for a ride. You try it. I give up.

Soundproof. (The Sound of Tomorrow Today.) Ferrante and Teicher, duo-pianists, tape-treated.
Westminster WP 6014

This is probably the ultimate that can be done with two pianos, seventeen channels, four mixers (monaural and stereo), "30" tape, and lots and lots of time. Each number adds a new electronic trick to those in the one preceding. Tape editing does the rest.

What's it like? Well, there are two things to consider. The tricks and effects, and the music. No doubt about it, the stunts here are fantastic and beautifully carried off, without a trace of clumsiness. The music just rips along with

never a slip, as though it were, indeed, being played this way by human beings. The "music concrète" tapesichord boys had best look to their laurels, technically; this is the most expert stuff yet.

What you hear is a sort of orchestra, for which these are arrangements. Piano sounds, harp-like effects, lots of pluckings and pizzicato, a few vibrato sounds, not unlike Hawaiian guitars (could this be a celesta brought in clandestinely?), woody xylophone-like noises, plenty of low, low bass (moved down an octave) and lots of skittering high virtuoso spurts of incredible speed (moved up an octave or two). It all flows along effortlessly and naturally, if you can see what I mean. Nothing weird about it.

But the music? That's the rub, for me. With all the enormous effort and time and skill spent on it, the stuff ends up as just a lot of rather conventional dinner music, with a Latin-American sort of flavor. "What is This Thing Called Love," "Dark Eyes" and so on.

Now isn't this typical of our age? On the one hand, the clumsy, idealistic "classical" experimenters try to write original, new, different stuff, with tape techniques that vary from amateurish to so-so. And on the other, the popular artists turn out fabulous, unbelievably fancy technical perfection—and play the same old tunes in the same old way.

Now if some of our really original, progressive composers of music would just get together with the purveyors of this kind of tape trickery, we might come out with something to knock the listeners flat a couple of centuries hence. I doubt if this record will.

Elektra Playback System Calibration Record (Engineer: David Hancock).
Elektra EKL 35 (10")

All those who are test-minded should have this disc on hand, regardless of whether other test records may be favorites. It'll do no harm to have more than one, even if this one doesn't prove to be the best. I suspect maybe it is, however.

The record is simple, providing no more than a series of careful tone sweeps, with pauses at fixed and indicated frequencies. This combines the virtues of a sliding sweep, covering all frequencies (and perhaps picking up resonances and the like in your equipment) and the obvious values of steady-frequency tone. The spectrum is covered in three bands, plus two at 1000 cps for level setting, before and after. Within each band there are slight separations as the tone slides from one level to the next, so that with care you can "feel" each one and move the pickup accordingly. No speech or other direct identification of frequencies.

The two sides of the record are identical, providing double life. The cutting is done with RIAA bass but flat treble, in order to avoid pre-emphasis trouble at the high levels required for the very high upper tones, which begin at 20,000 cps.

I suspect the main practical problem with the record will be in identifying the frequencies as they pass by. The only sure way is to play each band from the beginning, following the list of frequencies printed on the album. Though you can, as I say, "feel" the subbands, it is easy to miss one and unless you have absolute pitch you're likely to lose your place frequency-wise.

As to quality, the evidence is that this one beats most or all others. The Christmas tree looks good, the engineer, David Hancock, has a good reputation and I hear good reports on the disc, as well, from many sources. Actual professional testing of test records is decidedly beyond my province.

How to Use Your Tape Recorder. Dir. Hal Michael; narr. Dr. Millard McClintock.
Golden Crest CR 3005

This is a sincere attempt to tackle the problem of amateur instruction via the LP medium, with recorded musical examples as well as test tones. The results are fair, some parts being usefully informative and others inconclusive.

The extensive narration is by Dr. McClintock of Sound Book Press (which has done interesting experiments in combining visual and recorded material). He speaks in a friendly way, but the material is read in the traditionally slow manner of spoken directions, impersonally, with exaggerated care, as though the audience were listening with ear trumpets. A waste of good time and especially since the entire spoken text is printed out in a handy booklet, word for word! You'll go nuts if you try to follow it at the record's snail-like pace. It seems to me that a more sensible use of the combined look-and-listen medium could have been devised than this.

The discussion and examples cover such items as frequency range, waver and wow from wrongly adjusted reel tension, recording level (with examples of low-level recording plus tape hiss and overload with distortion), mike placement, editing and the effects of magnetized heads, scissors, and the like.

Admittedly, the job of simplification here is an almost impossible one. Ramifications loom up at every turn; all sorts of uneasily sleeping dogs must be left strictly alone, so to speak. I found the discussion and examples of frequency range differences, of splicing and magnetism problems and of right and wrong recording levels the most useful for the practicing amateur, who will quickly recognize the "symptoms" as here presented to his ear and eye.

Some other parts struck me as probably more confusing than helpful, with the best of intentions. The mike placement examples offer a dreadful pianist (maybe he's a typical amateur!) hacking away at Chopin while mikes and drapes are shifted about. The close-miked effect here described as "intimate" sounds as though the body of the piano were a hundred feet away, which is hardly likely to clarify things though the effect is familiar to anyone who has worked with mikes. (It was correct, however, to do this recording in a home-type living room, where most amateur recording takes place.)

And finally may I take one more poke at a few instances where tough problems are dodged by falling back on technical mumbo-jumbo. (Mumbo-jumbo, that is, to the amateur.) Two unfortunate examples are the account of monaural miking and of the need for a direct program feed into the recorder (rather than a pickup with the mike from a radio or phono loudspeaker, as is commonly done by home users). Try this on your inquiring, non-electronic wife: "The proper way is to feed the electrical signal from the output of the detector or at any early audio stage in the FM receiver directly into the radial input of the tape recorder."

True, quite true; but if you can understand that language you don't need this record.

Elektra Code Course. Graded, with instruction booklet. **Elektra CC-1**

Jac Holzman of Elektra, having tried a standard—i.e. ancient 78 rpm—code course, thought, "I can do better than that," and herewith the results, on a single LP. Out of my field and I haven't taken time to try to learn, but the beeps are very neatly recorded (with only a slight annoying trace of groove echo) in a rich tone with plenty of blip at the beginning—no sine wave, this. And the grading is *very* gradual. Even I could keep up with the earlier lessons. Alphabet, mixed letters, letters and numbers, punctuation, two-character code groups, three, four, and finally towards the end, actual words and "ham" terms.

The tricky things are (a) you won't easily memorize the letter groups as you would words; a good idea, and (b) when you've got through the whole at 33, play it at 45 and then, if you dare, at 78. (If you have a big, fat professional table you can whirl it with your finger at about 60 rpm and get a positively whirlwind code speed.)

3. CLASSIC BY-WAYS

Mogens Wöldike Conducting. (J. C. Bach, Haydn, Mozart, Dittersdorf). Danish State Radio Chamber Orch.
London LL 1308

This fine record is full of mid-18th century melody, as purveyed by four composers whose

music is remarkably of an equality here—considering that two of the names are much more famous than the other two. All the music dates from that time of tremendously rapid change, the 1760's and 70's, just before the great flowering of Mozart's and of Haydn's later works. The Mozart here is the early Symphony #14 from his fifteenth year and the Haydn is a relatively early Divertimento from about 1760.

If you are a Mozart and Haydn fan—there are millions of them today—and if you are curious as to the origins of such marvelously perfected music, this is the sort of record that can open up whole new vistas of understanding. Here is the symphony itself in the process of coalescing—for that is clearly what happened. ("Papa" Haydn didn't simply invent the form as we used to be told!) We have here the lightness and decorative quality of the Italian music and the symphonic feel of an Italian type of overture to an opera—J. C. Bach, "the" Bach's youngest son, contributes a three-movement work of this sort which is virtually a symphony of the Mozart type. But Mozart's own small symphony features a Viennese addition that Bach didn't use, the dance-style minuet that rounded out the larger symphonic form to four movements. It came from many a Viennese work and Haydn's Divertimento, a typical one, has two minuets in its rather formal entertainment style.

Oddly enough, you'll find that the opening sections of the Dittersdorf symphony strikes as the most melodic and expressive music on this disc, with the Mozart symphony coming second. Both the Bach and the Haydn are on a more glittering, cool level of expression. All four works are beautifully recorded with bright, close-up tone color and full, round liveness, and the Danes play with excellent style and feeling. The record itself is very heavily cut and some passages may cause tracking trouble with cartridges of insufficient compliance.

English Keyboard Music (Tudor to Restoration). Paul Wolfe, harpsichord.
Expériences Anonymes EA-0013

This is really a very good harpsichord record, of sturdy British music from the Tudor age through to the mid-Seventeenth century. Mr. Wolfe, who has wandered far from his native Texas here, is nevertheless a relaxed, easy player with what my ear would call a considerable enthusiasm for the music he plays and a good feeling for counterpoint, an excellent sense of phrasing and rhythm and color. The music, as the saying goes, "comes alive."

Wolfe has studied with Landowska and with one of her pupils; my ear seems to detect a considerable Landowska touch in these performances—in the phrasing, the flexibility of the rhythm and in that peculiarly dramatic coloring (registration) that keeps Landowska's audiences figuratively hopping. Maybe it's the conscious imitation of a good student, but in Mr. Wolfe's case I can't find any reason to object; if the imitation is there, it is well done and highly effective. Landowska fans—who probably haven't ever heard the grand old lady play British music—should be especially pleased.

A good collection, one side of short works from a private Elizabethan collection, the Mulliner Book, and the other side several brilliant longer pieces from a late collection written out by the splendid madrigal and keyboard composer, Thomas Tomkins, of the early Seventeenth century; two by himself, one by William Byrd and one by John Bull—who was a genuine and very British composer, back in this period.

Mozart: Twelve Songs and Two Comic Ensembles. M. Guilleaume, sop., L. Wolf-Matthäus, alto, H. Krebs, F. Wunderlich, tens., H. G. Nöcker, bass; F. Neumayer, "Mozart" piano. **Archive ARC 3061**

I suppose you must like vocal music and Mozart in particular if you are to enjoy this one—but if you do, and if you are fond of exploring small corners of the musical world, this is a superb disc and awfully funny, as well as musically beautiful.

Mozart wrote more straight songs than most of his opera fans realize. They are not arias but true songs with "verses," not unlike those of Schubert himself, yet the music benefits from Mozart's enormous experience with the voice and operatic vocal expression. Indeed, if you know your Mozart you'll hear ever-so-clear influences from this or that opera—depending on the time of composition of these songs. Wonderful!

But there are some works here that are bigger, notably the Masonic-style cantata for tenor K. 619, one of Mozart's very last works. And the comic ensembles are preposterous—in the real Mozart horse-play tradition, highly suggestive, bawdy and howlingly funny, mixing Italian and German and sheer gibberish, taking off the extremes of fancy opera writing, about which Mozart knew so much.

Complete texts and translations, and the singing is clear, musical and imaginative throughout.

Woodwind Classics (Beethoven: Trio in G. Quintet; Shaw: Little Suite from "For the Gentlemen.") Berkshire Woodwind Ensemble. **Unicorn UNLP 1024**

A slightly misleading title—this is made up of two very early, little known Beethoven works and a short filler piece by an early American "primitive." The music is interesting, if not exactly tremendous stuff.

The best work is the Trio of Beethoven, dating perhaps from his fifteenth year but showing, as I hear it, quite Beethovenesque details of melody and harmony in its Haydn-like framework. A very well written and well balanced little work for piano, flute and bassoon. The Quintet, played by three horns, oboe and bassoon, is highly doubtful, having been largely lost; big hunks are filled in by a researcher named Zellner. It isn't the Zellner that leaves me cold—I'm sure most of us wouldn't be able to spot his additions—but merely the piece itself. Horny, thick, and sort of dull.

Mr. Shaw's Massachusetts tidbit of 1807 is the first woodwind music to be published by an American, and it's pretty dull too, and very amateurish as might be expected. No amount of patriotic fervor can make such early works interesting in the hearing!

It doesn't matter much, but Unicorn has mixed its labels and lists the Trio where the Quintet is. Somebody wasn't listening.

Adam Krieger: Neue Arien (12 Songs). M. Guilleaume, sop., Hans-Peter Engel, boy alto, J. Feyerabend, ten., F. Harlan, bar., Kammermusikkreis Scheck, Neumeyer. **Archive ARC 3055**

What unexpected pleasures there are in some of these forbiddingly-titled Archive albums! Herr Krieger died at an early age in 1666 at Dresden and left behind him numbers of the most catchy, lyric, humorous, musical little songs you can imagine, mostly solos but some duets, each one set to harpsichord-cello figured bass accompaniment, with a five-part string interlude between each verse.

Krieger is very German and so, of course, are these performers. But if you can get past that, you'll begin to hear the charming wit and philosophy, the superb melody, that makes Krieger a sort of minor early Schubert and Gilbert-and-Sullivan combined. Most of the songs are of the sort you'll be humming to yourself after a couple of hearings. One lovely duet is between Venus and Cupid, her son, with Cupid sung by a boy alto. Several of the items are quite rowdy drinking songs—and the performers are well aware of the fact. No prissy singing here! Recommended for any tune lover and especially those who can understand salty German.

4. BIG NAMES

Haydn: Four Piano Sonatas. Kathleen Long, piano. **London LL 1380**

For today's ear, so accustomed to big piano music both popular and "classical," the thin Haydn sonatas are at first a bit perplexing. But the many amateur pianists who have tried them out know well how quickly their charm grows—and how tough they are to play, under their seeming simplicity.

The key to this music of a time slightly earlier than Mozart is in the original instruments that must have played it. The sonatas, first, go very well on the harpsichord and are often played thus—they abound in big, rich arpeggio figures, trills and ornaments, clearly suitable for harpsichord tone, and their "thinness" comes in part from the greater overtone brilliance of the harpsichord, needing less padding-out of notes for a full effect than in the case of the big modern piano.

But there was a piano then, of course, and it also is a key to the sound of these works, in the period of transition from the harpsichord to the piano. The piano of Haydn's and Mozart's day as we now have frequently heard is a bright, hard, brilliant little instrument with a twangy, percussive bass and a steely upper register. On such an instrument these sonatas would not sound thin in tone at all.

Many a pianist today, intentionally or otherwise, plays this music with a hard, brilliant, loud tone that does in fact restore a good deal of the original style to the music. Kathleen Long is not a player of this persuasion, however. She is clearly of the older school that plays Haydn unequivocally for the modern piano, and plays it with delicacy and taste, if some tonal thinness. Her piano is a big one and the bass is strong and bumbling, as Haydn's would not have been. The sonatas do sound smallish.

But is "authentic" tone color more important than good musicianship? Hardly. If you will take all of the above into account in judging the outward sound of this Haydn on the piano, you'll the more enjoy Kathleen Long's fine musical sense, her conviction that these four works are top quality music and not mere bits of whimsy and tinsel. It's a good record.

Mozart: Piano Sonatas K. 333, 311, 282, 283; Rondo in A, K.511; Country Dances, K.606. Wanda Landowska, piano. **RCA Victor LM 6044 (2)**

Here is the famous harpsichordist in one of her long-time but less well known roles, that of pianist. (She has recorded piano before, on several occasions.) This album is a postscript to her "final" project, the Bach Well Tempered Clavier, already completed on the harpsichord.

Let's say at once—since it must be said—that I'm not in the camp who thinks the great lady can do no wrong. Like all famous and strong personalities in art, hers is so positive as, on occasion, to flout many a less spectacular artist who may have different ideas. This grand person is surely one of the big dramatic names in our music and with every reason. But her Mozart, fascinating stuff and as positive as ever, is going to hurt some people's feelings on the subject.

I think we can enjoy and learn from a person like Landowska without having to go along with her 100 per cent or be stepped upon. As always, her rhythm and her phrasing, her feeling for the musical drama, are superb and inimitable. She cannot play a note of any music without making it forceful in musical ways. And so Mozart, under her fingers, is strong and this very fact will distress some—though not me—who think that Mozart's piano music should be delicate and gossamer. Refined and well played—yes; but not gossamer! It could not have been so, in any case, on Mozart's own rather hard and brilliant little piano. (And it seemed big to him, who had never seen a Steinway.)

But there's more here. Landowska plays her Mozart, as I hear it, with a harpsichord touch, dry, almost staccato, sharp and percussive. Possibly authentic—for in his day the harpsichord was still the standard instrument and its technique was the established keyboard technique. But there is also something of the French-Russian approach to music in this style that is clearly at odds with the Austrian-German-English Mozart tradition, and this will grate on many souls, in the listening.

(*Continued on page 71*)

AUDIO ETC.

Edward Tatnall Canby

TENTH ANNIVERSARY

"The records listed below are not necessarily the finest recordings, technically speaking, of recent months. . . ."

With that somewhat negative statement, ten years ago, I began my first column in the first issue of AUDIO ENGINEERING. Believe it or not, this department really *did* begin as a Record Revue, and managed to stay in one piece under that title for six years, too. Until my increasingly irrelevant comments got so hopelessly far removed from records that common sense indicated a splitting up—and so "AUDIO ETC." was born, with the accent on the ETC.

In its slightly zany way, this column has had, in those ten long years, I gather, some influence on the course of home-style hi-fi. We don't have any Hoopers or Opinion Polls to tell us so and I could not prove it to you statistically. Moreover I'm *not* going to plough through 120 issues of AUDIO just to demonstrate it—I've just finished quailing at the very thought. I can only suggest it via quotes of what I said —when.

Thus I had hoped, this 10th Anniversary, to concoct a neat and easily readable summary of the Canby contributions to audio history over a decade. Instead I'm going to take a look at merely one year, our first! It was a fascinating year for all of us. It is our most distant one and the most glamorous for that reason, of course. But that first year was also in special ways a Year of Decision—for our magazine, for the audio field itself and for our whole country.

The war was almost two years over, in 1947, and at last, things were starting to move. That year we finally caught up, in America, with the time lost in the war. The whole pent-up force of progress, held back for so many years, burst forth and raced forward, beginning in that year. New things burst upon us from every side. New businesses, new products, new industries, new ideas. It was typical of that frenzied time of progress that our magazine, a new kind of magazine, should be founded, to cater to a newly emerging professional field, and that in the same year, the first serious beginnings of an immense new industry should have made themselves felt —the home "high fidelity" business.

It was there, too, that I stepped in, in my unprecedented role of garrulous record reviewer, writing about records "etc." So —let's look at my etceteras for 1947.

Our first "Record Revue" covered one page (small size) and the "reviews" weren't even reviews; I merely listed some likely 78-rpm items that seemed to offer good stuff for the engineer's ears: Khatchaturian's "Gayne" Suite in Columbia M 664, Copland's "A Lincoln Portrait" in RCA Victor DM 1088, the "Sylvia" ballet suite of Delibes on what I then listed as Decca London EDA 2—one of the very first of the famed ffrr records, then offered on 78-rpm shellac.

But in that first issue I did unwittingly start the chain of printed events that split Canby in two for the present dual sections. Right away, I started to editorialize, so to speak. And in the process I used up more than half the allotted space before I even got to the list of records! Typical, the editor is likely to breathe, perfervidly.

In each succeeding issue the preliminary stuff grew more extensive—and more varied —but still we blithely called it "Record Revue" and nobody seemed to mind. Soon my ramblings under that unlikely title became a sort of tradition. And "Record Revue" it stayed until December, 1953, when I finally broke in two of my own weight.

In that first-issue spouting of Canbyese I managed to make a flat prophesy that is rather typical of most of mine, and indicates rather neatly the problem I'm having in trying to glamorize my early years. I'll give it to you in all its unvarnished platitudinousness.

"It is quite possible that for really high fidelity equipment the plastic record is the only answer."

(That is, the only answer to the then acute problem of surface noise in the old shellac-type records.)

So the plastic record was the 1947 answer to the record problem! Anybody could have figured *that* out, you'll say. Look at the billions of 'em now. But in 1947 not anybody could. Only a very few "bodies" were then hepped up on the idea of a universal plastic record. Records were shellac and they stayed breakable, scratchy, and 78, for a long while afterwards. The LP record wasn't announced until over a year later—and didn't become universal for five. Anybody who came out for plastic records in 1947 was being radical-minded.

I wasn't radical. It was just common sense. I was all for plastic records because during the war I had worked with radio transcription libraries pressed on vinylite, and I was very well able to appreciate what a good plastic disc could do with the aid of wide-range recording and high-quality magnetic cartridges, such as the WE 9A heads we had used. I had even "aired" the first RCA plastic 78 on my program, with much furor, because it looked like a big thing to me. It was (even though I played it "flat," without roll-off, since I hadn't learned about such matters then!).

Audio 1947

You'll have to get your imagination to work, then, if you want to recapture with me a bit of the strange and distant world of audio in 1947, ten years ago, and you'll have to apply it to the whopping platitudes that I *seem* to have written back then! For the nearer they were to the true prophetic beam, the sillier they sound now. Plastic records! That was only the beginning.

In 1947 the home audio business, the

"hi-fi" of later years, did not exist. The standard home phonograph ruled supreme and it was *not* labelled high fidelity. The microscopic bit of "hi-fi" commercially available was then confined to two areas mostly, for the handful of hardy souls who had ideas about such radical things as separate-unit phonograph equipment. Either you got yourself one of the few expensive professional-type amplifiers and the like, or you went to the P.A. market and took home one of those nice little P.A. amplifiers with a mere 5 per cent distortion at 8 or 10 watts and no preamp. That was low-cost hi-fi in 1947, for the very few who knew about it.

In the fall of 1948 I quite seriously recommended these P.A. jobs as the only practical and inexpensive form of home high fidelity, short of your own home-made stuff. As of now, almost a decade later, I stand back of my suggestions. Indeed, I had a P.A. amplifier myself and I knew that it could bring to any home a vast improvement in sound quality over the equivalent standard one-piece phonograph's built-in amplifier. There wasn't anything else.

And don't forget records. In 1947 there was no microgroove, no LP, no 45. Only "standard" breakable 78's. Among them, once in a blue moon, a few of the new unbreakable plastics were thrown in, at positively outrageous prices. A single 78 plastic —4 minutes to a side—cost more than a top-price LP today. It was *that* sort of plastic I had to deal with, which made my prediction a pretty rash one!

But remember, too, that almost all recordings were then reissues of pre-war jobs, new postwar recording sessions having barely begun. And worse, the shellac material (so-called) had not yet recovered from that ghastly admixture of reclaimed flotsam and jetsam that had afflicted virtually all discs made during the disrupted war years. Surfaces in 1947 were terrible, and sudden wide-range sound had brought the noise problem horribly to the fore. Our first thought in "hi-fi" then was the record surface—our second, perhaps, was the sound quality.

As for the general public in 1947, it is politic to remember that the average record owner then played his records scratchlessly via a fat crystal cartridge that was not-so-flat to a high of around 3500 cps and required something like three or four *ounces* of weight on its removable steel point. The new magnetics for home use were barely launched and generally unknown to the layman, though this was not to be for long, thanks to the firm intentions of such as GE and Pickering.

But most of all, in 1947, there was no such term as HI-FI in the popular mind. Indeed, I suspect that the most significant part of my quoted statement above was not the reference to plastic, but *the use of the term high fidelity!* I'm surprised at myself, as of then, for this was long before high fidelity had gone over to the magazines, and to the makers of mascara and beer and what-have-you, and long before anyone had thought to label *every* record and *every* piece of phono equipment as hi-fi. High fidelity was a relatively esoteric term then, and if I didn't invent it—I certainly didn't—I was one of the first to start using it in everyday phonographic language.

Some distinction! I'm not too sure I'm happy about it, all things considered . . . Maybe I shoulda shut my mouth.

But I didn't, and soon after that I was in the first hopeless throes of an attempt to *define* high fidelity. A wasted labor of love—but, I see by the papers, people are still trying to do so, each time one of those

special hi-fi supplements to the newspapers and magazines comes out, each time a new book or pamphlet on high fidelity is issued.

More power to 'em. I gave up defining hi-fi about six years ago, when I started my book, which incidentally, until the editors thought better on possible ethical grounds, I had planned to call "High Fidelity for the Music Lover." That was in 1951, and we were scared the censors might think this fidelity stuff a bit too sexy for any kind of "lover." Some librarian might have put the book on the Marital Fidelity shelf. . . . So it became "Home Music Systems"—prosaic title—and I lost a claim to fame. Just as well.

Early Canbyese

That's a bit of the background. What, then, was eating me—and the audio world—back in 1947?

Well, it took me three or four issues to settle down to work. If I have had something to do with shaping at least a hunk of this mag, then the mag shaped me, too. I started out most formally, as was befitting for an outsider in the professional engineering field. (Remember—no hi-fi then.) But along about November of that year I began to hit my then new stride. "As a musician bungling into an engineer's private magazine (!), I occupy a somewhat anomalous and very stimulating position on this page," I began hopefully, and thereby set the tone for the next nine-and-a-half years. But before then I had, in a somewhat formal kind of language, barged into several interesting contemporary problems.

In our second issue—June, 1947—I took up the idea of low-priced pickups of the new lightweight types—wide-range crystal and magnetic—and pointed out what seems pretty darned obvious right now, that the low-output magnetics would never be practical for the home user until somebody started selling preamplifiers. Believe it or not, this had to be suggested, in them thar days! I don't know just when the first of the separate phono preamps appeared, but I can guarantee you the market was not exactly flooded with them in June, 1947.

Then in the next issue I got off into a fine account of the uses of tone color in giving a sense of loudness to music, an argument in favor of wide-range reproduction. If you blow or bow an instrument hard, you get more of the higher overtones, and this gives us a sense of strain and "loudness"—even if in the reproduction the actual volume isn't so loud. Cut off the highs and you can't hear this loud effect as well. Tricky, but essentially true and it still holds for the necessary dynamic compression that we still have in all present-day records.

In August of 1947 I unwittingly described to a T (or an SSS) the coming sound of our present hi-fi recording techniques. I was gabbing away about the tricks of mike accentuation that could make for brilliance of effect in musical recording even with a top reproduced range of around 4000 cycles, standard for home phonos and for jukeboxes of the day. But, said I, the advent of FM just before the war (and I did a broadcast on FM from 1943 onward) showed us what strange and remarkable sounds could be heard from close-mike techniques, given the novelty of real wide-range reproduction. Who among us had heard such sounds then? Not many people.

I described my wide-range, close-up sound thusly, and you'll admit that it fits today's sound effects, though we no longer very much object.

"A speaking voice at one foot range seems to hiss in your face; an oboe or similar instrument at two or three feet or even a dozen is strident and mechanical; the player's breath and the mechanics of finger work are horribly apparent. A flute player spits saliva between every note, perfectly audibly."

That's the first impact of hi-fi sound on an unsuspecting ear! It is amazing how we have adjusted ourselves to these same effects now, and like them too.

Even in juke boxes and in broadcast soap opera. You'll be amused at my August, 1947, description of what happened when a conventional AM-style radio drama was put on the FM air over our station. As in all tear-jerkers, the heroine of the show at one point broke down and had herself a real, good cry, on the air. But this was a high-fidelity cry—something quite new, back then.

"The heroine had a good cry—into her closely held microphone. The FM effect of this perfectly standard AM technique was as Niagara, or the air brakes on a dozen trains!"

And I went on to elaborate on the novel sounds of wide-range reproduction.

"A high-fidelity system is super-realistic in an embarrassing way; it gives you exactly, exactly the monaural sound that would be heard at the microphone's position. Close-to mike pickup, then, is impossibly high fidelity. [N. B. Now we'd say hi-fi], **a ghastly distorion (actually a lack of distortion) of the musical sound. Engineers now working with high fidelity are finding themselves backing away farther and farther. The whole beautiful edifice of close-to mike technique is coming up for a drastic overhauling, and the field is wide open."**

High fidelity, most definitely, was new, exciting and different in 1947. There were, of course, engineers who had heard wide-range reproduction of sound long before the war; but not many. A handpicked handful. The rest of us had been living and were still living with the standard 4000-cps top. I will not forget, myself, the thrills and excitements of those first days of real extended highs, the novelty of true sibilant sounds coming out of a loudspeaker, of violin edge and triangle tings and the scraping of an announcer's overtrained vocal chords. We couldn't believe it.

It was, you'll remember, only a short time before this that a sensational new lightweight pickup was introduced featuring a tiny, red plastic cartridge and built-in stylus, set into an arm that was named after a well known snake. We installed two of them in our FM station. By my own listening, they reproduced no audible sounds above roughly 4000 cps, and this model continued to do the same with great success for years afterwards. We found them just fine; the surface noise on our war-time records was gratifyingly reduced and the quality of the music was just what most people liked and wanted.

As far as the upper tones of music were concerned, our fine new FM channel sent out nothing but dead air!

We were all then so utterly conditioned to that old-style, velvety, muffled kind of sound that for us it was strictly "normal," quite standard, ordinary and acceptable. The new wide-range high-fidelity effect was strange, different and for many people very unpleasant—especially when well dosed up with attendant hiss and scratch. It was widely said then that the mass of the people obviously were never going to like high fidelity, which was strictly for engineers and special fanatics. Ho-hum.

Distortion? Well, of course there was plenty of it, especially on records. But "live" FM sound was on the whole pretty darned clean, and still people disliked it.

My theory, then as and now, was that it was a matter of association or conditioned reflex. Play *any* high tones to a 1947 ear and it winced automatically, even when the tones were actually clean. I thought then, and I was right, that when people finally got used to clean wide-range sound, pleasant and undistorted, they would get over the wince reaction and learn to love it. They did.

Nowadays, ten years later, even the juke boxes reproduce sibilants and wire brushes. The old-style "tone control," which dominated every electric phonograph for twenty years (and was inevitably turned all the way down) is now no more. Instead, we have RIAA and full-fidelity highs.

Said I in September 1947, reviewing Columbia 78 rpm album M 693, "Le Bourgeois Gentilhomme" by Strauss;

"One of the finest shellac records for high fidelity demonstration I've ever heard. Very wide range, beautiful liveness, excellent surfaces. [We always worried about surfaces then.] **But the music has much to do with it . . . the orchestration is perfect for microphone use—a biggish orchestra but constantly broken up into solos of all sorts and solo groups, with wonderful tone-color contrast. Try side 3—filter to 4000 cps and the solo violinist disappears like magic, open 'er up and he's there again!"**

That's the way those of us who saw big things in high fidelity went about promoting it, back in 1947. My judgment on that recording seems to have been pretty good. Today after ten years it is still in the current LP catalogue, as ML 4800. (The original master would have been a 16-inch disc at 33, from which the 78's were copied; the present LP was doubtless taped off the same.)

Binaural and Home Hi-Fi

And so it went during that first year that began with Vol. 1 No. 1 in May, 1947. (*Actually, it was Vol. 31, No. 3, deriving from* Pacific Radio News *which started in 1917, and several stages of* RADIO. ED.) Something new in audio every day, and most of it so thoroughly "old stuff" now that you can see how those of us who were interested in audio at that time really had to keep hopping.

I see my own attendance record wasn't quite perfect. To my astonishment, I find that in these ten years I've been represented in exactly 119 issues—out of 120. In December, 1947, I was unaccountably missing. Got my stuff in too late.

We started off that year 1948 with an audio bang. On the reverse of my column was a fine article with the magnificent title, "The Present State of Magnetic Recording, Part III." It came from the horse's mouth, or one of the horses' mouths, an engineer from Minnesota Mining, which at that point was getting itself wound up in a new kind of red tape—recording tape.

So what's exciting about an article on tape recording, you'll ask? Keep in mind again, this was 1948 and tape in this country was barely at its beginning. In 1948 the entire (78-rpm) record industry was still based upon disc master recording; tape didn't take over in that momentous area until the early 1950's and it didn't catch on in the amateur home field for many another year. Tape, like so much in the audio realm, was in its commercial infancy, but we were already talking about it.

And in that January issue I touched for the first time on a momentous subject, in the light of today—binaural.

No, I wasn't talking about binaural tapes—yet. But the stage was being set already for that development, and I was working myself into a tizzy about monaural

liveness and the amazing difference between its "one-eared" sound and the binaural, two-eared perception of natural listening.

High fidelity, I had been saying, is a faithfulness to an *imagined* original, since we very seldom actually get to hear the original live sound which is being reproduced for us. If we imagine a "concert hall" sound, we are comparing our monaural living-room reproduction with a binaural two-eared concert and the comparison is obviously false, unless we take into account the monaural-binaural difference.

". . . In nine cases out of ten even the intelligent listener who is asked to judge 'fidelity' is quite unaware of the complications of monaural sound. This single factor may account for a great deal more confusion than most experts are ready to admit."

That's as of 1948 and now, almost ten years later, the problem is very nearly the same. Few listeners even today appreciate the vast difference between monaural sound and the same sound heard with two ears on the spot.

Naturally, I was all ears, some time later, when Magnecord first announced its "binaural" twin-channel tape recorder and in no time at all I was immersed in the new excitements that blossomed, a bit prematurely, over "binaural" recording, and wrote all about it in this department. (Some of what I wrote I would gladly swallow today! One lives and learns.) And before twin-channel tape came along I had found still another angle to the binaural business—in the September, 1949, issue I speculated at length upon the effect of a two-eared, binaural hearing aid—one in each ear. I still think that this was a wonderful idea and hope that some day, somebody will try it out. (*Tch, tch—they have, in eyeglass frames.* ED.)

Well, our first year was almost over, and in the last of its months I got myself a bee in my bonnet, beginning in February, 1948, concerning separate-unit home audio equipment. Shades of today's hi-fi! These articles make strange reading now. For, you see, the very idea of separate-unit equipment for amateur home use was still a novel one—there was virtually none available commercially. And so I solemnly started off with what seems a monumental bit of obviousness—now:

"Most people insist on the all-in-one console, in spite of disadvantages, and this is significant for it must be considered. . . . I have consistently recommended the separate-unit arrangement [for home use]. **It offers more for the money, very much greater flexibility, resistance to obsolescence, and performance clearly superior according to engineers' standards, to that of standard consoles costing the same."**

Now that mild little paragraph, in February, 1948, was all unbeknownst to me very nearly the unofficial beginning of the great home hi-fi movement, for better or for worse. In 1948, it seems, very few people were making flat statements in print like that. Was I the first in print?

As far as I'm concerned the whole thing was fairly obvious then, and is so still; I'm merely wondering whether I didn't come out even earlier in the same vein, in the *Saturday Review*. But never mind—somebody had to start talking like that in print and this sheet, AUDIO ENGINEERING, was right in there spouting to all who would listen, first or no.

But you'll be astonished at what followed next, in that first article. This will show you neatly where I then stood on the business of hi-fi in the American home.

"For under a hundred dollars a man can have himself a good changer, a modest "high fidelity" amplifier or a P.A. amplifier and a good 12-inch speaker; for a bit extra there is the GE or Pickering cartridge or a nylon type crystal [!]. A piece of wallboard baffling gives as good results as most confined radio cabinets. In fact here is surely the ideal basic equipment to suit in its capacity the real needs of the . . . consumer.

"Except that it has to be put together. Simple for some, but for the majority this is an impossible thing! Wires to hook up, soldering to be done. A large number of phonograph owners are ready and willing to operate more than the over-simple controls on an average machine and they appreciate the immense values in the unit system enough to forego the convenience of a simple console model—but to put things together is another and an insuperable problem. We non-engineers are a bunch of incurable Milquetoasts in this respect! Most people have an unreasonable fear of radio innards. There is high voltage about, they know, and things suddenly go up in smoke, inside radios. . . . This, then, is a major disadvantage that keeps many of these people from even attempting the unit plan of construction.

"Suppose, then, to come to the point, I were asked for suggestions as to how an enterprising manufacturer might meet the needs of this growing number of record owners who are unsatisfied with conventional radios and phonographs? My approach would be something as follows: . . ."

And thus, logically, I was all primed to outline the next ten years of hi-fi in the home. I had led myself up to it and I plunged straight in, and spent pages getting over my basic idea, which was, very simply, inexpensive home equipment that would have the advantages of separate-unit specialization, flexibility and good construction plus an ease of hooking up that was, as you can see, very decidedly absent in those days.

I wouldn't quote you all those pages, if I could. I'm not proud of some of the zany ideas I had, and some of the less zany ones, too. (I'm not so sure I'm all for 2-watt amplifiers, as I was then, for instance.) But I don't think that is the point. What matters is that here we were, in 1948, beginning to think about simple equipment for ordinary home users, and I was out plugging for general principles that, quite clearly, have since become the basis for our vast hi-fi home market. A question of adapting equipment that until that time had been primarily professional, to a new and very different usefulness in musical homes, with all that this adaptation implied.

"The problem can be met, it seems to me, in the way that the vacuum cleaner men, the makers of home movie equipment and medium-priced still cameras have met a similar kind of problem. By facing the necessity for flexibility, for complications; and by solving these complications with fool-proof, mistake-proof, instantaneous connections and couplings, interchangeable parts, ingeniously simplified design that accords with the modern home owner's idea of convenience and dependability, that builds confidence instead of fear. A vacuum cleaner is no simple instrument these days and a good camera even less so. But ingenious (not costly) design has removed the disadvantages to a point where just about anybody can and does use both."

Thus, you see, this magazine which, theoretically, was an engineer's private magazine, was helping to lay up foundations for the enormous developments that have since taken place along these very

lines. I suppose I should claim in a big way that this department marched ahead in proud leadership; the fact is, I don't know whether it did or not—for all I can say, never a hi-fi man read this stuff I then wrote! But I surely can claim on the basis of this evidence that we were in there fighting along with the best.

And if we didn't lead the way in this magazine, then you must admit we prophesied. One or the other, necessarily, any way you look at it. I'll end by quoting you just the tail of my three articles, with which, symbolically, I concluded our first complete year in the April, 1948, issue:

"It remains to suggest, merely, that in order to fulfill the basic idea of flexibility and expansion for which the proposed outfit is best suited [i.e. the separate-unit low-cost system], **a number of accessories should be available, notably the radio tuner, AM or FM, the record changer, possibly other gadgets such as a disc or tape recorder (no wire recording for me!). The policy here would seem to be fairly obvious. Supply regular brands in these items, adapted to fit into the standardized plug-together system already envisioned. . . . Thus a changer, an AM, FM, or AM-FM tuner, so fixed up, could be plugged instantly into the existing system —extending both its usefulness and the beauty of its basic construction. In some cases the "adapting" might mean no more than the installation of a simple plug at trifling cost—yet right there is the very thing your customer does not want to have to do, for himself. That is our basic idea."**

And that, in 1948, would seem to me the basic idea on which home "hi-fi" has since been built. I'm certainly not sorry I wrote *those* lines.

★ ★ ★ ★

Thus endeth the First Year of this column, and in no time at all we began our Second Year; I plunged head over heels, the very next issue, into the raging controversy over H. H. Scott's Dynamic Noise Suppressor—and did I get myself snarled, though no more than a lot of other ardent souls, I suspect. And before long, that very spring, there was the sensation of the century, the LP record, which burst in our August issue, thanks to the usual press-schedule delay.

"If Microgroove recording is to survive commercially, it must spread throughout the industry until it is in effect co-standard with present recording."

I intoned right there at the beginning, when there were no LP's except Columbia's and RCA wasn't saying anything at all. So it went . . . and I'll have to stop.

In the next nine years, from 1948 on, this department managed to step into—or fall or bungle or slide into—practically every new event in the hi-fi audio area, and I spouted ideas, too many times to enumerate, that do, come to think of it, look like predictions, as of today. But not being a W.W. (Walter Winchell), I didn't make 'em dramatic and I can't make them so now. As I say, they come out sounding like platitudes.

That is precisely as it should be. For if I'd made a lot of sensational bloopers that really fell flat, I'd be anything but anti-climactic right now! You'd be splitting your sides.

So, though I don't ever expect to get an Oscar or a Fido, or what have you, as the Father of Home Hi-Fi, I do claim to have had my reporter's nose and brains at work on the subject as soon as anybody and as successfully. And I ardently hope, to tell the truth, that somebody *did* read all that stuff I wrote and that, therefore, maybe I did have a bit of influence on home hi-fi as it is now. It's nice to think so. ●

CHARLES A. ROBERTSON*

A Night at Count Basie's
Vanguard VRS 8508

No history of jazz can be complete without relating some of the accomplishments of John Hammond. The list of artists he has discovered or furthered in their careers over the past quarter of a century, from Benny Goodman to Ruby Braff, is lengthy and distinguished. Many a musician has been helped over a rough spot by his words of encouragement or aid in finding employment, making a story that will never be told in full. But his championing of jazz was preceded by an infatuation with the world of sound as revealed by the phonograph record. It has not waned over the years and finds outlet today in his activities as director of the Vanguard Jazz Showcase.

At the age of thirteen this youthful enthusiasm was fully formed and a request to attend a recording session was fulfilled two years later during Christmas vacation from Hotchkiss. The scene was the Pathe Studios at 114 E. 32nd St., as Herman Rose produced several sides by George Hall's orchestra, featuring Walter Gross. Not all the mysteries of the art were immediately unfolded, as Hammond explained: "It was 1926 and electrical recording was in its infancy. All the equipment was hidden behind a screen and no outsider was allowed to see it."

By 1932 his reputation as a collector and writer, especially for European periodicals, enabled him to obtain a commission to make a series of jazz dates for English consumption. These began with the Fletcher Henderson band in the old Columbia studios at 55 Fifth Ave., and Hammond said: "There was no question of multi-miking then. The company had three studios with two microphones to be shared among them. Henry Lollio was the engineer on all the dates I made for England, and I could not have picked a more competent instructor. I have yet to meet an engineer with a better, more honest ear. He is with RCA-Victor in the Philippines now, and before that n Mexico where I believe he produced the fine Perez Prado sides in 1949."

In the swing era, his close association with jazz musicians took him into nearly every important studio in the country. He remembers most favorably Liederkranz Hall on E. 58th St., when it was first acquired by Columbia in 1939, before it was split in half and finally willed to television. Victor used it up to 1929 and it was there the *Rhapsody in Blue* was first made. Hammond insists there is no electronic substitute for the tonal qualities of a large, acoustically-correct hall, and said: "Classical collectors are well aware many 78's still give listening pleasure because of this characteristic. It enables the ear to supply the missing frequencies better than some LP's on which overemphasized and distorted highs must be cut out entirely. Often the jazz collector does not have as much to work with, but an experienced listener can restore much of the vibrancy missing on an old record; particularly OKEH's recorded on Union Square.

So the visitor to his E. 57th St. home is as likely to find him playing a thirty-year-old collector's item as an unedited tape. And it is certain to be the latter which is subjected to the searchlight of Hammond's high musical and sound standards, tempered by a tolerance permitting him to discern talent in unlikely places and extending to some of the products of his competitors. "In jazz the improvised performance is all important," he stated. "When all the elements, economic and otherwise, surrounding a recording date are understood, allowances can sometimes be made for bad sound. But with the competition so keen more and more companies are finding it poor economy to stint on quality. Outright distortion is disappearing. However, jazz seems to be going through the triangle stage which afflicted the classical field a year or so ago. Various aspects of the music are emphasized for effect and the result does not compare with a live performance. Still it has escaped the worst of the echo chamber, so I suppose I can't complain too much."

His first full time position in the industry came in 1939 as associate recording director of the Columbia Recording Corp., an affiliate of CBS, as it was then known. With three years out for Army service, it continued until 1946. And his course in recording technique was advanced by Vinnie J. Liebler, now chief engineer at Columbia.

Next came a period as recording director at Majestic, which he left to become president of Keynote. This was merged with Mercury in 1947, where Hammond worked with Bob Fine, who developed variable pitch cutting of LP masters. Much of the experimental work on this process, now billed as margin control, was done on jazz masters. He is equally proud of having launched the company in classical recording before he left the industry in 1952 to devote more time to his growing family.

He was soon impatient to return to it, but at his own terms and in a capacity where the executive pressures would be less severe. In December, 1953, he began his association with Vanguard and it seems destined to be a lasting one. "I am having more fun than I ever had in the business," Hammond said. "I can make just the things I want, including the work of unknowns. After we record them, they usually are not unknown for long. Life is just too short to waste it on things I don't care about."

At about this time, Seymour Solomon, president and musical director, while walking near his home in the Fort Greene section of Brooklyn, came upon the hall used for all Vanguard domestic recordings. Its acoustical worth was evident on sight of the stretches of sturdy woodwork and was confirmed by tests. The series of jazz dates made there are recognized as the first by a commercial firm to bear comparison to the work of such a craftsman as Ewing Nunn. An attempt was made to keep the location secret. Persistent questioners were put off by citing an elusive barroom. Actually it is the auditorium of a fraternal organization. "It is the nearest thing to the old Liederkranz Hall I know," said Hammond. "We have experimented at length to determine how to put it to the best use and have found the stage curtains can be arranged for a final touching up of balance."

He is in over-all charge of each jazz date and stated well defined ideas on how they are best conducted: "That the musicians are at ease and ready to give a proper performance is of first importance. I don't think it helps them to separate sections as do some recording directors for multi-miking purposes, and I am violently opposed to splitting up the sections, especially the rhythm. Because it is less distracting, the equipment is set up off-stage in a separate room. Seymour is in charge of this, aided by Jan Syrjala, but we all check balance. In most cases two microphones are used, one for balance, though on occasion three may be necessary. Every session has its own problems. When using the Siemens AKG microphone, one that is constant is interference from the nearby FM station WNYE, and we can't start until it signs off in the afternoon.

"I am afraid I grew up in the single microphone school, where the band might be on one side and a vocalist on the other. When the hall is right, I believe it makes for the most natural dynamics and is closest to what would reach the ear on the scene. Many fine recordings have been made by the multi-mike technique, but more have been marred by false dynamics and the riding of controls. There is none of that on our records. Our executives are all practising musicians and we know what we want. Seymour is a violinist, his brother Maynard, who is business manager, a cellist, and I still play the viola. Quality is maintained through all steps of production. Masters are subjected to A-B checks with original tapes and recut if necessary. Samples from stampers are similarly checked."

Among the engineers on the current scene whose work he admires most is John Pallidino of Contemporary, William Chapman of Columbia, and Dick Bock of Pacific Jazz. Also Dave Hancock, an independent, who helped on the trip to the Apollo Theatre to catch an on-the-spot stage show. "I have enjoyed making our two dates on the scene and want to do more of them," said Hammond. "In fact, arrangements are being made to go to the Savoy ballroom for the Cootie Williams' band."

Since the 1930's he has regularly visited England and the Decca and EMI studios, when they were far in advance of anything on this side of the ocean. One of his models is London FFRR sound and his most treasured compliment comes from its astute head E. R. Lewis, who recently told Hammond his records were up to their standard. He keeps his hand in as a critic with a jazz column in the plush quarterly "Gentry."

For the past eighteen months, Vanguard has put domestic recordings on stereophonic tape.

The long friendship of Hammond and Count Basie makes the bar at 132nd Street and Seventh Avenue a natural stop in the round of on-the-spot recordings. The occasion was a welcome-home party for Joe Williams, singer in the Basie band for the past two years, on October 22, 1956. A choice group of blues specialists is introduced by the host with a front line of Emmett Berry, trumpet, Vic Dickenson, trombone, and Marlowe Morris at the Hammond organ. Bobby Donaldson, drums, and Aaron Bell, bass, provide the rhythm with Bobby Henderson, piano, and the blindfold test of this session is to tell if he is replaced.

This is the first time Joe Williams has been heard in such an informal setting and it should remove any doubts as to his abilities as a blues singer. He does his best work on record in the discursive *More Than One For My Baby*. He has a new approach to *I Want a Little Girl* and does *Sent For You Yesterday* for the first time. The band kicks off with *Indiana* and is heard in *Perdido*. *Too Marvelous For Words* and *Please Don't Talk About Me When I'm Gone* are duos for piano and organ. Dickenson puts a blues flavor into *Canadian Sunset* with some earthy choruses.

As an on-the-spot recording it has plenty of atmosphere and some satisfying jazz, but the engineers, under Seymour Solomon, were handicapped by the smallness of the rooms, especially with an electric organ. At the start there is congestion in the bass which clears up as the room fills with a sound-absorbing mass of humanity. Though the random noise increases, one of the requisites of limited acoustics seems to be a goodly crowd. Norman Granz, head of Clef Records, kindly allows Count Basie to take part. It would be a happy event if he would ask Hammond to return the favor by taking the Basie band out to Brooklyn to record it for him as it should be heard for a change.

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

Kid Ory's Creole Jazz Band 1944/45: Tailgate! Good Time Jazz L 12022

The historic sixteen sides made by Kid Ory in his comeback in 1944–45, after a decade away from music, have been remastered by recording director Ray DuNann and issued on one LP. As one who bought the originals as they were released, I remember the sound as being outstanding in the days of poor wartime surfaces and undistinguished studio work. It stands up well today. And so does the music, as evidenced by the cheers greeting Ory, Ed Garland and Minor Hall, of the original group, on a recent European tour.

Bobby Henderson: Handful of Keys Vanguard VRS 8511

The rediscovery of pianist Bobby Henderson makes one of those enjoyable tales which soon becomes part of the folklore of jazz. In the early 1930's, he had been accompanist for the youthful Billie Holiday in Harlem and in her debut on W. 52nd St. Then he disappeared from the scene until John Hammond came across him in Albany last summer. Under the assumed name of Jody Bolden, he had passed the last twenty years as a successful entertainer in upstate cities.

The forty-six-year-old Henderson grew up in the best tradition of the great Harlem party piano as exemplified by James P. Johnson, Fats Waller and Lucky Roberts. He began his professional career in Harlem clubs in the 1920's, but avoided playing in bands and never got to a recording studio. Now a series of albums are projected to show his qualities as a pianist, composer, singer, and trumpetman.

The six selections on the first side are all Waller compositions, making a comparison to the recorded originals inevitable. He most closely resembles the early Waller, as he was so seldom heard in public performances and in the studios in later years. There is less exuberance, but the same joy in the piano and the completeness of its voice. His dynamic shading is more subtle and he likes to caress and linger over a phrase that Fats would toss off with an air of bravado. He plays open twelfths with both hands and puts down a beat which draws the fullness of a jazz band from the instrument. Jazzmen of this calibre are truly timeless, and it is good to have Henderson around in 1957.

There is an extended *Jitterbug Waltz*, a singing *Squeeze Me* and the title tune, among others. A ten-minute improvised *Blues for Fats* opens the second side with moving tenderness. *Sugar*, *Sweet Lorraine*, and *Twelfth St. Rag* are all based in the period when Waller was doing his best work and are given experienced and melodic treatment. Really excellent piano sound, full dynamics, and a depth that comes from a microphone not too close to the sounding board.

Miles Davis: Birth of the Cool Capitol T762

Generally regarded as one of the high points in modern jazz, eleven of the twelve numbers recorded by the Miles Davis group in 1949–50 are successfully updated in sound by remastering on one LP. They are not in the least overshadowed by subsequent developments in the idiom and the wide-range brought to the scores by the use of baritone sax, French horn, and tuba give them a rich tonal depth.

Formed with Gerry Mulligan and Gil Evans the band was able to find only two weeks employment in a club. It is more emotional and heated than the cool groups which gravitated to the West coast, and more disciplined than those remaining in the East. For various reasons, some of them economic, its creative impact has not been surpassed by a working unit, or by specially assembled studio groups.

It might do well on the club circuit today, but would do better in the concert hall. Some enterprising entrepreneur should be inspired to make up a package of the Miles Davis quintet, the Gerry Mulligan sextet, and the Modern Jazz Quartet, among others. Musicians from each could be drawn on to form a larger group for the last portion of the concert. Only in a sustained atmosphere of interchange of ideas can such creative work be forwarded.

Trigger Alpert: Trigger Happy!
Riverside RLP 12-225

The Glenn Miller bass from 1940 on through the Army band, Trigger Alpert has settled down to studio work in recent years. The virtues of allowing such a respected sideman to program and take charge of a session are evident in the pains taken to secure eminent personnel and arrangements of more than momentary value.

One of Alpert's ideas was to use only bass and Ed Shaughnessy, drums, in the rhythm section. Arrangers Tony Scott, Dick Hyman, and Marty Paich have written to give him considerable solo room. *Trigger Happy* by Scott and his own *Trigger Fantasy* are showcases for the instrument.

The seven standards are all unhackneyed and are further enlivened by the doubling done by the reeds. Scott plays clarinet and tenor; Zoot Sims, tenor and alto; Al Cohn, tenor and baritone. Joe Wilder, trumpet, and Urbie Green, trombone, complete the smooth-working septet, sparked by the happy sound of Alpert's walking, bottom bass. Recorded by Reeve Sound Studios.

Lee Morgan Indeed! Blue Note 1538

Eighteen-year-old Lee Morgan has held down a featured-trumpet chair in the Dizzy Gillespie band for the past six months. Since the age of fifteen, he played weekends with pickup groups around his native Philadelphia, and helped out the Jazz Messengers during one of their visits. He has the brashness of youth, the technique of the prodigy, and an instinctive grasp of the modern idiom.

All of which might not be enough to ensure a successful LP without the sympathetic support given by the men on the date and some incisive writing. Horace Silver, piano; Wilbur Ware, bass; and Philly Joe Jones make a faultless rhythm section. The quintet is completed by Clarence Sharpe, another newcomer and friend from Philadelphia, who provides a supple and sensitive contrast to the outpourings from the Morgan horn. It is a case of two comparative unknowns accomplishing more in concert than either might with someone more experienced but less compatible.

Horace Silver contributes *Roccus*, Benny Golson, of the Gillespie band, *Reggie of Chester* and *Standby*, and *Little T* is by Donald Byrd. Owen Marshal shows promise with *Gaza Strip* and the slow, graceful *The Lady*. At present Morgan resembles the mature Gillespie, who was twenty when he reached New York and the Teddy Hill band. It took him several years to put as much solo space on record as Morgan has on this one disc. Just how healthy is the present competition among record companies for each new star will be decided by time and, in final analysis, the individual musician.

Bill Evans: New Jazz Conceptions
Riverside RLP 12-223

Bill Evans, a 28-year-old pianist from Plainfield, N.J. and the Mannes School of Music, has been working in the Tony Scott quartet for the past year. In his first LP he closely resembles the clarinetist-leader in his ability to give maturity to modern jazz ideas while maintaining an individual voice. Rather than use his musical vocabulary as a base for innovation, he applies it to throwing fresh light on standards, constructing long melodic lines in his originals and in recasting the bop tunes *Our Delight* and *Conception* in new perspective.

He is joined by Paul Motian, drums, also a member of the quartet, and Teddy Kotick, bass, in eight numbers. Evans plays three solos and contributes four originals, from the stimulating up-tempo *Five* and *Displacement*, the too-brief *Waltz for Debby*, to the impressionistic blues *No Cover*. Clear piano sound by Reeves Studios, but more dynamics from the drums.

Duke Ellington: A Drum Is a Woman
Columbia CL 951

Described as a musical fantasy paralleling the history of the origins of jazz, the word fantasy should be underlined as Duke Ellington calls on his far-reaching imagination and capacious wit to tell the tale of Carribee Joe and his drum. He wisely refrains from asking his orchestra to copy the early styles of jazz when he sketches the New Orleans period and introduces Buddy Bolden, for he is well aware of the difficulties his present band would have in tintyping former Ellington organizations. When it is called upon to perform works long associated with him, it is allowed to try to capture a mood on its own terms. So it is Ellington's own individual approach to jazz as expressed by his current musicians that is used to outline the eras touched in this capricious saga, from the West Indian jungle to a visionary emerald rock garden on the moon. Whether it be New Orleans, bop, calypso, or progressive sounds, it is always Ellington.

The theme for such a project was first proposed to the leader in 1941 by Orson Welles and abandoned in the planning stages. It was exhumed in 1956 and revamped in three months with an eye to possible production on television. It is evident that little is left of the original idea. Since then the jazz scene has altered considerably, and Ellington and Billy Strayhorn collaborated with the late John Latouche on a musical version of "The Beggar's Opera." If anyone's influence is to be found in this work, it probably comes from this association.

Joya Sherrill, who toured with the band in the mid-forties, has been recalled to sing the rewarding part of Madam Zajj, the willful siren who represents the drum which lures Carribee Joe, as sung by Ozzie Bailey, from his island home. Margaret Tynes, a soprano known for her appearances in opera at the New York City Center, makes her debut with a jazz group and introduces the title song. Candido and Terry Snyder are added to help out drummer Sam Woodyard in the West Indian interludes. Betty Glamann, harpist, is heard in the celestial *Ballet of the Flying Saucers*.

There are frequent opportunities for the featured instrumental soloists, but they give most pleasure as a rich backing for the singers and narrator. Much narration on records does not wear well after several hearings. Ellington is of a different caliber, and he is as artful as the late Fats Waller in his humorous way of turning a fanciful phrase. If this work does nothing else, it may bring a little humor back to the creative side of jazz.

Cecil Taylor Quartet, Vol. 1
Transition TRLP 19

An adventuresome pianist who takes up where most of the modernists leave off, Cecil Taylor is presented in his first LP with Ed Lacey, a cool exponent of the soprano sax so long associated only with Sidney Bechet and his protegee Bob Wilber. The auditory effect of the vibratoless sound is more pronounced than in other members of the sax family. Those accustomed to the hot Bechet tone may not recognize the instrument until some of its characteristics become evident.

With a background in music theory at the New England Conservatory of Music, Taylor is an accomplished technician and distributes a fund of ideas much too liberally for immediate absorption. He seems impatient to get his message over and does not hesitate to be angular and dissonant, leaving an impression of anxiety which can be intriguing or irritating depending upon the mood of the listener.

His three originals include an eleven-minute blues, the balladic *Song*, and the up-tempo *Rickickshaw* which bounces and bobs along like its title. With some exciting drumming by Denis Charles, it would serve as a quick sampling of the vital Taylor imagination. *You'd Be So Nice To Come Home To* is taken as a piano solo. Buell Neidlinger is heard on bass in the adequate recording by Steve Fassett.

Byrd Blows On Beacon Hill
Transition TRLP 17

It may have been the location or the atmosphere of a rainy, spring Sunday afternoon which served to elicit a most relaxed and lyrical performance from the much-recorded new trumpetman Donald Byrd. Like many of this label's dates, it was recorded by Steve Fassett in his home on the Hill.

A full quartet is heard in four of the six numbers: an idiomatic *Little Rock Getaway*, a moody *Polka Dots & Moonbeams*, a reflective *Stella By Starlight* and *If I Love Again*.

This last tune was recently revived by Thad Jones and a comparison of the two solos is rewarding. The efficient bassist Doug Watkins and pianist Ray Santisi are allowed to improvise at length on *What's New* and *People Will Say We're in Love*. Jim Zitano, drums, completes the rhythm section.

Ted Heath: First American Tour
London LL 1564

Ted Heath's memento of last year's successful visit to the United States is released as his current tour of our concert halls gets under way. He presents polite swinging versions of a dozen numbers named for various cities and localities, from the south-of-the-border *On the Alamo* to a robust *Lullaby of Broadway*.

Good sound, danceable arrangements and an occasional solo of interest, as in the Trumbauer-oriented *I'm Coming Virginia* and the trumpet in *Stars Fell on Alabama*, make this a desirable item for his numerous fans.

Chauncey Gray: Dancing at the Embassy Club
Riverside RLP 12-804

Chauncey Gray is a current favorite in the line of smart supper club orchestra leaders who used to fill the airwaves in the days of Bert Lown and Eddy Duchin. Now assorted commentators have taken over the night air and this suave music can be best heard on records, or by picking up the tab at the Hotel Ambassador's Embassy Club, where Gray has played since 1954, on leaving the El Morocco after a fourteen-year stretch.

The pianist-composer directs his band in a dozen hit songs from this season's *The Street Where You Live, I've Grown Accustomed to Your Face* and *I Could Have Danced All Night* to a sedate *When the Saints Go Marching In*. His twenty-five years on the stand takes him back to *'Bye, 'Bye Blues*, which he composed with Lown. Danceable tempos in good sound.

La Fiesta Brava, Vol. 3, Torero!
Audio Fidelity AFLP 1818

The comprehensive documentation of the music of the bull fight by the Banda Taurina of the Plaza Mexico, under Genaro Nunez, is continued with nine selections closely associated with the colorful spectacle. As many of the compositions related to particular episodes in the action have been presented in the two previous albums, the content is for the most part a concert of diverting Spanish-tinged backgrounds which fill interludes in the action.

Silverio is dedicated to the famous Mexican matador. *Valencia* is given an extended reading, as is *Granada*, named for the province in Spain. The haunting *Cuerdas de me Guitarra*, or "string of my guitar," begins side two which is completed by the three-part suite *Aires Andaluces*. Soundmen should note the four rousing fanfares which separate the various tracks and are musical signals denoting the *Toque de Cuadrillos, Toque de Muerte, Toque Banderillas* and *Toque al Corral*.

The unusually attractive package includes a well-illustrated booklet of fifty pages on the history and art of the ring by the Mexican artist Rafael Vilar Alvarez, who is also credited with the dramatic cover poster. No better brief introduction to the subject is available. Helped along by a large auditorium, the recording has the same healthy out-of-doors sound marking the rest of the series.

Jo Basile: Rome With Love
Audio Fidelity AFLP 1822

Jo Basile is on home grounds as he takes his accordion to Italy's capitol city for a program of a dozen selections reflecting the color and charm of its gracious streets and surrounding countryside. As the violin is to the Viennese so the accordion is to the Roman, and Basile makes it sing with the romantic skill of the native.

The superior recording places the instrument in a showcase displaying all its basic power in danceable melodies which include the *Tango Chitarra Romana, Tarantella, Anima e Core* and *Luna Rossa*. Also such songs as *La Piccinina, Non Dimenticar'* and *Reginella Campagnola*, making a varied program of agreeable mood music for the soundwise ear.

(*Continued on page 72*)

ABOUT MUSIC

HAROLD LAWRENCE*

Clouds, Panels and Draperies

EVER SINCE THE FIRST 20-piece band clustered round a horn in pre-microphone days, the proudest claim a record manufacturer could make about his product was to compare it to concert hall, 'seat-on-the-aisle' realism. But if the discophile is also a concert-goer who is familiar with theatres and auditoriums, he will know from personal experience that the seat on the aisle is not always the ticket to aural paradise.

Among the thousands of cartoons on "audio-pathology" that spoof the enthusiast's search for the ultimate in sound reproduction, certain basic themes predominate. There is the "house-wrecker" who will stop at nothing to transform his home into a laboratory, his living room into a baffle; the "dial watcher" who is hypnotized by the twitch of a needle or the suspense of a frequency run; and other species of the sound kingdom. One character who reappears frequently is often pictured sitting in a hall during a symphonic program. Turning to his companion, he whispers indignantly, "This is awful. There are no 'highs' in this performance!" The dual implication here is that (1) this is his first concert and therefore his first encounter with 'live' sound, and (2) he is obviously a reckless treble booster.

But our shocked audiofan may not be as naive as all that, for a poorly constructed hall can be frequency-discriminating to a marked degree. With inadequate reflecting surfaces to distribute sound and a high proportion of drapery and plush to absorb it, acoustic sharpness is at a minimum and there is a perceptible slicing off of the upper sound spectrum.

Some Hall Examples

Clarity and brilliance replace the conventional mellowness—and in some cases fogginess—of nineteenth century auditoriums in such acoustically naked surroundings as London's Royal Festival Hall. Acoustical engineers have traveled far and wide to see and hear the new hall and have in many instances patterned their own designs on this model. The trouble with most of these imitations is that the brilliance achieved is of a hollow nature and strangely disappointing. Upon closer examination, it may very well prove that, instead of a clean reverberation, there is a "slap" at loud passages due to the shape of the hall and the materials that went into its construction. The frequencies discriminated against are likely to be in both bass and treble, thus producing a sort of compressed bounce in forte sections and a lackluster quality in softer moments. Clarity is thus obtained at the expense of a truly wide dynamic and frequency range, a situation which gives the hall a curiously exposed sound. "A creaking shoe, a blow through the exhaust valve of a horn, and a noisily turned page become a major catastrophe," wrote a Boston critic about the new Kresge Auditorium at Massachusetts' Institute of Technology where the reverberation period is one and a half seconds, half a second longer than that of N.B.C.'s Studio 8-H.

Studio 8-H, the former home of Toscanini's orchestra, represented the culmination of the radio approach to sound. From its infant days, the broadcasting studio was designed to blot out all reverberation, soak up all resonance. Now an all too prevalent sonic anachronism, the "dead" studio is graphically illustrated by a certain gesture of the announcer whose voice is in danger of being swallowed up in the cotton-like atmosphere: to improve things for himself at least, he will improvise a baffle by cupping a hand behind an ear, thereby amplifying and giving body to his mellifluous tones. Even in this era of FM transmission and improved AM broadcasting, however, the dead studio continues to be built, though not every time.

In a tower in Hollywood that belongs to no movie set and is neither old nor leaning, Capitol Records constructed recording studios that are more *sec* than 8-H. Instrumentalists experience the peculiar sensation of hearing their tones evaporate in mid-air, and singers' vocal cords seem to wilt rather than vibrate as they should. But no matter. In an underground concrete reverberation chamber located below a parking lot at the side of the tower, resonance-starved signals are sent coursing through channels for a turn at the aural trough before being mixed at the console. Capitol's echo chamber is a very flexible audio device: both the reverberation period and the amount of reverberation can be adjusted and the effect can be applied to one microphone or to many at the same time. In "pop" repertoire this has proved to be a very handy electronic gadget, or rather acoustical gadget as the people at Capitol prefer to call it. It is simple in construction and yet capable of the most subtle effects. Classical sessions, however, are another matter. Musicians find the dry acoustics disturbing and frustrating and derive no comfort from the knowledge that somewhere underneath, a microphone and loudspeaker are adding the necessary re-

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verberation later. They want to hear it for themselves—while they're playing.

Concert halls require their own built-in reverberation chambers, and no mixer can compensate for inadequate or too abundant doses for the listener in the hall. But even in the finest old halls, few designers have succeeded in spreading sound evenly throughout the theatre. In Carnegie Hall, for example, with its renowned acoustics, there are a number of "deaf spots." The sides of the parquet (orchestra) invite phase distortion; in the entire parquet, center included, the music soars over the audience's head from an above-ear-level height leaving a distinct off-focus impression. The dress circle hears something that resembles a speaker system being demonstrated in a heavily carpeted and draped room filled with people wearing their winter clothes. The best seats in the house are in the balcony and the boxes (provided you come early enough to claim front positions in the latter).

Suggested Remedies

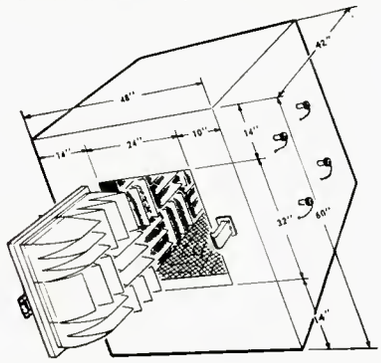
A hall with shortcomings need not be doomed to a sort of acoustical purgatory. It can often be rehabilitated. If its weakness lies in lack of brilliance, wooden panels along the sides or "clouds" on the ceiling could improve matters by providing reflecting surfaces. If the orchestra's shell is made of a flimsy, porous material, it is undoubtedly performing a miserable job of projection and should be replaced with a sturdier model. As for drapery, that is a twofold menace in that it both deadens the sound and can throw the orchestral musician off balance. Leopold Stokowski once refused to conduct in Washington unless a set of rich velvet draperies were drawn in Constitution Hall. He gave his audience a 17-minute lecture on the science of acoustics and the refusal of the management of the hall to recognize sound principles. If more conductors took such a stand, concert-going could be a much more pleasant entertainment sonically than it now is in too many halls.

A first-class recording places the listener in a seat he could seldom hope to land in the concert hall, one to which the entire frequency range is evenly projected, with the right reverberation period for the work and the orchestral forces involved, with each instrument in proper relation to each other, and with no acoustic interference on the part of drapery, jutting balconies overhead, and other sonic distractions.

On a smaller scale, the audiofan is faced with similar acoustical challenges when it comes to playing back this recording. Given a balanced set of components, he must determine the best position for his speaker system. Are the highs being properly dispersed? Is there a sufficiently long path for the bass waves to follow? What about the proportion of hard reflecting surfaces to those of soft, absorbent material. Is the room square, rectangular, small, large, with low or high ceiling? Thus, the discophile must solve in miniature the problems that confront acoustical engineers if he is to approximate live concert hall sound. ●

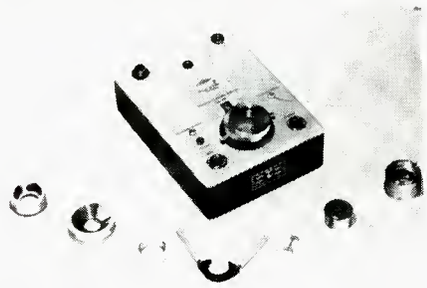
NEW PRODUCTS

• **Portable Anechoic Chamber.** This new "AN–ECK–OIC" chamber is designed for the scaled-down testing of small microphones, hearing aids, signal devices, and other miniaturized electronic and mechanical equipment. Measuring only 48"w × 42"d × 60"h over-all, the chamber can be



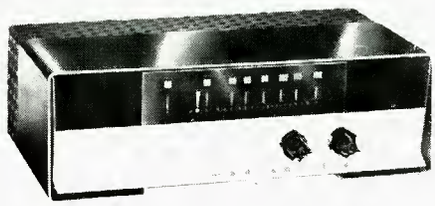
easily moved between widely spaced industrial test areas. The portable unit incorporates essentially the same structural features as full-size anechoic chambers, including AN–ECK–OIC acoustical wedge units, complete wire mesh lining of the chamber, a hinged wedge-covered chamber access door, and provisions for external electrical connections. The test chamber, measuring 16" × 20" × 32", is designed for a low-frequency cutoff of 250 cps. Floors which are set within the free area of the chamber between wedge points can be built of either spring-tension cable or grating. Manufactured by Eckel Corporation, 155 Fawcett St., Cambridge, Mass. **E-9**

• **Microphone Calibration Apparatus.** Designed for accurate calibration of the Brush condenser microphone Model BL-4111 as well as the MK-0002 microphone cartridge employed in the Brush "artificial ear," this equipment permits both a calibration procedure which is a simplified form of the standardized reciprocity calibration technique in accordance with the



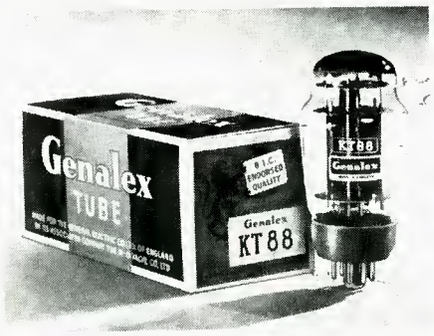
ASA standard Z24.4., and the determination of the complete frequency-response curve of the microphone by means of an electrostatic actuator. The first measurement yields the accurate absolute sensitivity of the microphone at any arbitrary frequency without the use of any precalibrated standard by using three condenser cartridges. The second measurement gives the total frequency response of the microphone between 20 and 20,000 cps. Brush Electronics Company, 3405 Perkins Ave., Cleveland 14, Ohio. **E-10**

• **Madison Fielding FM Tuner.** Exceptional sensitivity and frequency response of 20 to 20,000 cps within 1 db characterize the new low-priced Madison Fielding Series FM-15 FM tuner. Full limiting is achieved with a 0.75-microvolt signal, while 20 and 30 db quieting result from



0.9 and 1.8 microvolt signals, respectively. Drift is only 20 kc from a cold start, with complete stability reached after only one minute of operation. Complete shielding permits reduction of spurious radiation to a point far below FCC requirements. Cathode-follower output gives 3 volts for 100 per cent modulated signal, and permits up to 200-ft. separation between tuner and amplifier. The tuning system is unique in the fact that as the pointer travels across the dial it takes the form of an exclamation point (!) as the center of each channel is reached. Controls include station selector, level control and on-off switch. Madison Fielding Corporation, 863 Madison St., Brooklyn 21, N. Y. **E-11**

• **Genalex KT88 Output Tube.** This tube is designed to keep pace with the trend toward compactness in amplifiers and to furnish high power with exceptionally low distortion. Developed and manufactured by General Electric Company of England, it is essentially a more powerful version

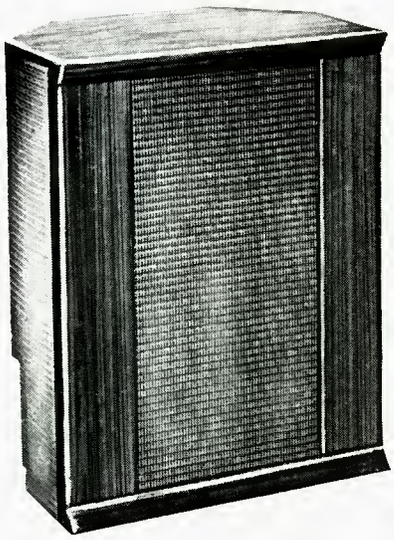


of the popular KT66, with up to twice the output and even lower distortion. Despite the higher rating, it is considerably smaller than the KT66. With fixed bias, an output of 100 watts may be obtained from a pair of KT88's with a plate supply of 560 volts. The KT88 fits the standard octal socket and has the same pin connections as the 6L6 and KT66. For full information, write Department K-22, British Industries Corp., Port Washington, N. Y. **E-12**

• **Condenser Microphone.** Sturdy construction and stable operation are combined with high precision in the new Sony Type C37A microphone. Stated to have a frequency range of 20 to 18,000 cps ± 2 db, the unit uses a hand-made titanium dia-

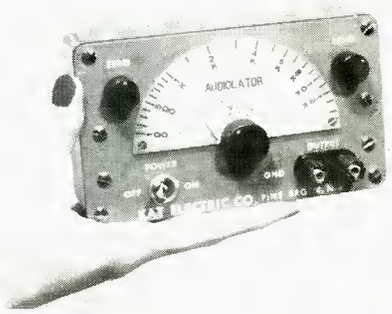
phragm of unusual design. A switch at the rear of the microphone permits selection of omnidirectional or unidirectional response. A control which permits a choice among three low-frequency response curves is located on the power supply. Output is −70 db. Distance between microphone and power supply may be up to 240 ft. Output impedance is 600 ohms. The C37A microphone is manufactured in Japan by Tokyo Tsushin Kogyo, Ltd., and is imported exclusively in the U.S. by Intersearch, 7 Arcadia, Cincinnati, Ohio. **E-13**

• **Klipsch-Designed Speaker Enclosure Kits.** Designated the "Quik-Craft" series because of the ease with which they are assembled with only one tool—a screwdriver, these new Knight speaker enclosures are of the widely accepted Klipsch corner-horn type. Supplied in easy-to-assemble knocked-down form, all exposed wood panels of these low-cost cabinets are



furniture finished in mahogany or blonde and models are available for 12- and 15-in. speakers. All parts are precision-cut, and there is no need for sawing, sanding, gluing, or drilling. Flexibility of the Quik-Craft enclosures is heightened by the inclusion of an adapter panel which permits internal mounting of tweeter components. Further information may be obtained by writing Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. **E-14**

• **All-Transistor Audio Oscillator.** The Audiolator, a fully-transistorized BFO small enough to be held in one hand, covers a frequency range of 50 to 15,000 cps within 1 db with a single sweep of the dial. Powered by mercury or penlight batteries, the instrument is designed primarily for field service including industrial,

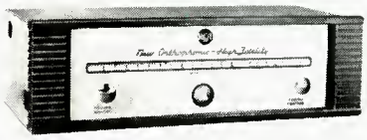


HARVEY *Reports on* HI-FI

May, 1957

When there is something new in Audio, you will always see it first at Harvey's. *Each audio advance seems to find Harvey Radio Company right in the midst of its advancement. Manufacturers as well as consumers have gotten to realize that the men down at Harvey's know their audio business, both in what they sell and in how they sell it. Probably the best example of Harvey's place in the industry is the choice of Harvey Radio as the outlet for the RCA Great Britain line.*

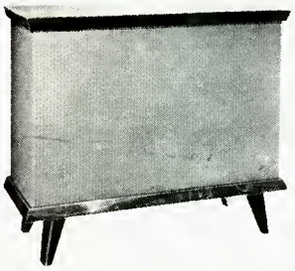
To the high fidelity fan in England **the RCA label** *on a high fidelity component means the ultimate in quality. Now at last, the American audio enthusiast who wants to buy superior English design in high fidelity is given the opportunity.*



Take the wonderful FM Tuner as an example and you will find an exactness and precision very rarely duplicated in manufacturing design. The new RCA electron-ray tuning indicator insures exact tuning for perfect response. You tune for level heights of the 2 fluorescent light bars and perfect tuning is yours. Here is the most sensitive, easy to use tuning indicator you have ever seen. Another of the many refinements in the RCA FM tuner is the automatic frequency control. Once you have tuned, the "electronic lock" of A.F.C. holds your tuning permanently. Exceptional sensitivity to 2 microvolts for 20 db quieting gives greatly improved results, particularly in fringe areas. Price: $79.50 (less power supply). Power requirements—395 volts at 40 mils; 6.3 volts AC for filament at 2.25 amps.—which is readily available from the average amplifier. Plug in connector is furnished for use in connection with RCA Amplifier below.

Then evaluate the RCA Power Amplifier and its companion equipment, the preamplifier control unit *and you have a package which embodies the latest in electro-acoustic features. Maintaining the highest level of physical design and careful workmanship, you can be sure of the utmost quality and the enjoyment which only comes from using the finest. Just take a look at these amplifier features. A power output (20 watts; undistorted, 40 watts peak) maintained to the limits of the audible frequency spectrum . . . Distortion at full output measurable only by the most sensitive laboratory equipment. This is truly a fine amplifier system and can well stand comparison with the best in American design.*

The companion preamplifier control unit *is so designed as to provide accurate record compensation for all agreed standards. Complete mixing facilities are available for microphone, radio and tape. The output is 1.2 volts from cathode follower stage. The RCA power amplifier and preamplifier control unit are so perfectly integrated as to provide a combination that can meet any pick-up or recording requirement. Price: $169.50*



In this day of fine speaker systems, audio perfectionists still maintain a preference for the Bozak product. The full utilization of the basic Bozak loudspeakers are such as to provide a bass, midrange and treble sufficiently capable to translate the original into an exact reproduction. They are capable in their physical and acoustical characteristics, and like building blocks, combine easily into speaker systems of various sizes. They differ in realism and power by reason only of the number of individual speakers and the size of enclosure employed. Typical of the Bozak design, both in terms of sound reproduction and furniture styling, is the Elegant B-305. Housed within the infinite baffle enclosure are 2 B207As, a complete 2-way system in itself; 1 B209, a mid-range of the highest clarity; and 1 N102, a convertible crossover network. The resultant sound is a treat to the ear, clean and full throughout the entire audible spectrum—crystal-clear middles balanced naturally against a robust true pitch bass and sweet non-metallic highs, with a wide angle listening area of 120 degrees. The enclosure measures 36½" wide, 18½" deep, 32" high. Price: Model B-305, Contemporary . . . $390.00

There is no question in the mind of the hi-fi listener that a fine cartridge is a requisite for the best reproduction. Each component must of necessity reach maximum standards for maximum listening pleasure and when looking for the best cartridge, **you just can't overlook the Electro-Sonic Concert Series,** *recognized among the finest by record manufacturers, radio stations and audio engineers. The ESL cartridge does make a difference where a difference is required. Impartial Audio League tests show that the ESL is unsurpassed in smoothness, clarity and naturalness of reproduction. The design not only gives your record a treat, but what you hear is an endless treat of listening pleasure. The price is far less than you would imagine — $35.95.*

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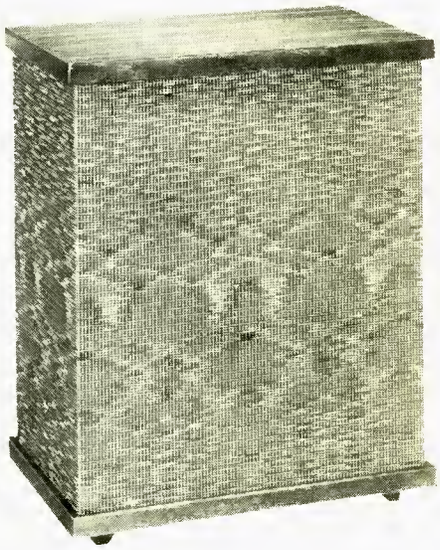
commercial and domestic hi-fi, and military applications. Adjustments are provided for zero beat and fine frequency control. Output of the Audiolator is 1 volt maximum at 600 ohms output impedance. Attenuation is continuously variable from zero to maximum. Dimensions are 6 × 2 × 3¾ ins. For complete information and detailed specifications, write Kay Electric Company, 14 Maple Ave., Pine Brook, N. J. **E-15**

● **Weathers Stylus Force Gauge.** This low-priced device provides an easy and accurate method of checking stylus force while a record is playing. Simple to operate, the user places the tone arm on the record, hooks the gauge beneath the arm,

then lifts the gauge until the stylus is raised from the surface of the record. As soon as the sound ceases, the gauge indicates the stylus force at which the tone arm is functioning. Manufactured by Weathers Industries, 66 E. Gloucester Pike, Barrington, N. J. **E-16**

● **Speaker Enclosure.** The new Californian speaker cabinet, recently introduced by Argos Products Company, Genoa, Ill., is available in finished form or as a pre-finished kit. The top panel is made of St. Regis Panelite, a material which gives the appearance of wood, yet is extremely hard



and which resists scratches, scuffing, cigarette burns, and common stains. The Californian uses the new Jensen Ultraflex principle to enhance speaker performance. Space for a tweeter is incorporated. Available in blonde or mahogany at the same price. **E-17**

RECORDS

(*from page 55*)

Most controversial are Landowska's ornamentations and cadenzas, added deliberately to the written music. She is dead right in principle. It was, in plain fact, expected of the player then that he improvise and ornament the plain notes of the printed music! The art of it was complex, highly musical—and very clearly explained in all sorts of treatises. Landowska is perfectly correct in asserting her own right to ornament Mozart as she sees fit. We all should do it more, as the pops and jazz players do in their music. They have the proper approach.

I have only one reservation: I don't think much, if I may dare to say so, of Landowska's additions. They aren't anything to write home about and I'm sorry to have to say that I think her added cadenza to the B Flat Sonata is badly composed and out of all proportion in its length and size. It could be beautiful.

Landowska, it seems, is after all a performer first, and no composer, in true 20th Century style.

Bach: Concerto in D minor for Harpsichord. Bach: Concerto in C for Two Harpsichords. Karl Richter, Eduard Müller, harps.; Ens. of the Ansbach Bach Festival, Richter. **London LL 1445**
Bach: Concerto in D minor for Piano. Sviatoslav Richter; State Orch. of U.S.S.R., Sanderling. **Prokofieff: Violin Concerto #2.** Leonid Kogan; State Orch. U.S.S.R., Kondrashin. **Monitor MC-2002**

By an odd coincidence here is Bach's familiar D minor Concerto played by two gentlemen named Richter, one on the harpsichord and the other on piano. Karl R. is German, Sviatoslav R. is Russian, and both play the music very well on their respective instruments.

The Russians are lately doing very well, too, in recording. This Monitor LP, from Russian tapes, is beautifully recorded and the Bach is played with an admirable smoothness and accuracy, without a trace of harshness yet with intensity and fine phrasing. This is as good a piano version as I've heard in a long time—and the music is well suited to the piano.

The highly lyric Second Concerto of Prokofieff on the reverse is played with the same purity and accuracy, but, I'd say, without the warmth and passion that there is in the music, and the same goes for the fiddler, Leonid Kogan. Maybe I'm making mental comparisons with the old and now-extinct Heifetz recording, which was more dramatic than this one.

The Ansbach Festival players in Germany also play the Bach well, in a different manner. Theirs is more of an intimate, chamber concerto effect, milder and less dramatic—but they are dealing with the less powerful harpsichord and the difference is quite proper. Especially since, praise be, London has recorded the harpsichord at the right very low level as it actually sounds in performance against a string group.

Good! It's surprising how often the "limitations" of music such as this turn out to be assets. An amplified harpsichord in this music is ugly and heavy, the effect monotonous, the string sound thrown out of balance; yet many a recording has been made that way. Just listen to the solid sound of the strings here, against the delicate thinness of the harpsichord's music. This is how Bach heard it, and felt it.

The same goes for the two-harpsichord work, which benefits even more pleasantly from the low-level harpsichord miking. Bach sketches only a minimum of orchestral accompaniment, letting the two keyboards intertwine in the utmost complexity. Here, the silvery, faint sound of the two instruments is both clear and easy to follow, the occasional gruff interjections of the strings a good contrast.

JAZZ

(*from page 65*)

Frederick Fennell: Music of Leroy Anderson **Mercury MG 50130**

The welcome record debut of Frederick Fennell as a conductor of "pops" repertoire will be cheered by all admirers of his work with the unique Eastman Symphonic Wind Ensemble, as long as it does not interrupt the flow of discs by that lively organization. He has chosen the refreshing composition of Leroy Anderson to introduce the Eastman-Rochester "Pops" Orchestra. It is heard in the trotting *Sleigh Ride, Forgotten Dreams, Serenata, Trumpeter's Lullaby, Penny-Whistle Song, Sandpaper Ballet,* and *Bugler's Holiday.*

The second side is devoted to an arrangement of six Gaelic airs in the *Irish Suite.* Anderson is well-known for his novelty effects and they are kept in musical context in sound characteristic of the Olympian series.

This Is My Beloved **Atlantic 1252**

Since its publication in February, 1943, Walter Benton's slim volume of poems in the form of a diary conveying the joys and heartaches of young love has gone into thirty-two editions and become standard stock with booksellers everywhere. It reached records in the early days of LP and soon found a secure place on the shelves. Now in a setting composed and orchestrated by Vernon Duke, its continued popularity seems assured.

The young actor Alfred Ryder lends a virile voice to the reading and is sensitive to its many moods. The author has rearranged the poems in more dramatic order, as well as editing and slightly emasculating some passages. It is a version to take a place beside this season's other bit of esoterica: Caedmeon's presentation of Siobhan McKenna in the Molly Bloom Soliloquy from James Joyce's "Ulysses."

The score is brittle and sophisticated, more in the spirit of the upper East Side than Greenwich Village setting. However, the original locale has become a high-rent district and many of its former inhabitants have moved uptown or to the suburbs, and the sentiments are universal. It will not be surprising to find a folk singer putting parts of it to guitar accompaniment. Best touches are in the bar scene, a distant barrel organ, and a heartfelt waltz for "Each season of the year I will be forgetting you."

Lehman Engel conducts the orchestra, and a chorus which does not intrude more than to change the scene or mood. You may want to mark equalization setting on the liner, as it cannot be done successfully until after entry of the piano.

Vinton Wight: Sound of Steam Locomotives No. 2 **Folkways FX 6153**

The behemoths of the roadbed are left to speed on their way as Vinton Wight turns to the smaller switch engine to detail the make-up of a train in his second volume on the steam locomotive. His equipment was set up in the Burlington yards in and about Lincoln, Nebraska, to catch the sounds of the cars as they are shifted and classified. He then follows a loaded string to a grain elevator near the city and brings them back empty.

By Western standards a switcher is still quite a hunk of engine so there is no dearth of sound as they meander about the yard, or double up to help surmount a hill. Finally the roundhouse is entered as they are put to bed with snorts, grunts and ponderous wheezing.

No adventurer with a tape recorder should neglect to become acquainted with Wight's work. It is sound that tells a story, has more than momentary value, and was found within motoring distance of his home. The editing required the splicing of a thirty minute tape as many as forty-four times to remove extraneous noises. It is testimony to what care, patience and a little imagination can accomplish.

ABOVE ALL, THE EAR

(*from page 16*)

put variations of the microphone at various frequencies and intensities. How are these variations mapped? By feeding sounds from a speaker into the microphone and measuring the output. Here, the electrical-to-sound-output variations of the speaker must be taken into account. How are *these* variations mapped? With a microphone. . . .

I could continue on this circle endlessly but I think enough of its arc has been constructed to show that it *is* a circle. I suppose that there have been instruments devised to measure sound pressures almost uniformly, but there is never any way of knowing when the measurements *are* uniform. The whole problem could be written in a trivial algebraic expression involving two unknowns, and neither of the unknowns can be found until the other unknown becomes known. Which comes first, the chicken or the egg?

This same circle is encountered in almost all energy measurements, such as the volt or the erg, but the measurement is given a beginning point by the establishment of a definite unit of measurement (volt and erg) which are defined in terms of certain results and which are in turn correlated to the other units of energy. Thus the volt is simply that electromotive force required to send a current of one ampere through a conductor having a resistance of one ohm. By appropriate computations, it can be found that a volt is equal to 10^7 ergs.

Finding a similar unit for sound was not so easy, but the decibel was finally arrived at, based on power in watts expended in certain loads. The decibel, however, is not closely correlated to the human ear and is more an electrical measure than an actual sound measure. This, among other things, can be inferred from the Fletcher-Munson research.

Of course, I have been exaggerating the situation somewhat in order to put across my point. Considering the basic impossibility of measuring pure sound as such, engineers have succeeded remarkably in approximating measurements. But the point still remains: the ear stands aloof and inviolable, the final and most important link in any sound reproducing system.

Mr. Briggs even concedes to the importance of the ear in various places throughout his book. In chapter 12, which is devoted to questions and answers, a New York City man writes and complains that a bass-reflex enclosure he had constructed sounded excellent with the back removed but with the back screwed on, "The 15-inch unit continued to produce the bass, the tweeter poured out the highs, but the body was missing.

Removing the back remedied the defect. Should I leave well alone?" Mr. Briggs replied, in part, "It seems to me that when you leave the back off the cabinet you obtain very useful reflection from the wall and there is a lot to be said for this type of reproduction. I would certainly use the system which sounds best, even if contrary to every textbook.

"In any case, as the body has disappeared, there would not be much point in screwing down the lid of the coffin."

Bravo! Mr. Briggs. That which sounds best is genuinely to be preferred, "even if contrary to every textbook." And thank you for that delightful pun.

We must remember, if we had no ears, there would be no point in expending our energies (and incomes) on high fidelity. Yet, there are people who quote response figures endlessly and prattle on about cathode followers and air couplers, and when asked how their rig *sounds*, seem to be deeply insulted. Sometimes I wonder if they ever turn their reproducing systems on, except to make measurements.

Out of all this, I hope to distill a few sterling particles of advice to each of the several categories of hi-fi people, as follows:

To the man with good response data—We admire and love you. We would like to have good data too. But you are henceforth limited to three minutes of describing your data, after which you will turn the rig on, allow the listener to select the recordings he wishes to hear, and then *shut up and listen* with your guest.

To the man with good sound—You are one chosen among many. Don't worry about a thing. You have achieved the ultimate. If the man with good data comes to visit you and starts asking about the data on your rig or starts describing the data on his, put on your favorite Brahms and turn up the volume of your good sound so high that you can't hear each other. Thus good sound, literally and figuratively, overrides data.

To the man who knows nothing of hi-fi—Perhaps you are better off than all the rest. If you visit the house of the man with good sound, you will want to return again and again and you may be infected with a desire to know about hi-fi. This may eventually lead you to the man with good data. Don't be discouraged; arm yourself with this one request: "Let's hear it play." If he refuses, then break off your friendship. He's not worth knowing and he can't teach you anything about appreciating hi-fi.

To the novice who's shopping for a rig—You, too, have one powerful weapon against all comers, that being the demand to hear the rig in operation. Don't shop on the basis of specifications alone. *Never* buy without first hearing. And don't be ashamed of your lack of hi-fi knowledge. Even if you don't know IM from Imdrin, you're on a par with the experts if you *listen* carefully. An ear is an ear is an ear. If you feel that your ear isn't *trained* like that of an expert (what should it do—sit up and bark?), remember, it's *your* hi-fi rig; you've got to live with it, not the experts.

And to all the rest of you—Remember the ear. Yours are *perfect*.

VARIABLE ATTENUATION BOX

(*from page 46*)

corresponding to the losses marked on the plug-in unit.

As an example, suppose we plug in a network of 150 to 150 ohms impedance with shunt resistors for 25, 30 and 35 db losses, respectively. Then, impedances at the input and output binding posts will be 150 ohms and losses of 25, 30 and 35

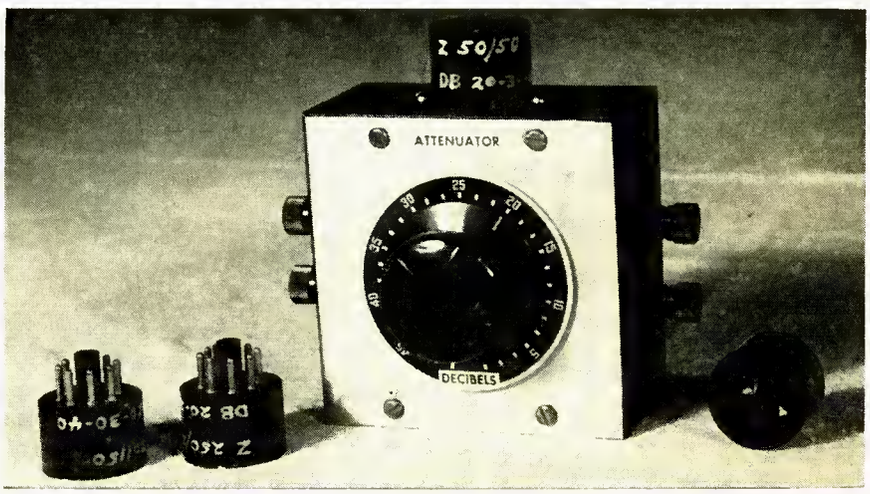


Fig. 3. Using the method described, the switch may be mounted on a small metal box with a socket for the plug-in pads, each of which accommodates three values of attenuation.

db will be obtained when the switch is set to these values as indicated on the dial. It can be seen, therefore, that the device is very flexible, inasmuch as several shunt resistors may be used without changing the series resistors, or for close tolerance work, individual networks may be plugged in, using the exact values of R_1, R_2 and R_3 as required.

The values of resistors for various impedances and attenuations may be obtained by the constructor from numerous published attenuator tables, two of which will be found in the references[1,2] given at the end of this article.

For the mathematically inclined reader the following formulas are included which may be used to compute the resistor values for attenuating networks of equal input, output impedances and varying losses. The symbols given in the formulas are as shown in *Fig.* 1.

$$R_1, R_2 = \frac{Z}{2} \frac{(K-1)}{(K+1)}$$

$$R_3 = \frac{2ZK}{(K+1)\ (K-1)}$$

where $Z = Z_1 = Z_2$, (that is, Z_1 and Z_2 are of the same impedance value) and K equals the voltage or current ratio of the input and output of the network. K, then, is also equal to, $K = 10^{\frac{db}{20}}$. This is true because $db = 20 \log E_1/E_2$, or $20 \log I_1/I_2$. The above formulas are for "H" pads. For "T" pads the same equations apply except the values found for R_1 and R_2 must be multiplied by 2.

Accuracy Check

If the constructor has available an audio oscillator and sensitive a. c. voltmeter he may check the attenuating characteristics of his networks, if necessary for critical applications, by hand picking the resistors or using various resistors in parallel, and may thus construct pads with very close tolerances. The signal from the oscillator is fed to the attenuator input which will not require a terminating resistor if the oscillator output impedance matches the attenuator impedance. If the oscillator is of the more generally used high-impedance type, a terminating resistor equal to the input characteristic impedance of the pad must be placed across the input and the oscillator bridged across the resistor. In either case, a terminating resistor equivalent to the pad output impedance must also be connected across the output of the pad.

The signal voltage is then measured across the pad input with the meter and recorded as E_1. The voltage at the output of the pad is also measured and recorded as E_2. The loss of the attenuator in decibels is then equal to, $db = 20 \log E_1/E_2$. As an example, if $E_1 = 2$ volts, and $E_2 = 0.2$ volts, then the loss is $20 \log 2/0.2$, or 20 *db*.

These pads are designed, of course, for low power work and high test-signal voltages should not be applied to the input when using low wattage resistors.

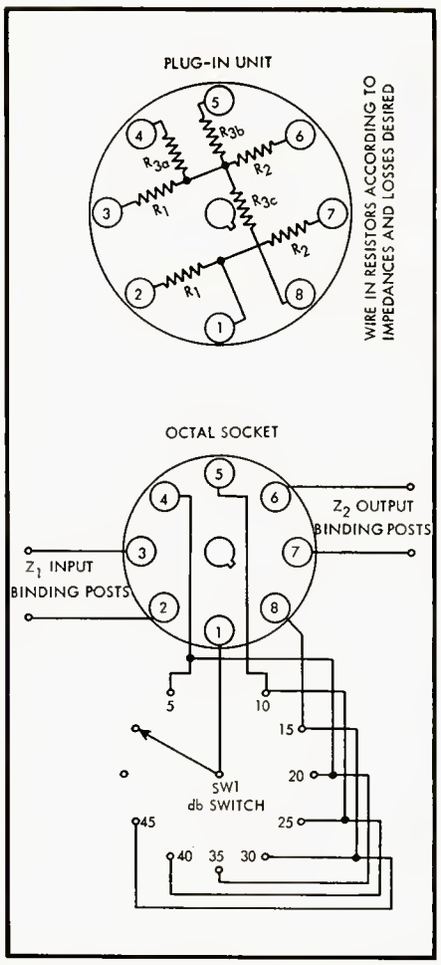


Fig. 4. (A) Wiring of the pads as constructed in plug-in form, and (B), the wiring of the switch in the unit shown in Fig. 3. Only those switch positions indicated on the pads are to be used. Any three adjacent values separated by either 5 or 10 db may be used.

[1] "Commonly Used T and H Pads", *The Recording and Reproduction of Sound*, page 775, by Oliver Read, Howard W. Sams and Co., Publisher.

[2] "Forty Commonly Used Pads", *Electronics For Engineers*, page 9, by Markus and Zeluff, McGraw-Hill Book Co., Publisher.

PRINTED WIRING

(*from page 20*)

not so obvious is that a similar advantage applies in the construction of any feedback amplifier. Feedback amplifiers rely on the over-all performance around the feedback loop at the extreme low and high frequencies for the stability criteria. Many feedback amplifiers have to be re-engineered during production, merely because lead dress changes. Maybe one of the assemblers left the

line and the replacement dresses the lead almost imperceptibly differently, in spite of the fact that tools are provided for this purpose.

In the amplifiers for this product line, a type of circuit and output transformer have been combined *that would not be economically possible with conventional production methods.* The extreme consistency of the production method makes the circuit feasible (and indeed a very good one to operate) because it precisely controls the stability criteria enabling performance to be consistently maintained.

Who Benefits?

This investigation shows conclusively that the printed wiring technique has a place in high fidelity equipment. The *consumer* benefits by getting a better product, custom produced, at lower cost.

In the high fidelity field many consumers seem to visualize their amplifier as having been custom built by the manufacturer. They believe the engineer had that particular amplifier on the bench and adjusted its performance to be well nigh perfect. The conventional method of construction does not produce any such a consistency of product. It is true a prototype may have been built like the consumer imagines he has in his home. But the production item he actually gets is far from meeting this standard of perfection. The deviation between individual units in a production run of high fidelity equipment is likely to be much wider than in a run of automobiles, for example, because of the cumulative effect of component tolerances and differences in lead dress on the over-all stability criteria and other characteristics of the amplifier.

Use of the printed wiring technique enables much closer tolerances to be maintained in all these parts of the amplifier production. It enables a close inspection at every stage in production so the final product really does come out as the "custom built" item the consumer visualizes. This extremely close control makes it possible for the designer to put out a product that comes much nearer the peak of its performance than is feasible with conventional methods, which require too much tolerance for production deviation.

But the consumer is not the only one to benefit. From *management* point of view, a decision is involved. A much bigger initial investment is necessary before any product starts coming off the line. A lot of work is needed to change over from one system to the other. But Harman-Kardon experience shows the benefits are well worth it.

Production people have a much happier job. There is more interest and less frustration in their work. *Quality control* is much easier and they can keep the standards up quite well. *Employees*

are better satisfied because they feel an incentive and that they have a "stake" in the end product instead of being just one of the cogs in a large production machine.

With conventional design of high fidelity equipment, *purchasing* personnel are often in trouble due to no fault of their own. The output transformer, for example, does not seem to behave, because of some changes that may or may not be due to the work of the transformer supplier. The purchasing agent is always the man "in between" who has to try and keep both ends happy. This problem is eased by the use of the printed wiring technique, which makes it much simpler to lay down a satisfactory procedure.

Engineers have had a perpetual moan that they are never allowed to finish developing a really good product. It always has to be rushed into production and in consequence needs re-engineering at various stages during production almost continuously. The printed wiring technique has brought an end to this state of frustration for the engineer. He can now work a good design right to the end, finalize it, then translate the design to printed wiring. He then has something he knows will work consistently in production. He can now forget this item and allow production to take it away and make it by the thousand, while he starts to work on the development of another good product for the company line.

Maybe some engineers, being the perverse people they are, will now feel regret at the loss of opportunity to roam around production "trouble-snooping." But once the re-orientation is made and new products are designed on the basis of producing a good unit and then translating it into a printed circuit, engineering personnel should be much happier that the product turns out consistently according to their design.

Finally let's not forget the man who always complains he is forgotten—the *service technician.* Although printed wiring turns out a better product, this does not mean it will be free from possible defect or failure. So how does the service technician fare when it comes into his shop? Unlike many of the printed TV sets, that bristle with boards in obscure places, the design adopted here is extremely lucid.

The printed board is laid out extremely visibly close underneath the bottom plate. In the service manual a photograph of this printed wiring conforms *exactly* with what the technician will see when he removes the bottom cover. This was impossible with the old wiring method. The wires never ran in exactly the places that either a photograph or a sketch showed. Having the entire amplifier on a single printed board makes the unit extremely compact so a few

quick measurements can quickly trace down the fault.

The work of removing faulty components and replacing requires a slightly different soldering technique, but one that most technicians will by now be used to, from handling TV sets with printed boards. Even complicated components, like tube sockets or function switches, can be replaced by snipping the connections round, removing each spike or pin one at a time with a solder iron, and putting in the replacement. The time taken will be considerably less than for replacing the equivalent component in a conventionally wired set and there is much less likelihood of error, because it is impossible to connect the wrong wire to the wrong pin of a tube socket or the wrong terminal of a switch.

The over-all impression gained from this investigation is that printed wiring represents a turning to a new phase in high fidelity equipment manufacture. This makes possible the bringing of high quality high fidelity equipment into the home of a great many more people, just as the invention of movable type, and particularly the mechanical compositing machine, made books and printed magazines available to a much wider number of people. Nowadays it is possible to have the highest quality books in the home at extremely low cost. This development is making the best quality high fidelity equipment available to the widest number of people for a minimum cost.

LETTERS

(*from page 6*)

the ear must again be used for the final judgement and approval. There would be little point in listening to music which laboratory instruments claimed was adequately reproduced while the ear was painfully violated. The point is, however, that *if properly and carefully conducted testing is done,* (Italics ours. Ed.) there will be good agreement between the objective and the subjective evaluations.

One more fact must be realized. The ear is very adaptable, and unless unusually well trained, finds acceptable and pleasant many sounds bearing little resemblance to the original. Thus many sound systems are tolerable, but once given a quick A-B switch to the original sound, or to a more nearly perfect reproducer, even an uncritical listener is aware of the difference.

Each manufacturer undoubtedly does as well as he can, but unfortunately not all reach the same degree of success, and the uniformity of excellence may be questioned seriously. There is not more than one tweeter on the market, for instance, which comes even close to doing a proper job as far as this listener's ears are concerned. Instrument checks are consistent with that opinion. Similar statements could be made for pickup cartridges, enclosures, and the rest. Many products have such intolerable departures from adequate performance that they are immediately ruled out. Yet their advertising claims glow as attractively as the rest.

If one does not have recourse to a lab full of equipment or a trusted expert opinion, try this. Get a demonstration of several systems as quickly as possible after coming from a live concert, preferably full orchestral material with more strings than percussion. The experience will be charmingly instructive.

Leon D. Harmon,
Institute for Advanced Study,
Electronic Computer Project,
Princeton, N. J.

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RADIO MAGAZINES, INC.
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Industry Notes . . .

• **AMPEX FORMS NEW DIVISION.** In a move designed to improve service to the company's customers for professional equipment, Ampex Corporation has formed a new Professional Products Division, devoted exclusively to the production and sales of equipment for the professional recording and broadcast industries.

Robert Paulson, formerly Ampex audio sales manager in the New York area, has been named sales manager of the new division and will headquarter in the company's home office at Redwood City, Calif.

In announcing the new set-up, Phillip I. Gundy, vice-president, stated that the new division would begin operations May 1, selling directly from factory to customers in the specified industries.

Sales engineers in seven metropolitan areas will inaugurate the direct sales program, calling only upon professional customers.

Ampex products which will be marketed by the Professional Products Division include Videotape recorders, automatic programming systems, time-delay systems for broadcasting, high-speed tape duplication systems, Models 300 and 350 studio recorders, Model 601 portable recorder, and Model 620 amplifier-speaker. Ampex dealers who have been selling professional Ampex products will continue to handle Models 350, 601 and 620.

• **NEW PLANT FOR REK-O-KUT.** A new 25,000 square foot plant devoted exclusively to the manufacture of Rek-O-Kut high fidelity components and recording equipment will be placed in operation in July, according to George Silber, company president. An outgrowth of the greatly increased sales volume in the high fidelity industry in recent years, the new plant will be entirely modern and will enable Rek-O-Kut to substantially increase its production over present facilities. Occupying an entire city block in Queens, N. Y., the plant will feature executive offices, production facilities, testing, inspection and shipping departments all located on one floor.

Silber reports that in addition to expansion, plans for 1958 call for greater diversification in the products Rek-O-Kut manufactures.

• **IHFM P.R. COMMITTEE MEETS.** Plans for an extensive educational campaign, utilizing all available forms of exploitation, were blocked out during the first meeting of the newly-formed Public Relations and Promotion Advisory Committee of the Institute of High Fidelity Manufacturers. Members of the committee are: Tom Dempsey, Reeves Soundcraft Corporation; Lawrence J. Epstein, University Loudspeakers, Inc., Chairman; Arthur Gasman, British Industries Corporation; C. G. McProud, Radio Magazines, Inc.; Ray Pepe, James B. Lansing Sound, Inc.; Adrian Price, Wexton Company; Oliver Read, Ziff-Davis Publishing Company, and Harold Reiss, Friend-Reiss Advertising.

In the chairman's report of the meeting, Epstein says that "I am delighted to report encouraging progress, and have no hesitancy in stating that much can be achieved from the activities of this committee."

Members of the committee were chosen with the thought of taking best advantage of the special talents and experiences available within the Institute. Membership comprises two representatives each from (a) technical press, (b) member advertising agencies serving member clients and (c) advertising and promotion managers of Institute members.

ADVERTISING INDEX

SIMPLE AS ABC

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.

E

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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.

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AUDIO — Please send me further information about the coded items circled below and about those advertised on the circled pages of the May issue.
(PLEASE DO NOT USE THIS CARD AFTER SEPTEMBER 1, 1957)

E-1	E-10	E-19	SB	8	37	53	63	73	79b
E-2	E-11	E-20		9–11	39	54	64	74	79c
E-3	E-12	E-21	1	13	40–41	55	65	75	79d
E-4	E-13	E-22	2	14	43	56	66	76	79e
E-5	E-14	E-23	3	27	45	57	67	77a	79f
E-6	E-15	E-24	4	29	47	58	69	77b	79g
E-7	E-16	C-2	5	31	49	59	70	77c	79h
E-8	E-17	C-3	6	33	50	60	71	78a	79k
E-9	E-18	C-4	7	35	52	61	72a	78b	80a
							72b	79a	80b

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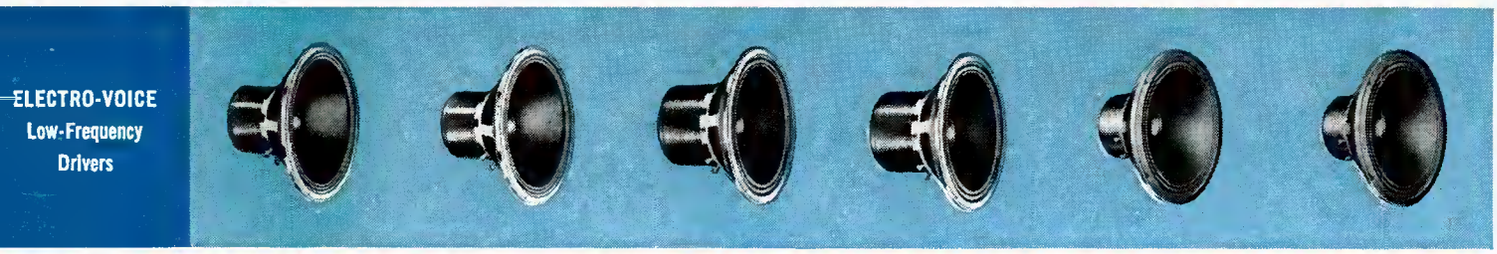
is necessary to get more information about any New Product or New Literature item, or about any product advertised in these pages.

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.

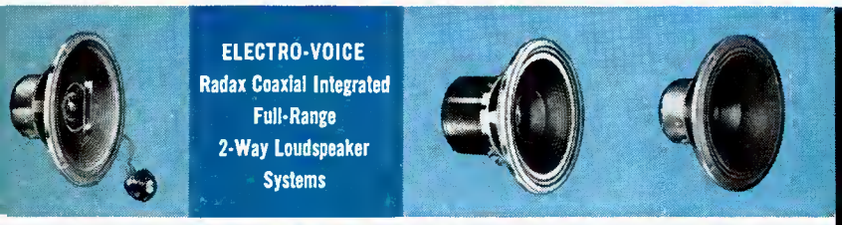
To get more information about the products that are advertised in each issue of AUDIO—use the new card at the left. Fill in your name and address clearly and circle the number of the page on which the advertisement appears. When there are two or more ads on a page, each one has under it a notation such 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.

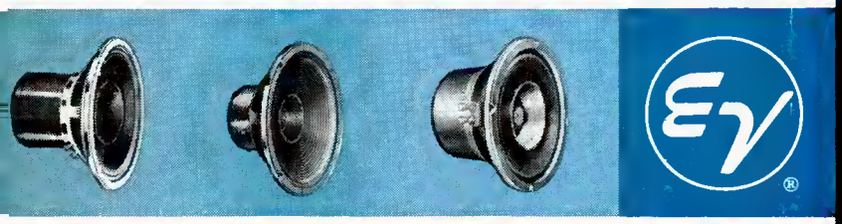


Model 18WK, Net $115 | Model 18 W, Net $115 | Model 15WK, Net $85 | Model 15W, Net $85 | Model 15BWK, Net $43 | Model 15BW, Net $43

Model 12WK, Net $65 | Model 12W, Net $65 | Model 12BW, Net $33 | Model 15TRX, Net $145 | Model 15TRXB, Net $79 | Model 12TRX, Net $120



Model 12TRXB, Net $64 | Model SP15, Net $85 | Model SP15B, Net $43



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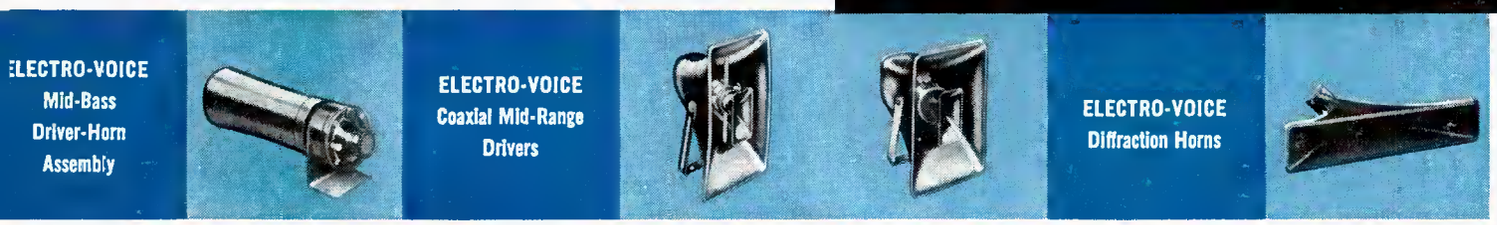

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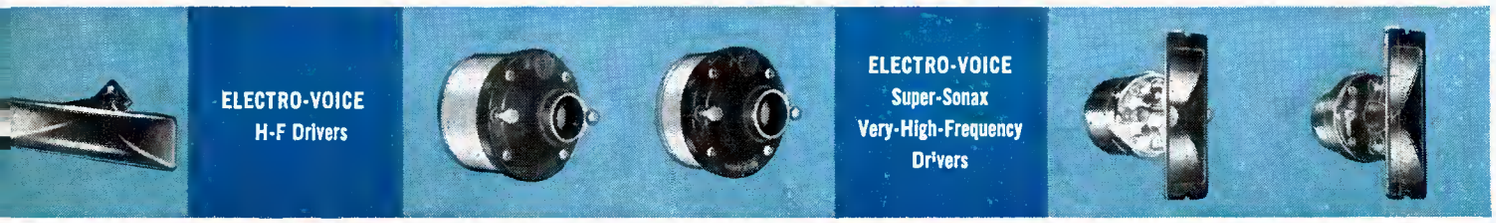

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