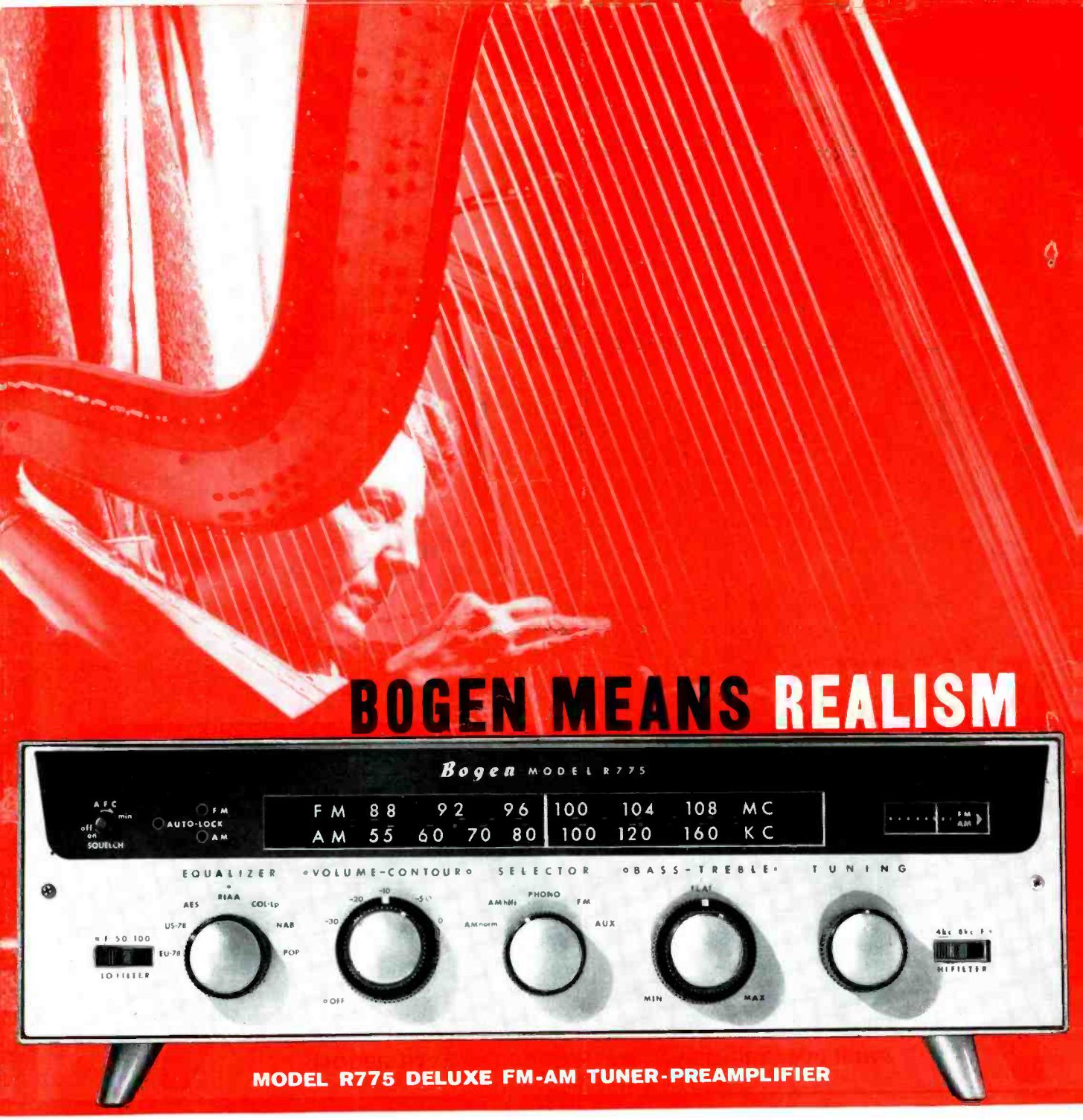
AUDIO

OCTOBER, 1957
50¢



It took Bogen creative engineering to develop the tuner that automatically "fine" tunes itself. Just turn the tuning knob until you reach the fringe of the station you want (as indicated by the meter)—then let go. A light goes on to tell you that Bogen is taking over. Walk away. The exclusive Auto-Lock tuning "zeros in" like a homing pigeon. Then it locks out all unwanted signals – however strong – and locks your station in for keeps. No drift. Pin-point-perfect reception, even in areas where others fail. All this plus special "squelch" circuit which eliminates interstation noise. Complete chassis: $249.50. Blonde or mahogany-finished enclosure: $8.00.

SPECIFICATIONS: Controls: Volume; tuning; separate bass and treble; 7-position record equalizer; loudness contour selector; separate high and low frequency filters; function selector. Colored dots indicate average listening settings. Audio response 10 cps to 100,000 cps ±0.5 db. Extreme sensitivity (2 microvolts for 30 db quieting on FM). Extremely low distortion (0.4% at rated output). Adjustable hum-eliminator. Tape recorder output. Inputs for magnetic, ceramic, and crystal cartridges. Write for complete catalog and/or send 25¢ for 56-page book "Understanding High Fidelity" to Dept. 000.

David Bogen Company, Paramus, N. J. • A Division of Unitronics Corporation

Bogen
HIGH FIDELITY
... because it sounds better

MANUFACTURERS OF HIGH-FIDELITY COMPONENTS, PUBLIC ADDRESS EQUIPMENT AND INTERCOMMUNICATION SYSTEMS

THE BRITISH INDUSTRIES

Sounding Board

The New
LEAK Line
of Amplifiers
and Preamplifiers

3 ENTIRELY NEW LEAK POWER AMPLIFIERS

2 ENTIRELY NEW LEAK PREAMPLIFIERS

THE 3 NEW LEAK AMPLIFIERS

High power . . . 50. 25. 12 watts . . . all at 1/10 of 1% (0.1%) distortion

These new units were produced to provide you with broadcast and professional components and workmanship in an amplifier for home use.

Simply stated: these amplifiers incorporate every desirable feature you have ever wanted in an amplifier . . . and without compromising the high Leak standard of craftsmanship.

CIRCUITRY

These new amplifiers continue to use a triple loop, negative feedback circuit. The unusually high amount of negative feedback in the Leak circuitry permits us to keep distortion to 1/10 of 1% (0.1%) at full rated output, and to reduce hum noise and the effects of tube aging or replacement to a minimum. In order to utilize this amount of negative feedback, and to achieve these advantages, a highly stable circuit is necessary. This requires the finest components and great skill in testing and assembly. For example, costly sealed condensers are used exclusively.

POWER RATING

There has been a consistent demand for higher power in amplifiers for home music systems, and recent developments and improvements in output tubes have now made it possible to satisfy these demands without altering the proven Leak circuitry or compromising the Leak "Point One" performance standards. The Leak "TL/50 Plus" amplifier employs the newly-developed, high output KT88 type tube; the "TL/25 Plus" incorporates the recognized KT66 type, and the "TL/12 Plus" the N709 type.

The Sounding Board

cut along dotted line and save

by a 50 watt "plus" Leak amplifier. We rate this amplifier at 50 watts because that is the point at which the harmonic distortion reaches 1/10 of 1% (0.1%) at 1000 cycles. In actual fact, this amplifier can deliver as much as 64 watts, still with negligible distortion. This explains the word "Plus" in the model number. In the same way, the "TL/25 Plus" delivers 32 watts, the "TL/12 Plus" delivers 14 watts . . . therefore, these model designations also contain the word "plus."

CRAFTSMANSHIP

One way to recognize the care taken in manufacturing a Leak amplifier is to turn it upside down and compare it with any other amplifier. Take a good look at these components . . . fine as they are . . . all are utilized well below their maximum ratings, which insures great stability and long life. These are the kind of considerations which produce the recognizable difference between Leak sound and that of any other amplifier.

PRICES: "TL/50 Plus".....$149.00
"TL/25 Plus".....$109.50
"TL/12 Plus".....$89.00

THE 2 NEW LEAK PREAMPLIFIERS

Compact, handsome and flexible . . . built specifically and only for the Leak power amplifiers! The first impression you will get is the handsome, compact look of these preamplifiers. They have been completely restyled in rich gold, brown and white by world-famous designer Richard Lonsdale-Hands.

EXCEPTIONAL VERSATILITY

Careful thought has been given to the varied installations and arrangements to which these preamplifiers must be adaptable. For example, one exclusive feature is the tape recording and playback jacks on the front *and* the rear panels—to facilitate portable as well as permanent tape recording installations.

THE NEW "POINT ONE" PREAMPLIFIER

The "Point One" Preamplifier includes more expensive components, and a more complete circuitry than you will find in most preamplifiers. The reason for its low price of $55.00 is that this preamplifier was designed without a power supply, since it takes its power from the amplifier. The "Point One" is a low-noise, low-distortion 2-stage feed-back tone control preamplifier. The first stage provides record compensation through frequency selective negative feedback. The second stage embodies feedback tone control of both bass and treble frequencies . . . ± 16 db at 30 c/s and ± 18 db at 20,000 c/s. A 4 kc, 6 kc and 9 kc filter permits comprehensive control of treble frequencies in old or worn records. The four playback characteristics cover all records ever made! The inputs for tuner, tape and phono cartridge each have their own balancing controls! You simply cannot get more preamplifier for the money!

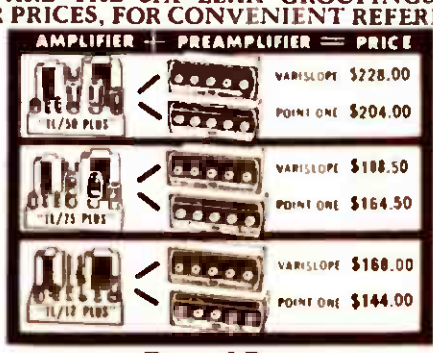
THE NEW VARISLOPE III PREAMPLIFIER

This preamp has all the features of the new "Point One" and, in addition, has two magnetic input positions, a rumble filter, and the exclusive Leak Slope Control. This important control makes available an infinite number of equalization positions.

Here's how the Varislope works: When the Filter Control is turned to 9, a filter is switched into circuit, the turnover frequency being 9 kc/s. Other turnover frequencies of 6 kc/s and 4 kc/s are also obtainable. The Slope Control varies the rate of attenuation above the turnover frequency, between 5 db per octave and 35 db per octave. The Treble control is operative at the same time, and you can see that these three give a most versatile control of the high frequency range. In actual practice, records which may sound distorted . . . harsh or shrill . . . can be controlled to remove the distortion, yet keeping all the musical content. This will give you the greatest listening pleasure possible for every record in your collection.

Point One: $55.00 Varislope III: $79.00

HERE ARE THE SIX LEAK GROUPINGS AND THEIR PRICES, FOR CONVENIENT REFERENCE:



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LEAK INDUSTRIES CORP

The Sounding Board

OCTOBER, 1957 VOL. 41, No. 10
Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

CONTENTS

COVER PHOTO—Lovely to look at and still more enjoyable to listen to is this Heathkit "Legato" three-way loudspeaker system—one you can build for yourself with certainty of good sound when it is completed.

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

AUDIOCLINIC??

JOSEPH GIOVANELLI*

Note: I have received many letters containing requests for complete plans for custom-designed equipment. In order to fill these requests, it would be necessary for me to construct each unit. Clearly, this is impractical. To those of you who have written such letters, I can only recommend sources in which relevant information can be found. Anyone who actually requires a piece of equipment designed to meet his needs would be best served by a consulting engineer. I am truly sorry that I cannot fill such requests; nevertheless, I appreciate the confidence in me shown by those who sent them.

Ills of Stereo

Q. I have recently installed a stereo tape playback system, and I am having trouble with it. I'll describe the symptoms first and then the system.

Wherever I place my two speakers, I get sounds that do not blend properly. If I place the speakers close together, the effect is that of a single speaker. If I move the speakers farther apart, there is a hole between them and I am very much aware that I am hearing two speakers. In fact, some instruments give the illusion of coming first from one speaker and then from the other. While some instruments are very definitely located at right or left, no sound seems to come from a position somewhere between the two speakers. Each channel is made up of equipment which is not matched by the other channel. One channel feeds a Georgian speaker system, while the other feeds a twelve-inch speaker with a Heathkit range extender added. One of the amplifiers is a fifty-watt Dynakit; the other is a seven watt unit. Since the stereo tape head came with inadequate installation instructions, I am not sure that it is properly aligned. Can misalignment destroy the stereo effect?

The room in which the equipment is housed is small and, roughly, T-shaped; it may, for convenience, be divided into two sections. Area X is approximately 12 feet wide, 8 feet deep, and six and one-half feet high. Area Y is about 25 feet wide and 12 feet deep. The center of area Y is full ceiling height, 6½ feet, but walls slope to sides so that there is about 35 inches of clearance at outer edges. In neither section do I get good results. Clarence W. Kaufman, Lincoln, Nebraska.

A. Your problem is largely one of room acoustics. If possible, close off the section of the room you decide not to use. If there is too much reflection from solid surfaces, too much of the sound intended for one ear will be reflected to the other and the stereo effect will be lost. Therefore, place some kind of absorbent material on the wall and floor. These can take the form of draperies and rugs. Covering the ceiling would be helpful but it may be impracticable.

Some of your trouble may be electrical in nature. Perhaps, as you indicated, the playhead is not properly aligned. To remedy this most easily, listen to one channel and note when the high frequencies are heard most clearly. Alignment itself is accomplished by rocking the playhead from side to side. In some installations, the pivot point is in the middle and in others, it is at one end. In still others, there is no provision for this alignment, and therefore, it is likely that it is correctly done when the head is mounted flat against the motor board, and when the tape runs perfectly parallel to the board. Assuming the alignment to be correct, it is possible that you do not have the channels properly balanced against each other. Correct balance can be obtained by playing a full track tape using both channels. When they are properly balanced, the sound will appear to come from a virtual source midway between the two speakers. The fact that your two speaker systems are mismatched will have some bearing on the problem. If the speakers have similar sound quality, good results should be expected. We have, however, conducted experiments here which indicate that a large speaker used for one channel and a table radio used for the other can give quite a good feeling of third dimension. However, such small speakers have resonances which can emphasize instruments such as horns far out of proportion to their real strength, so that while these instruments should be in the center, let us say, they will actually appear to come from the side where the resonating speaker is dominant.

If the phasing of the two speakers is not correct, sound from one speaker would tend to cancel that from the other. Therefore, rather than blending, sound would come from one or the other of the two speakers, depending upon which had the greater volume at any instant. To correct this condition, reverse the leads to *one* of the speakers.

Hum in Preamplifier

Q. Several years ago, I assembled Audio's Preamp with Presence. *I like the unit very much but I do have a hum which is objectionable on soft passages of music. I have added more filtering to the power amplifier used to supply B plus to the unit, together with a hum balance with d.c. bias; I have also tried various stunts with the coax between the amplifier and the preamplifier, such as grounding the shield at only one end, with the chassis for the two units bonded together with heavy bus. Nothing has helped. What can you suggest for me to try next? A. D. A. Crawford. San Francisco, Cal.*

A. This hum is probably caused by lack of internal shielding or by poor ground lead placement, leading to ground loops. Perhaps

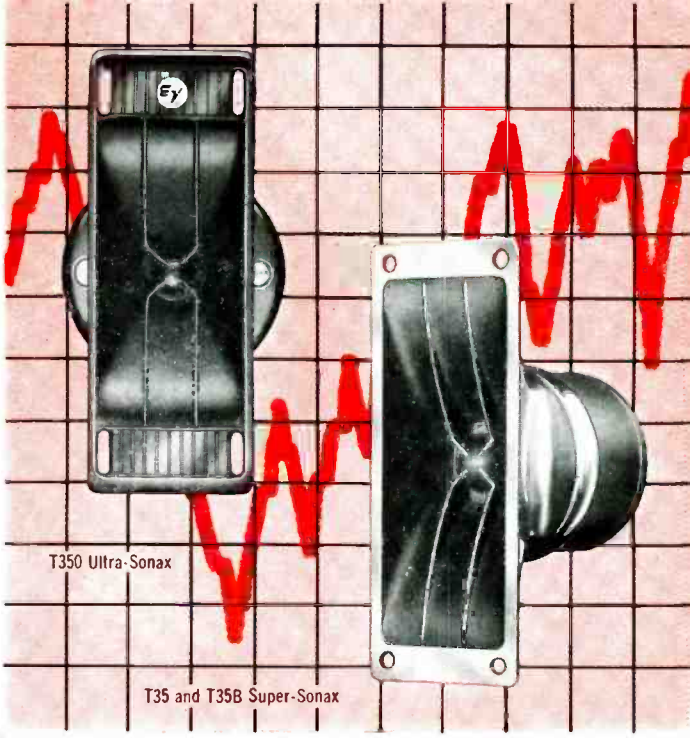
* *3420 Newkirk Ave., Brooklyn 3 N.Y.*

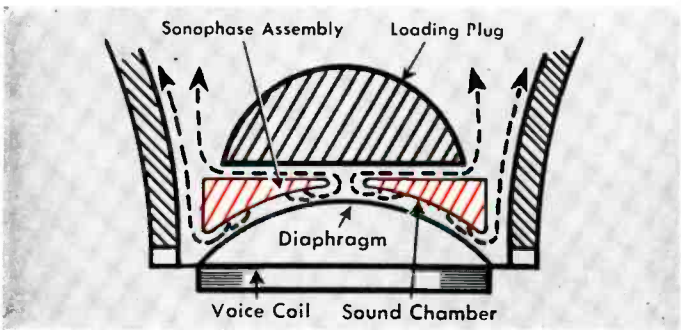
Electro-Voice

NEW Ultra-Sonax and Super Sonax Very High Frequency Drivers, Diffraction Horns and Revolutionary E-V Avedon Throat Design

No other manufacturer gives you very high frequency drivers combining all the customer benefits of these unique new Electro-Voice models. Today's folded horn and phase loaded speaker systems with their low first-octave response *require* flat, extended high range response beyond the very limit of audibility if essential musical balance is to be achieved. These very high frequency drivers, employing the time-tested diffraction principle and the new Avedon throat design, overcome range and sensitivity limitations, function without distortion at the highest ranges.

All three models—T35, T35B and T350—have 180° dispersion patterns, program capacities of 50 watts, peak 100 watts, voice coils one inch in diameter and 16 ohms impedance. Chart shows other characteristics of each model.





Specifications	T35	T35B	T350
Frequency Response:	± 2 db 2 kc—19 kc	± 2 db 2 kc—18 kc	± 2 db 2 kc—21kc
RETMA Sensitivity Rating:	57 db	54 db	60 db
Magnet Weight:	7 oz.	4 oz.	1 lb.
Gauss	13,500	9,000	20,000
Size:			
Horn:	5¼ in. long x 2 in. wide		7½ in. long x 2⅞ in. wide
Pot Diameter:	2¼ in. maximum		3½ in. maximum
Depth:	3¼ in. overall	3 in. overall	4½ in. overall
Shipping Weight:	3 lbs.	3½ lbs.	9½ lbs.
Net Price:	$35.00	$22.00	$60.00

And These are the Reasons Why

The Avedon Throat Design

The unique throat design illustrated here overcomes a problem common in conventional high frequency drivers. This is diaphragm deformation at high frequencies, occurring at frequencies above 5 kilocycles. Piston action is destroyed, the phase is shifted and the result is destructive interference.

These Electro-Voice UHF drivers solve the diaphragm deformation problem with a longer sound path from the center of the diaphragm. This restores proper phase relationship. This is important above 12 kilocycles, where sound must be taken from the center of the diaphragm *and* from the outer edge simultaneously. The diagram shows E-V's Avedon construction.

The Hoodwin Diffraction Horn

This is the Electro-Voice development which is used in all E-V horns to disperse sound *equally in all lateral directions* from a single point source. This is especially important in stereophonic reproduction to preserve the undistorted depth and width of the original sound. Diffraction horns insure balanced levels of both right and left stereo speakers. These drawings tell the diffraction horn story:

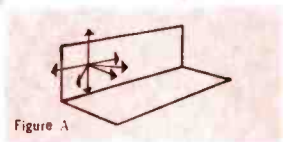
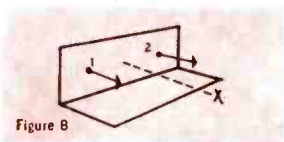
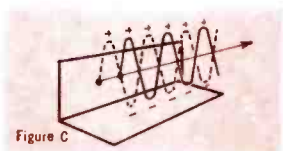


Figure A—This shows how sound disperses equally in all directions from a single point source.



In Figure B two sound sources are shown. On the axis, at point "x," double the sound power results as the resultant pressures are in phase.



But in Figure C, if the distance between the two sources is ½ wavelength or greater, the sound from the two sources will be considerably out of phase for points off the axis, resulting in decreased sound pressure.

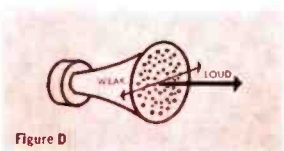


Figure D will show the deficiencies in horns of wide lateral dimensions compared to the wavelength being emitted. Any horn mouth can be considered as a group of small point sources of sound. They must beam the sound down the axis by their very nature.

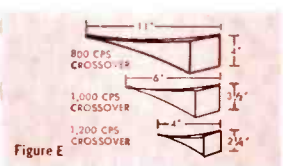


Figure E shows representative horns, illustrating that horns must have a certain length, as well as cross sectional area along this length and at the mouth to load the driver diaphragm down to the lowest frequencies to be reproduced. The lower we go, the longer must be the horn and the greater the mouth area.

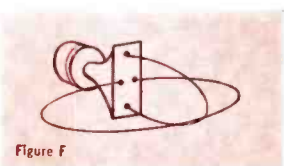


Figure F shows that narrowing the horizontal area and extending the vertical dimension of the horn mouth preserves the loading area necessary for good low end response, disperses the sound perfectly in the horizontal direction where it is so necessary, and keeps interfering reflections off the floor and ceiling.

Electro-Voice

ELECTRO-VOICE, INC. • **BUCHANAN, MICHIGAN**
Export: 13 East 40th Street, New York 16, U.S.A. Cables: ARLAB

Electro-Voice manufactures the most complete high-fidelity product family ... speakers, speaker systems, speaker enclosures, amplifiers, preamps, tuners, phono cartridges, do-it-yourself enclosure kits and microphones. Available at leading high fidelity distributors.

LETTERS

National Anthems

SIR:

We submit this suggestion to you because of AUDIO's influential position and our mutual interest in good music.

Wouldn't it be wonderful if some large recording corporation made an album containing a collection of foreign national anthems as well as our own. The company could have the best chorus and orchestra from each individual country do their own national anthem. After all, who can express the nationalism and personality of a country more than a native artist? Would you go to bat for such a project? (*Yes.* ED.)

Just think of the variety, color, and human interest that could be put into it! It could be DYNAMIC.

Speaking for ourselves, we would love to have such an album, and we strongly feel that many people would share our enthusiasm if they were given the chance.

We hope this letter has encouraged some sort of action other than a move towards the wastebasket.

LINDA CORRELL and
MARGARET PARKHURST
2035 North Brighton,
Burbank, California

Hi-Fi Design Questions

SIR:

These few questions have been bothering the writer for some time, and it is possible that some of your readers may have opinions on them.

Construction articles, descriptions of commercial designs, and advertisements appear from month to month making claims for the advantages of this circuit or for that construction method. This is only natural, since the authors have something to sell—either an idea or a product. However, one is inclined to wonder whether they are isolated examples of the enthusiasm of some builder or advertiser or are indicative of a trend or fad.

One of the most obvious questions concerns the number of controls, particularly on preamplifiers. Many preamps available today have anywhere from four to fourteen controls which have some effect on tone quality, whether as tone controls, rumble or scratch filters, or recording compensation controls. Are they all really necessary? Or, somewhere along the line, have they become so numerous and so complicated that they defeat the purpose of the whole system, which is—or at least should be—to make possible the faithful and enjoyable reproduction of music or other sounds. The prime purpose of some of the more complicated correction systems would seem to be that of impressing the uninitiated, in much the same manner as the chrome-plated carburetors and other gadgets on an adolescent's hot-rod are meant to do.

For example, preamps may have compensation for many different recording characteristics. Those which are now, or have been recently, in use are so similar that only a hypercritical ear can tell the difference. The standard instructions for the use of one of these preamps seems to be to set the compensation to match the record being played and then to adjust the tone controls for the best sound coming from the speaker. This, of course, assumes that the recording characteristic for each item is available, but this would be far from true, especially with older records. It would certainly be far simpler,

and for 99 per cent of us would permit more enjoyment of the music, to have the compensation set for a single recording characteristic, preferably the now standard RIAA curve, with possibly a simple toggle or slide switch to remove the treble rolloff for use with old 78-rpm records. The tone controls would still perform their normal function of "touching up" the response for best listening, but this would also include the touching up for slight variations in record compensation. My own system has been used in this manner for the past year or so and I have not felt the need for any additional corrections or compensation which were beyond the capability of the tone controls.

Another point in question along the same line is whether the sonic purist, after he has set all his compensating controls to correspond to the corrections theoretically needed for a particular record being played, or to match some other signal source, has any real idea of the over-all response of his sound system, including (most especially including) the speaker. While the response of the purely electronic portions of the system is fairly easy to check, speaker response determinations are something else again for the average hi-fi addict. Leaving actual measurements out of the picture as being beyond the scope of most hi-fi fans' equipment or ability, just look at the frequency-response curves for some of the better speaker systems, as published by their manufacturers. They are held, not to the 1-db tolerance of the amplifier boys, but to 5 db, a total range of 10 db within a specified frequency range, which might be 60–9000 cps if you want to spend less than $50 for your speaker, or it might be 30–20,000 cps for a much higher price. Since these measurements are undoubtedly made under conditions as nearly ideal as the manufacturer can devise, the peaks and valleys of the published curves represent the least that can happen to the signal after it has passed through that perfectly compensated preamp and that power amplifier (guaranteed flat from 20 to 20,000 cps). Reflection and absorption in the room will undoubtedly alter the sound still more before it reaches the ear. All this brings us right back to using the tone controls to give the most pleasing sound; in other words, to place the various sections of the audio frequency range where we like them, dynamically speaking. They may, or may not, correspond to the dynamic placement of the original, depending in part on speaker and room characteristics, and in part on personal preferences. I actually know one person who lacquered his speaker cone because he preferred the sharper, almost tinny, sound that resulted. However, such subjective factors make too intensive and involved a topic to discuss here.

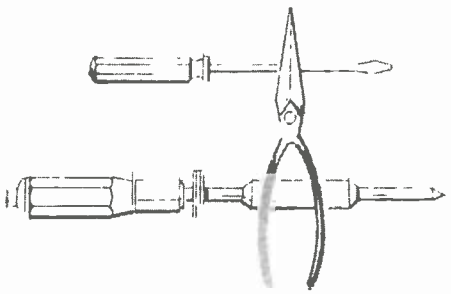
Speaking of speakers, articles on speaker enclosures range from the authoritative, well engineered descriptions by representatives of the major companies to the well meant but inadequate write-ups of various home-designed-and-built systems. It cannot escape notice that the professionals, in discussing the performance of their systems, refer to sound intensity (or pressure) as their criterion of performance. They show curves of sound intensity *vs.* frequency, determined under conditions approaching the free-field state, which show both efficiency and smoothness or response over the entire audio range.

On the other hand, the amateurs, if they give any quantitative data at all, show only the impedance curves of their units for the low-frequency end of the range. This is understandable, since impedance is about

(*Continued on page 86*)

treat your family to all the fun and enjoyment of fine high fidelity at one-half the price you would expect to pay

HERE'S ALL YOU NEED



to build your own

HEATHKIT HI-FI

HEATHKIT HIGH FIDELITY FM TUNER KIT

This FM tuner is your least expensive source of high fidelity material! Stabilized oscillator circuit assures negligible drift after initial warmup. Broadband IF circuits assure full fidelity, and 10 microvolt sensitivity pulls in stations with full volume. High-gain cascode RF amplifier, and automatic gain control. Ratio detector gives high-efficiency demodulation. All tunable components prealigned. Edge-illuminated dial for easy tuning. Here is FM for your home at a price you can afford. Shpg. Wt. 7 lbs.

MODEL FM-3A $25.95 (with cabinet)

HEATHKIT BROADBAND AM TUNER KIT

This tuner differs from an ordinary AM radio in that it has been designed especially for high fidelity. The detector uses crystal diodes, and the IF circuits are "broadbanded" for low signal distortion. Sensitivity and selectivity are excellent. Quiet performance is assured by 6 db signal-to-noise ratio at 2.5 uv. All tunable components prealigned. Incorporates AVC, two outputs, and two antenna inputs. Edge-lighted glass slide rule dial for easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 8 lbs.

MODEL BC-1A $25.95 (with cabinet)

HEATHKIT "MASTER CONTROL" PREAMPLIFIER KIT

This unit is designed to operate as the "master control" for any of the Heathkit Williamson-type amplifiers, and includes features that will do justice to the finest program material. Frequency response within ±1½ db from 15 to 35,000 CPS. Full equalization for LP, RIAA, AES, and early 78's. Five switch-selected inputs with separate level controls. Bass and treble control, and volume control, on front panel. Very attractively styled, and an exceptional dollar value. Shpg. Wt. 7 lbs.

MODEL WA-P2 $19.75 (with cabinet)

HEATHKIT "BASIC RANGE" HIGH FIDELITY SPEAKER SYSTEM KIT

The very popular model SS-1 Speaker System provides amazing high fidelity performance for its size because it uses high-quality speakers, in an enclosure especially designed to receive them.

It features an 8" mid-range-woofer to cover from 50 to 1600 CPS, and a compression-type tweeter with flared horn to cover from 1600 to 12,000 CPS. Both speakers are by Jensen. The enclosure itself is a ducted-port bass-reflex unit, measuring 11½" H x 23" W x 11¾" D and is constructed of veneer-surfaced plywood, ½" thick. All parts are precut and predrilled for quick assembly.

Total frequency range is 50 to 12,000 CPS, within ±5 db. Impedance is 16 ohms. Operates with the "Range Extending" (SS-1B) speaker system kit later, if greater frequency range is desired. Shpg. Wt. 30 lbs. **MODEL SS-1 $39.95**

"BASIC" SPEAKER SYSTEM

HEATHKIT "RANGE EXTENDING" HIGH FIDELITY SPEAKER SYSTEM KIT

The SS-1B uses a 15" woofer and a small super-tweeter, to supply very high and very low frequencies and fill out the response of the "Basic" (SS-1) speaker system at each end of the audio spectrum. The SS-1 and SS-1B, combined, provide an overall response of ±5 db from 35 to 16,000 CPS. Kit includes circuit for crossover at 600, 1600 and 4000 CPS. Impedance is 16 ohms, and power rating is 35 watts. Measures 29" H x 23" W x 17½" D, and is constructed of veneer-surfaced plywood, ¾" thick. Easy to build! Shpg. Wt. 80 lbs.

MODEL SS-1B $99.95

RANGE EXTENDER

...and save!

HEATHKIT "LEGATO" HIGH FIDELITY SPEAKER SYSTEM KIT

The fine quality of the Legato Speaker System Kit is matched only in the most expensive speaker systems available. The listening experience it can bring to you approaches the ultimate in esthetic satisfaction.

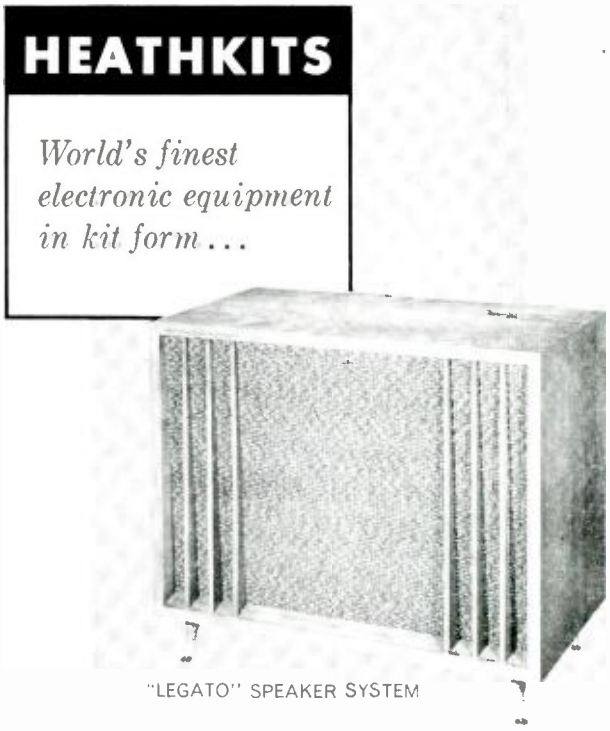
Frequency response is ±5 db 25 to 20,000 CPS. Two 15" theater-type Altec Lansing speakers cover 25 to 500 CPS, and an Altec Lansing high frequency driver with sectoral horn covers 500 to 20,000 CPS. A precise amount of phase shift in the crossover network brings the high-frequency channel into phase with the low-frequency channel to eliminate peaks or valleys at the crossover point. This is one reason for the mid-range "presence" so evident in this system design.

The attractively styled "contemporary" enclosure emphasizes simplicity of line and form to blend with all furnishings. Cabinet parts are precut and predrilled from ¾" veneer-surfaced plywood for easy assembly at home. Impedance is 16 ohms. Power rating is 50 watts for program material. Full, smooth frequency response assures you of outstanding hi-fi performance, and an unforgettable listening experience. Order HH-1-C (birch) for light finishes, or HH-1-CM (mahogany) for dark finishes. Shpg. Wt. 195 lbs.

MODELS HH-1-C or HH-1-CM $325.00 each

HEATHKITS

World's finest electronic equipment in kit form...



"LEGATO" SPEAKER SYSTEM

Pioneer in "do-it-yourself" electronics

HEATH COMPANY

A subsidiary of Daystrom, Inc.
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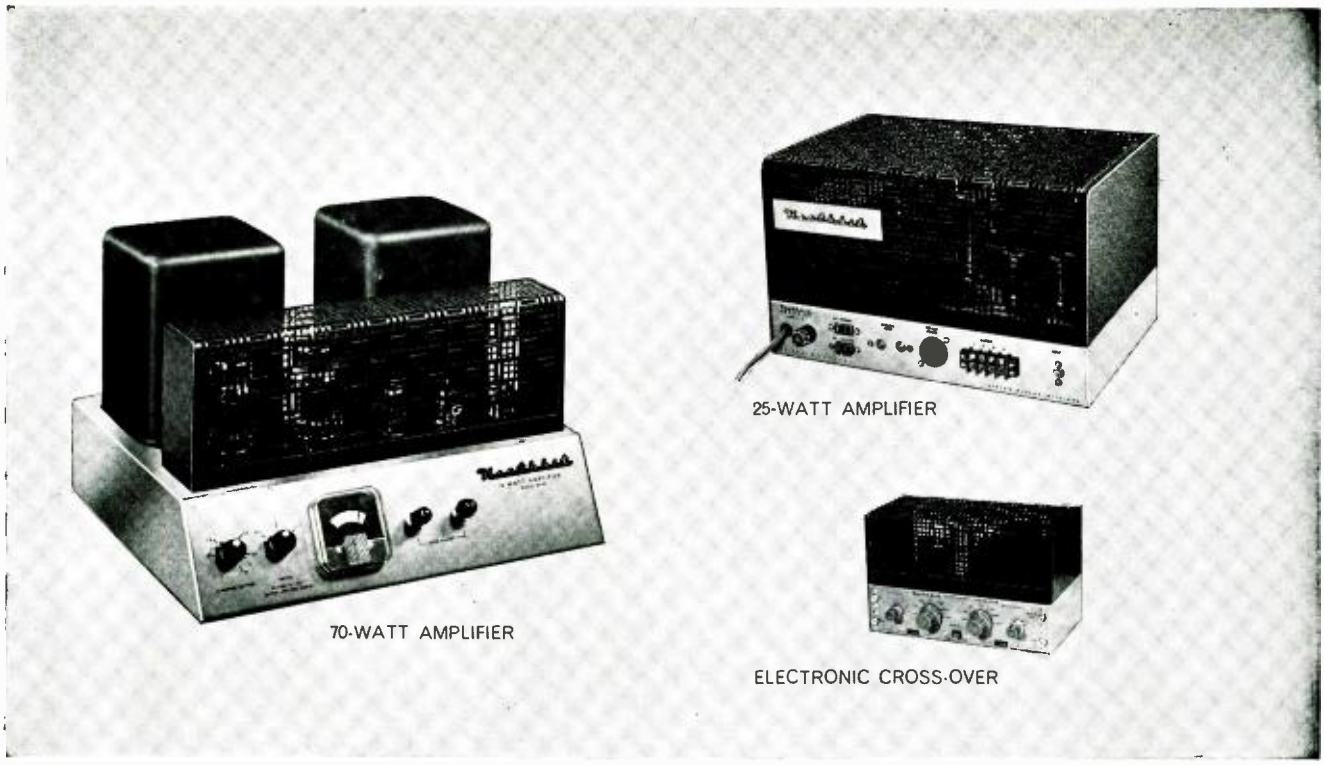


easy-to-build designs by HEATH *insure*

You get more comprehensive assembly instructions, higher quality circuit components, and more advanced design features, when you buy HEATH hi-fi!

HEATHKIT 70-WATT HIGH FIDELITY AMPLIFIER KIT

This new amplifier features extra power reserve, metered balance circuit, variable damping, and silicon-diode rectifiers, replacing vacuum tube rectifiers. A pair of 6550 tubes produce full 70-watt output with a special-design Peerless output transformer. A quick-change plug selects 4, 8 and 16 ohm or 70 volt output, and the correct feedback resistance. Variable damping optimizes performance for the speaker system of your choice. Frequency response at 1 watt is ±1 db from 5 CPS to 80 KC with controlled HF rolloff above 100 KC. Harmonic distortion at full output less than 2%, 20 to 20,000 CPS, and intermodulation distortion below 1% at this same level. Hum and noise are 88 db below full output. Variable damping from .5 to 10. Designed to use WA-P2 preamplifier. Express only. Shpg. Wt. 50 lbs. **MODEL W-6M $109.95**

HEATHKIT 25-WATT HIGH FIDELITY AMPLIFIER KIT

The 25-watt Heathkit model W-5M is rated "best buy" in its power class by independent critics! Faithful sound reproduction is assured with response of ±1 db from 5 to 160,000 CPS at 1 watt, and harmonic distortion below 1% at 25 watts, and IM distortion below 1% at 20 watts. Hum and noise are 99 db below rated output, assuring quiet, hum-free operation. Output taps are 4, 8 and 16 ohms. Employs KT66 tubes and Peerless output transformer. Designed to use WA-P2 preamplifier. Express only. Shpg. Wt. 31 lbs. **MODEL W-5M $59.75**

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. The XO-1 is used between the preamplifier and the main amplifiers. Separate amplification of high and low frequencies minimizes IM distortion. Crossover frequencies are selectable at 100, 200, 400, 700, 1200, 2000, and 3500 CPS. Separate level controls for high and low frequency channels. Attenuation is 12 db per octave. Shpg. Wt. 6 lbs.

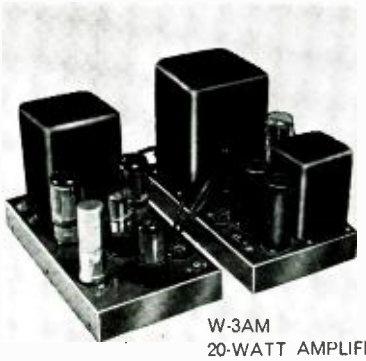
MODEL XO-1 $18.95

HEATHKIT W-3AM HIGH FIDELITY AMPLIFIER KIT

Features of this fine Williamson-type amplifier include the famous Acrosound model TO-300 "ultralinear" transformer, and 5881 tubes for broad frequency response, low distortion, and low hum level. Response is ±1 db from 6 CPS to 150 KC at 1 watt. Harmonic distortion is below 1% and IM distortion below 1.3% at 20 watts. Hum and noise are 88 db below 20 watts. Provides output taps of 4, 8 or 16 ohms impedance. Designed to use WA-P2 preamplifier. Shpg. Wt. 29 lbs. **MODEL W-3AM $49.75**

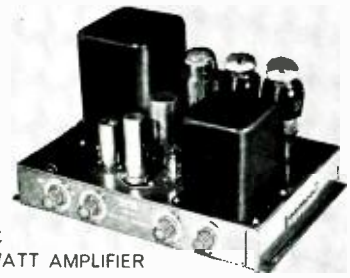
HEATHKIT W-4AM HIGH FIDELITY AMPLIFIER KIT

A true Williamson-type circuit, featuring extended frequency response, low distortion, and low hum levels, this amplifier can give you fine listening enjoyment with a minimum investment. Uses 5881 tubes and a Chicago-standard output transformer. Frequency response is ±1 db from 10 CPS to 100 KC at 1 watt. Less than 1.5% harmonic distortion and 2.7% intermodulation at full 20 watt output. Hum and noise are 95 db below full output. Transformer tapped at 4, 8 or 16 ohms. Designed to use WA-P2 preamplifier. Shipped express only. Shpg. Wt. 28 lbs. **MODEL W-4AM $39.75**



W-3AM
20-WATT AMPLIFIER

W-4AM
20-WATT AMPLIFIER



A-9C
20-WATT AMPLIFIER

A-7D
7-WATT AMPLIFIER

HEATHKITS

World's finest electronic equipment in kit form . . .

. . . *top* **HI-FI** *performance*

HEATHKIT A-9C
HIGH FIDELITY AMPLIFIER KIT

This amplifier incorporates its own preamplifier for self-contained operation. Provides 20 watt output using push-pull 6L6 tubes. True high fidelity for the home, or for PA applications. Four separate inputs—separate bass and treble controls—and volume control. Covers 20 to 20,000 CPS within ±1 db. Output transformer tapped at 4, 8, 16 and 500 ohms. Harmonic distortion less than 1% at 3 db below rated output. High quality sound at low cost!
Shpg. Wt. 23 lbs. MODEL A-9C $35.50

HEATHKIT A-7D
HIGH FIDELITY AMPLIFIER KIT

This is a true high fidelity amplifier even though its power is somewhat limited. Built-in preamplifier has separate bass and treble controls, and volume control. Frequency response is ±1½ db from 20 to 20,000 CPS, and distortion is held to surprisingly low level. Output transformer tapped at 4, 8 or 16 ohms. Easy to build, and a fine 7-watt performer for one just becoming interested in high fidelity. Shpg. Wt. 10 lbs. MODEL A-7D $17.95

Model A-7E: Same as the above except with extra tube stage for added preamplification. Two switch-selected inputs, RIAA compensation, and plenty of gain for low-level cartridges. Shpg. Wt. 10 lbs. $19.95

HOW TO ORDER . . .
Just identify the kit you desire by its model number and send check or money order to address below. Don't hesitate to ask about HEATH TIME PAYMENT PLAN.

Pioneer in "do-it-yourself" electronics

HEATH COMPANY
A subsidiary of Daystrom, Inc.
Benton Harbor 25, Mich.

FREE CATALOG

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CITY & STATE _____

Please send **FREE** *Heathkit Catalog*

ABOUT MUSIC

HAROLD LAWRENCE*

Recording in Milan

MOVEMENT, MARBLE, AND MUSIC are three features of Milanese life that impress the visitor at first encounter. This is a bustling metropolis with a fast-moving stream of pocket-sized autos, motor-scooters, and bicycles. Here you must have your wits about you when you cross the narrow old streets of the city. At the first "buzz" of a Vespa or a Lambretta, get back to the sidewalk as quickly as you can. If you have already reached the point of no return, scurry to the opposite curb for safety. Autos, with their less boisterous motors, have a way of sneaking up on the unwary pedestrian, aiming at him, and then narrowly avoiding him at the last instant. The streets of Milan are an Italian Indianapolis Speedway on to which the public has been allowed to walk. A keen sense of hearing is essential for avoiding motor-scooters; for autos, a perfect field of vision. During the first days in Milan, it is still disconcerting to stroll along the *rias* to the accompaniment of the whizzing sound of the motor-scooters. It's almost like being startled out of your sleep by finding a mosquito trapped in your ear.

Along with the fast pace of Milanese traffic, the sound of pneumatic drills, tractors, and wrecking crews, points up one of the brightest aspects of Italy's economic picture. New buildings are sprouting up in the heart of this industrial city at a fantastic rate. One of the principle materials used in these constructions is marble. Not marble in the decorative sense alone, but as a basic structural element: in huge slabs, columns and tiles, and in myriad colors and patterns. Marble abounds in incredible profusion; the sidewalks themselves are made of it in certain streets.

The Milanese have not overlooked the aesthetic value of marble in planning the interiors of their spanking new buildings. The city's largest music-equipment-instrument shop, G. Ricordi, contains a recording studio in which light-colored marble is combined with the deep, warm tones of hard wood to produce a truly stunning effect in modern design. Terrace apartments in the newer apartment houses include interesting marble-tile embellishments on walls and floors. In addition to decoration, the solidity of the stone allows for extraordinary flexibility; this, coupled with the

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

Teatro Alla Scala, famed Milan opera house.

— Photo Courtesy Italian State Tourist Office.

Removes all static and dust while record is played; new moving coil microphones and transistor amplifier

ESL DUST BUG

The automatic record cleaner

The problems of dust, lint, and static buildup on phonograph records and pickup styli have been solved by this ingenious new invention which cleans the record as it is being played. The plush pad is slightly moistened with special, harmless activating fluid supplied in a replaceable applicator. This helps to loosen groove dust and dirt, which is then collected by the pad. It also neutralizes the static charge present in all records. Every point on an LP record is cleaned by the wide pad approximately one hundred times during a single play.

ESL Dust Bug, complete with Dust Bug Fluid in applicator **$5.75**

ESL MOVING COIL MICROPHONES

Highest fidelity at moderate cost

Electro-Sonic Laboratories is pleased to announce a complete new line of superb moving coil microphones, microphone transformers, and miniature earphones. For every application—broadcasting, professional recording, home recording, dictating machine, and public address—there is a low impedance ESL microphone specifically designed to provide the highest quality of performance at sensible cost.

A brochure describing the entire line of ESL moving coil microphones and accessories is available free upon request.

ESL TRANSISTOR AMPLIFIER

Hum-free low impedance amplification

This hum-free, low-distortion amplifier can provide improved performance with moving coil microphones, for which it is a preamplifier, and with ESL electrodynamic cartridges, for which it is a pre-preamplifier. As its frequency response is flat and unequalized, it does not replace the conventional phono preamplifier. It permits use of greatly superior low-impedance microphones—such as the ESL—with medium-price tape recorders.

Voltage gain: *20-30 db (1:10-1:20 voltage step-up)* • Signal-to-noise ratio: *minus 50 db* Frequency response: *20-20,000 cps ± 1½ db* • IM distortion: *1/10 of 1%* • Input impedance: *100 ohms* • Output impedance: *2,000 ohms* • Battery life: *1 year* • Hum level: *zero*

ESL-1A, complete with battery **$16.50**

FOR LISTENING AT ITS BEST

Electro-Sonic Laboratories, Inc.

Dept. A • 35-54 Thirty-sixth St • Long Island City 6, N.Y.

Additional information available free upon request to ESL

imagination of a fine architect, resulted in a marble staircase in a shop in the Duomo that seemed magically suspended in air.

Music is, of course, an integral part of Milanese life, centering around the historic Teatro Alla Scala. At the end of the summer, the members of the La Scala Opera Orchestra return to Milan after their vacations and begin preparing for the new season. Last month, recording sessions were held prior to the opening of the fall season. All the seats in the hall were removed; the stage was stripped, and the orchestra pit raised to the same level as the stage.

In design, the Teatro Alla Scala is one of the most unusual halls in the world. It seats some 2500 people, approximately half of whom are situated in the parquet, and half in boxes. The boxes do not project into the theatre, but are stacked one on top of the other, and are inset into the frame of the hall, all the way to the dome's summit. The semicircular effect of the rising tiers inspired the theatre's name: "Ladder-Like Theatre."

A chandelier of enormous proportions is suspended from the height of the dome, like a multifaceted jewel hanging from the neck of a beautiful woman. Red velvet and gold leaf, the traditional symbols of grand opera, are illuminated by clusters of globes extending from the boxes. The stage of La Scala is gigantic; it recently acquired a cyclorama of Cecil B. DeMille dimensions, which helps to make its productions of such operas as *Aïda* unsurpassed in grandeur and physical scope.

The musicians in the La Scala Orchestra seem the same as their counterparts in other countries, with minor variations in temperament. During one rehearsal, a first violinist sneezed in the middle of a passage. All his colleagues in the immediate vicinity said "God Bless You." He in turn bowed graciously to each of them, saying, "Grazie." All this without losing track of a single note. A bass player, between notes, made himself self-appointed assistant conductor. He gave cues, molded phrases, and beat time along with the real conductor. Another bass player sang the arias of the opera whose orchestral accompaniments the men were rehearsing.

What seemed like an army of stagehands and technicians put itself at the disposal of recording staffs from all over the world, carrying out with alacrity every wish of the engineer or recording director. These men obviously take great pride in their theatre and in their jobs. One of the workers (an employee of La Scala for nearly two decades), however, made a rather amazing statement after escorting me on a tour of the spacious, elegant lobbies of the Teatro. In answer to my query about his personal tastes in music, he said: "I don't care much for opera. It's really such a silly business: dying heros, with their hands clutching a fatal wound, somehow find time to emit an aria before passing away; fat middle-aged sopranos singing Juliet-like roles; etc.—too ridiculous for words! I prefer symphonic music."

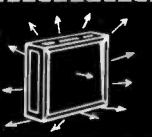
Despite this note of dissent, the heart of opera beats strongly in this forward-looking city of Milan.

(To be continued)

A new system concept by G. A. Briggs based upon the absolutely unhindered performance of the speakers themselves, which results in unparalleled reproduction. Yet, it is moderate — even low — in price!

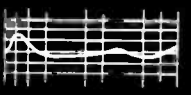
Speakers and enclosure matched and acoustically integrated to perform as a single unit, and as a single unit only! (These special speakers and enclosure not usable separately)

Three Wharfedale Speakers specifically designed to work together in this system. 12" Low Frequency, 10" Mid-range, 3" Treble.



Omni-directional spacious sound resulting from open design, which allows the speakers to radiate in all directions; eliminates "point source effect". (This is the reason for its magnificent stereo performance when used in pairs.)

Featuring all the Wharfedale advantages: plastic foam suspension, cast chassis, high flux density. Each speaker custom-built and individually tested.



Exceptional smoothness and excellent transient response make the sound of this full range system a revealing experience in any home environment.

Resonance-free, sand-filled baffle . . . because sand makes the baffle inert; effectively damps all vibrations. No cabinet resonance, because there is no cabinet of the ordinary type.

Free-standing and mobile! This speaker system performs without dependence upon placement against walls, corners, etc.

Read what's behind this great new concept in speaker systems

the NEW Wharfedale SFB/3 3-WAY SPEAKER SYSTEMS

SAME SPEAKER SYSTEM . . . SAME PERFORMANCE IN TWO STYLES

Bass Resonance: 30–35 cps.
Frequency response: 20–20,000 cps.
System impedance: 15 ohms.
Weight: Approximately 75 lbs.
Size: Custom: 34" w., 31" h., 12" deep.
Deluxe: 35½" w., 31½" h., 13" deep.
Finishes: Mahogany, Walnut and Blond

SFB/3 Warwick Custom $199.00

SFB/3 Windsor Deluxe $249.00

The SFB/3 systems are now on display at your dealer.
Write for full information on these and other Wharfedale Speakers and Speaker Systems.

BRITISH INDUSTRIES CORPORATION, Dept. WR-27, Port Washington, N. Y.

EDITOR'S REVIEW

TWO DOWN—ONE TO GO

THE "ONE TO GO" is, of course, the New York High Fidelity Show, which opens at the New York Trade Show Building on October 8. The "two down" are the two shows held in Chicago around the middle of September—one presented by the International Sight and Sound Exposition and staged at the Palmer House on September 13–15, and the other presented by the Institute of High Fidelity Manufacturers at the Morrison Hotel September 18–21. The former consisted mainly of packaged hi-fi, with some components being exhibited by local jobbers; the latter was a show of component high fidelity only.

Both were interesting—as any audio show would be to this observer, we presume—and if it may have been said in previous years that stereo was important or was the theme or that it dominated the show, it must be said that this is the first year those statements *should* have been made.

At the Palmer House, the Magnetic Recording Industry Association presented an excellent demonstration, along with a talk from a representative of Armour Research—where most of the present-day developments in tape recording originated. The show, called "The Magic of Tape," exhibited a minimum of stereo gimmicks, and was a really adult presentation of the subject from the musical point of view. It should have been educational to those who attended.

No formal indoctrination or entertainment was scheduled for the IHFM Show at the Morrison, but several of the manufacturers staged their own demonstrations which served the same purpose. An exceptionally good example was that of Westminster and Sonotape, which offered some eleven minutes of good entertainment in a well prepared tape. This show was consistently crowded—we are glad we heard it twice before the show opened. And we did sit through it twice in succession because we considered it such a good demonstration of the stereo system.

On the subject of stereo, we attended another Westminster demonstration the day we returned from Chicago to hear a magnificent stereo recording of the one-act opera, "The Devil and Daniel Webster." Since Mr. Canby was also there, and since he covers the musical picture for these pages, we will leave comments on the opera to him. Technically, however, we considered the entire presentation an exceptional stereo job.

The trend toward well decorated and planned exhibits is still growing—practically no exhibitor offered a room that looked like a hi-fi dealer's establishment of two or three years ago. In many respects the industry is growing up and beginning to recognize that not everyone is fascinated by a maze of wires running around the room from a number of uncovered chassis placed in a haphazard fashion on uncovered tables. We were also pleased to note that—with very few exceptions—over-all sound levels are coming down to a practical range for the average living room, and we trust this condition will obtain for the forthcoming New York Show. After all, we like reasonably high listening levels, but certainly not up to the threshold of feeling. Nor is everyone conditioned to levels of 90 to 100 db.

We realize that demonstration rooms where the sound level is that which might be considered normal by the average person are often the least crowded, and we fully realize that a perfectly balanced reproduction would not appear to be particularly striking to the visitor to the shows, but we also believe that in past years many exhibitors have overdone the "enhancement" of sound reproduction. There undoubtedly has to be some boost of lows and highs in order to make the sound sufficiently "different" so that it will be noticed. It is quite probable that the average person would not listen to the standard "audio show curve" for very long after he installed a new system, but for demonstration purposes it is certain that some theatricalism must be injected. Several years ago it was acceptable, but not now.

So, having seen two of the major shows of this season, we can hardly wait until the next one—right here in our own bailiwick.

NO SHOW IN MEXICO

According to our latest information, there is to be no high fidelity show in Mexico City this fall. It appears that shows will be held only on alternate years if present plans continue.

Furthermore, partly because of the multiplicity of regional shows in the U.S., the first Puerto Rico Hi-Fi Show will be cancelled—at least as a manufacturers' show. We are sorry to learn of these cancellations for we feel as though both of these areas constitute large and almost untouched markets.

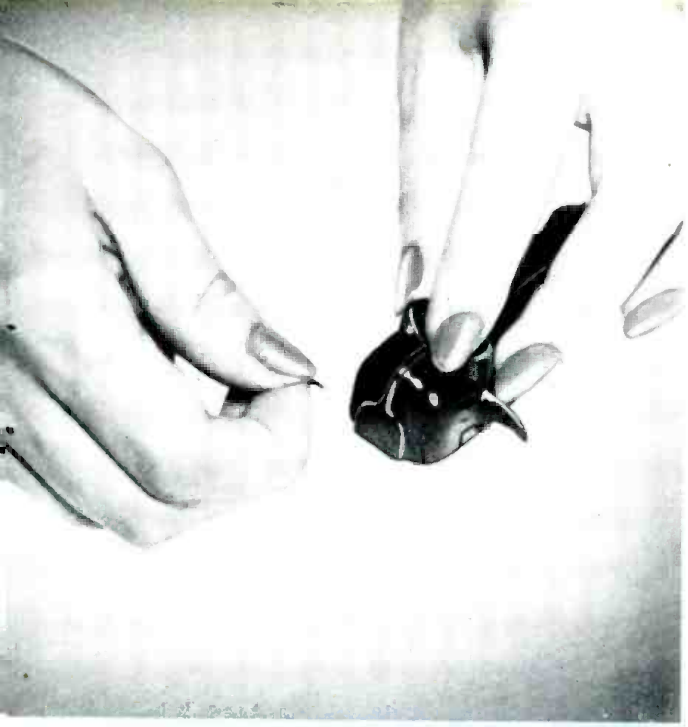
There goes our "vacation" this year, if attending shows can ever be called a vacation.

ROBERT LEE STEPHENS

As the Institute Show opened in Chicago, the entire industry was saddened to learn of the death of Robert Lee Stephens, founder and retired president of Stephens Manufacturing Company, following an operation at Iowa City, Iowa.

One of the real pioneers in the high fidelity business, Bob was building high-quality loudspeakers long before he started his company, and before that he was a sound technician in the picture industry where we first made his acquaintance in 1938. He retired from active management of Stephens Manufacturing Company during the summer of 1956, after having built it up to an imposing position in the industry.

In the sincerest meaning of the phrase, he was "a jolly good fellow," well liked by everyone and a solid and staunch friend to all. We will all miss him, and the Shows won't seem the same without his genial presence.



NO FINGERNAIL FUMBLING!

Exclusive

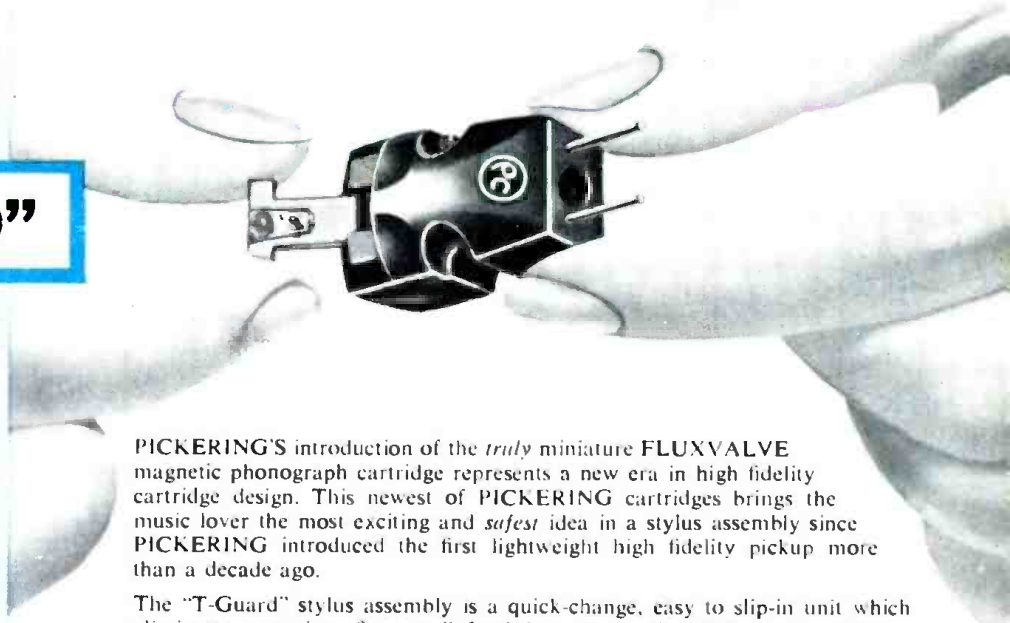
"T – GUARD"

STYLUS

only with the

PICKERING

fluxvalve



PICKERING'S introduction of the *truly* miniature FLUXVALVE magnetic phonograph cartridge represents a new era in high fidelity cartridge design. This newest of PICKERING cartridges brings the music lover the most exciting and *safest* idea in a stylus assembly since PICKERING introduced the first lightweight high fidelity pickup more than a decade ago.

The "T-Guard" stylus assembly is a quick-change, easy to slip-in unit which eliminates precarious finger-nail fumbling. Its practical "T" shape provides a firm and comfortable grip for safe and easy stylus change.

The most flexible cartridge in the world . . . the FLUXVALVE is the *only* cartridge with the remarkable ½ mil stylus . . . exclusive *only* with PICKERING. The FLUXVALVE can be used with any one of *five* styli, to meet any requirement or application . . . to play any record, at any speed.

If you are planning to buy a new cartridge—the fact that PICKERING developed this revolutionary stylus is *important to you!* All of the research, development and planning that went into the "T-Guard" stylus is conclusive proof of the superlative engineering skill in every FLUXVALVE model you buy.

FLUXVALVE TWIN SERIES 350 – A turn-over cartridge providing a rapid change of stylus point radius. Available in 12 models featuring many combinations of styli, prices start at a modest $24.

FLUXVALVE SINGLE SERIES 370 – A miniature high quality cartridge for use in any type of auto-changer or manual player arm. Available in 5 models, prices start at a low $17.85.

The FLUXVALVE features exclusive hum rejection circuit—requires no adjustment!

Model 1041D UNIPOISE Pickup Arm—A new . . . lightweight . . . integrated arm and cartridge assembly containing the FLUXVALVE with exclusive "T-Guard" stylus. The complete assembly – tone arm and cartridge – is only a fraction of the weight of conventional tone arms. The high compliance of the "T-Guard" stylus, with the lightweight tone arm and single friction-free pivot bearing assures distortionless tracking of microgroove and standard groove recordings. Available with the ½, 1 or 2.7 mil diamond styli, prices from $59.85.

"For those who can hear the difference" FINE QUALITY HIGH FIDELITY PRODUCTS BY

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

Look . . . only the Fluxvalve has 100% IQF*

Choice of the *best* phonograph pickup can *only* be resolved by comparison! What is the yardstick? . . . How can you tell? . . . What do you look for? . . . the answer is 100% **Important Quality Features***!

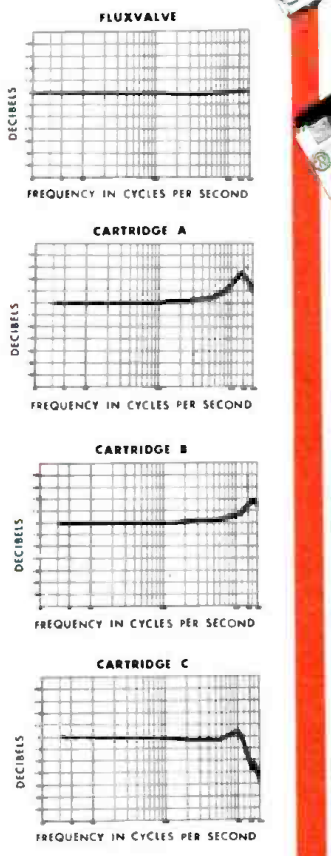
PICKERING has had long experience in the cartridge field, supplying the finest quality products for recording studios, broadcast stations, wired music services, and high fidelity home music systems. As a result of this extensive experience, PICKERING has developed the **FLUXVALVE** . . . the *one* cartridge which incorporates *all* of the **Important Quality Features*** *so* necessary for high fidelity reproduction from records.

Before you choose a cartridge . . .

LISTEN AND COMPARE . . . demand 100% IQF*!

Feature	FLUXVALVE	Cartridge A	Cartridge B	Cartridge C
Frequency Response: Flat 20-20,000 cps ± 2 db (see curves on right)	YES 20 Points	NO 0 Points	NO 0 Points	NO 0 Points
Low Tracking Force, 2-4 grams	YES 20 Points	NO 0 Points	YES Points	NO 0 Points
High Output, No Transformer Required	YES 10 Points	NO 0 Points	NO 0 Points	YES 10 Points
Replaceable Styli	YES 10 Points	NO 0 Points	NO 0 Points	YES 10 Points
½ Mil Stylus	YES 15 Points	NO 0 Points	NO 0 Points	NO 0 Points
One Cartridge For LP's and 78's	YES 5 Points	NO 0 Points	NO 0 Points	YES 5 Points
Anti-Hum Design	YES 10 Points	YES 10 Points	YES 10 Points	YES 10 Points
Hermetically Sealed	YES 10 Points	NO 0 Points	NO 0 Points	NO 0 Points
TOTAL POINT VALUE	100%	10%	30%	35%

FREQUENCY RESPONSE CURVES



Peaks and/or resonances in the stylus assembly at any recorded frequency will distort; and, damage the record groove. Therefore, any deviation from flat response over the recorded frequency band results in eventual breakdown of the groove wall. Deviations of from 3-6 db distort the record material as much as 60-100%.

* **IMPORTANT QUALITY FEATURES —so necessary for high fidelity reproduction from records.**

THE FLUXVALVE . . . chosen time and again as the *top cartridge* solely on the basis of *listening quality* . . . by panels of qualified experts . . . tests which have proven that it is *actually* less costly to own a **FLUXVALVE**

The **FLUXVALVE** preserves the quality and prolongs the life of your record since there is complete absence of resonances throughout the audio frequency range.

It may interest you to know that the **FLUXVALVE**, because of its ability to make *precise* and *reproducible* record measurements, is used for calibrating recording channels and record masters.

Make the IQF* test today . . . listen to your favorite record reproduced with a FLUXVALVE . . . the gentle pickup.

Series 1940 UNIPOISE Pickup Arm with FLUXVALVE Cartridge

Model 1940 with 1 mil diamond "T-Guard" stylus	$59.85
Model 1940 with 2.7 mil diamond "T-Guard" stylus	59.85
Model 194 5D with ½ mil diamond "T-Guard" stylus	65.85

SERIES 370 SINGLE FLUXVALVE

370-1S	1 mil Sapphire	17.85
370-2S	2.7 mil Sapphire	17.85
370-1D	1 mil Diamond	29.85
370-2D	2.7 mil Diamond	29.85
370-.5D	½ mil Diamond	35.85

SERIES 350 TWIN FLUXVALVE*

350-DD	1 mil Diamond	36.00
350-.5DD	½ mil Diamond	42.00
350-DS	1 mil Diamond 2.7 mil Sapphire	42.00
350-DD	1 mil Diamond 2.7 mil Diamond	54.00
350-D.5D	1 mil Diamond ½ mil Diamond	60.00

SERIES 3500 "T-Guard" STYLI

S-3510	1 mil Sapphire	6.00
S-3527	2.7 mil Sapphire	6.00
D-3510	1 mil Diamond	18.00
D-3527	2.7 mil Diamond	18.00
D-3505	½ mil Diamond	24.00

*Available in many other combinations of styli **Other stylus radii available on special order.

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Audio Engineering Society

NINTH ANNUAL CONVENTION

October 8-12, 1957

NEW YORK TRADE SHOW BUILDING, NEW YORK

Program of Convention Papers

Tuesday, October 8.

9:30 a.m. TECHNICAL SESSION: DISC RECORDING AND PLAYBACK.

Edward Sorensen, Columbia Records, Inc., Chairman.

LATEST ADVANCES IN EXTRA FINE GROOVE RECORDING.
Dr. Peter C. Goldmark, CBS Laboratories, New York, N. Y.

CUTTING MECHANISM IN DISC RECORDING.
A. Y. C. Tang, Walworth Company, Boston, Mass.

PERCEPTION OF WOW.
Sheldon I. Wilpon, New York Naval Shipyard, Brooklyn, N. Y., Chairman.

MEASUREMENT OF FLUTTER IN MAGNETIC TAPE RECORDING.
Roger H. Prager, U.S. Navy Electronics Laboratory, San Diego, Calif.

A RECORDER FOR THE PRODUCTION OF WOW MEASUREMENT TAPE.
Jack Bayha, V-M Corp., Benton Harbor, Mich.

THE SUBJECTIVE DISCRIMINATION OF PITCH AND AMPLITUDE FLUCTUATIONS IN RECORDING SYSTEMS.
Alan Stott and Peter Eric Axon, The British Broadcasting Corp., London, England.
(Read by Dr. K. R. Sturley)

Tuesday, October 8

1:30 p.m. TECHNICAL SESSION: MEASUREMENT OF DISC AND TAPE FREQUENCY RESPONSE.

Sheldon I. Wilpon, New York Naval Shipyard, Brooklyn, N. Y., Chairman.

THE CALIBRATION OF DISC RECORDING BY LIGHT PATTERN MEASUREMENTS.
Peter Eric Axon and William K. E. Geddes, The British Broadcasting Corp., London, England.
(Read by Dr. K. R. Sturley)

CALIBRATION OF DISC FREQUENCY RECORDS.
Lincoln Thompson, Raymond Engineering Laboratory, Inc., Middletown, Conn.

AN ANALYSIS OF TAPE NOISE IN A 100 KILOCYCLE BANDWIDTH.
Robert E. Glendon, U.S. Navy Underwater Sound Laboratory, New London, Conn.

LOOPHOLES IN STANDARD QUALITY PERFORMANCE TESTS.
John M. Leslie, Jr., Ampex Corp., Redwood City, Calif.

CALIBRATION OF TEST RECORDS BY B-LINE PATTERNS.
Benjamin B. Bauer, CBS Laboratories, New York, N. Y.

THE STANDARD TAPE AS A PROFESSIONAL AUDIO TOOL.
Frank F. Richards, Ampex Corp., Redwood City, Calif.

SYMPOSIUM

TEST RECORDS FOR PHONO PICKUP MEASUREMENTS.

Benjamin B. Bauer, CBS Laboratories, New York, N. Y., Chairman.

PANEL

William S. Bachman, Columbia Records, Inc., New York, N. Y.
Roy Dally, General Electric Co., Syracuse, N. Y.
Julian Hirsch, Consultant, New Rochelle, N. Y.
J. H. McConnell, Electro-Sonic Laboratories, Long Island City, N. Y.
Lincoln Thompson, Raymond Engineering Laboratory, Inc., Middletown, Conn.
Paul Weathers, Weathers Industries, Barrington, N. J.
B. J. White, RCA Victor Record Division, Indianapolis, Ind.
Sheldon I. Wilpon, New York Naval Shipyard, Brooklyn, N. Y.

Wednesday, October 9

9:00 a.m. TECHNICAL SESSION: STUDIO ACOUSTICS AND PSYCHO-ACOUSTICS.

Dr. Leo L. Beranek, Bolt, Beranek & Newman, Inc., Cambridge, Mass.

RECENT EXPERIENCES IN STUDIO DESIGN.
L. L. Beranek, W. E. Clark, W. R. Farrell, J. B. C. Purcell, B. G. Watters, all of Bolt, Beranek & Newman, Inc., Cambridge, Mass.
(Presented by Dr. Leo L. Beranek)

TECHNIQUES FOR MEASURING AND EVALUATING NOISE.
J. J. Hamrick, International Business Machines Corp., Endicott, N. Y.

THE PSYCHOPHYSICAL PARAMETERS OF THE MASKING EFFECT AS APPLIED TO SOUND RECORDING AND REPRODUCTION.
John A. Cooley, Georgetown University, Washington, D. C.

BASIC CONSIDERATIONS IN STUDIO DESIGN.
H. V. Munchhausen, Munchhausen Soundproofing Co., Inc., New York, N. Y.

AUDIO APPLICATION PROBLEMS.
Gordon Mercer, Audio Vision Company, Santa Barbara, Calif., Chairman.

USE OF SPEAKER ARRAYS FOR HOME INSTALLATION.
Gordon Mercer, Audio Vision Company, Santa Barbara, Calif.

Wednesday, October 9

1:30 p.m. TECHNICAL SESSION: ELECTRONIC MUSIC.

Professor Otto Luening, Columbia University, New York, N. Y., Chairman.

THE INSTRUMENTS OF EXPERIMENTAL MUSICS.
Dr. Abraham A. Moles, Consultant to French Broadcasting System, Paris, France.

THE PROCESSES OF EXPERIMENTAL MUSICS.
Vladimir A. Ussachevsky, Columbia University, New York, N. Y.

MUSICAL COMPOSITION WITH A HIGH SPEED DIGITAL COMPUTER.
L. A. Hiller, Jr. and L. M. Isaacson, University of Illinois, Urbana, Ill.

ELECTRONIC INSTRUMENT, TOY, EDUCATIONAL AID.
Leonard E. Geisler, Japan Electronic Trading Co., Tokyo, Japan.
(Read by George Horinchi)

ARTIFICIAL REVERBERATION.
John M. Hollywood, CBS Laboratories, New York, N. Y., Chairman.

SOME NOTES ABOUT ARTIFICIAL REVERBERATION.
Carlos E. R. A. Moura, RGE Records Ltd., Sao Paulo, Brazil and Sergio Lara Campos, Columbia dó Brazil, Rio de Janeiro, Brazil.
(Read by John M. Hollywood)

SOME PRACTICAL ASPECTS OF MAGNETIC TAPE REVERBERATION GENERATOR DESIGN AND OPERATION.
C. J. LeBel, Audio Instrument Co., Inc., New York, N. Y.

STEREO-REVERBERATION.
R. Vermeulen, Philips Research Laboratories, Eindhoven, Netherlands.

Thursday, October 10

9:00 a.m. TECHNICAL SESSION: TAPE DUPLICATION.

Julius Konins, Dubbings Sales Corp., Hewlett, N. Y., Chairman.

COMMERCIAL DUPLICATION OF STEREO AND MONAURAL TAPES.
Russell J. Tinkham, Ampex Corp., Redwood City, Calif.

PROBLEMS AND CONSIDERATIONS OF TAPE DUPLICATING PRODUCTION.
Julius A. Konins, Dubbings Sales Corp., Hewlett, N. Y.

AUDIO TRANSISTOR APPLICATIONS.
Frank Dukat, Raytheon Manufacturing Co., Newton, Mass., Chairman.

A TRANSISTORIZED PREAMPLIFIER FOR PROFESSIONAL TURNTABLES.
Harold J. Paz, Radio Corp. of America, Camden, N. J.

TRANSISTORIZED MAGNETIC AND PHOTOELECTRIC INPUT STAGES FOR SOUND MOTION PICTURE PROJECTORS.
S. F. Bushman, Bell & Howell, Chicago, Ill.

A PORTABLE TRANSISTOR MUSIC-SYSTEM.
Richard S. Burwen, Minneapolis-Honeywell, Boston, Mass.

Thursday, October 10

1:00 p.m. TECHNICAL SESSION: MAGNETIC TAPE DEVICES.

Walter H. Erikson, Radio Corp. of America, Camden, N. J., Chairman.

A SURVEY OF FACTORS LIMITING THE PERFORMANCE OF MAGNETIC RECORDING SYSTEMS.
Eric D. Daniel, National Bureau of Standards, Washington, D. C.; P. E. Axon and W. T. Frost of The British Broadcasting Corp., London, England.

A CONTINUOUSLY VARIABLE TAPE DRIVE MECHANISM FOR THE INVESTIGATION OF SOUND PHENOMENA.
John J. Hanson, Pyramid Enterprises, Nashville, Tenn.

VARIABLE SPEED SCANNING OF RECORDED MAGNETIC TAPE.
William S. Latham, U.S. Navy Underwater Sound Laboratory, New London, Conn.

DESIGN OF AN AUDIO PROGRAM SELECTOR IN A MAGNETIC TAPE RECORDER.
A. Y. C. Tang, Walworth Co., Boston, Mass.

(Continued on page 103)

Shown at Bell Laboratories, Murray Hill, N.J., are, left to right, F. J. Herr, S. T. Brewer, L. R. Snoke, E. E. Zajac and F. W. Kinsman.

They're wiring the seas for sound

These five Bell Labs scientists and engineers may never "go down to the sea in ships." Yet, they're part of one of the most exciting sea adventures of modern times. Along with many other specialists, they are developing the deep-sea telephone cable systems of the future.

Here's how they join many phases of communications science and engineering—to bring people who are oceans apart within speaking distance.

F. J. Herr, M.S., Stevens Institute, is concerned with systems design and analysis. He studies the feasibility of new approaches and carries out analysis programs to select optimum parameters for a proposed system design.

S. T. Brewer, M.S. in E.E., Purdue, communications and electronics engineer, explores new designs for sea-bottom amplifiers needed to step up power of hundreds of simultaneous telephone conversations.

L. R. Snoke, B.S. in Forestry, Penn State, is the team biologist. He investigates the resistance of materials to chemical and microbiological attack in sea water. Materials are evaluated both in the laboratory and in the ocean.

E. E. Zajac, Ph.D. in Engineering Mechanics, Stanford, is a mathematician. He studies the kinematics of cable laying and recovery. Cable's dynamic characteristics, ship's motion, the mountains and valleys in the ocean bottom—all must be taken into account.

F. W. Kinsman, Ph.D. in Engineering, Cornell, solves the shipboard problems of storage, handling and "overboarding" of cable. New machinery for laying cable is being developed.

Deep-sea cables once were limited to transmitting telegraph signals. Bell Labs research gave the long underseas cable a voice. New research and development at the Labs will make this voice even more useful.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT

Stereosonic Magnetic Recording Amplifier

ARTHUR W. WAYNE*

Describing a specific amplifier designed for a Ferrograph Tape Deck, but one which could be adapted fairly easily to accommodate any other type of stereo deck with heads of similar impedances and drive requirements.

THE BASIC REQUIREMENTS of any magnetic recording system are few and simple. They are:

(1) A tape transport deck
(2) (a) A loudspeaker and (b) a box or baffle for it.
(3) An amplifier
(4) A reasonable amount of intelligence in the use of (1) (2) and (3).

Requirement (4) is easily disposed of, as it is obvious that every reader of AUDIO will more than satisfy it; and of the remaining three items, the only ones in reach of the ordinary amateur constructor are (2) (b) and (3). So far as (2) (b) is concerned, suggestions will be made in Appendix 2 for the construction of a resonant enclosure suitable for use with *one particular make of speaker only;* and, as there are few amateurs with the necessary facilities for acoustic determinations, where other loudspeakers are preferred, the maker's recommendations should be sought.

This leaves us with (3); and a strictly practical description of a commercial amplifier, intended for stereosonic or single-channel use at will, and eminently suited for amateur construction, follows.

With a genuine high-fidelity output of 15 watts per channel, rising to 25 watts peak, and a comprehensive tone-control system, it provides a quite useful amount of noise for the smaller P.A. operator as well as for the home.

The basic amplifier, the Shirley Laboratories Ltd. FS101, shown in *Fig.* 1 was deliberately developed with "listenability" in mind, a subtle facet of hi-fi, not always completely covered by contemporary design. Most modern amplifiers have approximately equal characteristics, but there is no doubt that, to paraphrase "Animal Farm," some amplifiers are more equal than others. Now, we engineers are a parochial lot, much given to blinding ourselves by science, and with a touching faith in figures: moreover, we labour under the extraordinary delusion, perhaps in company with the biologists, that these figures tell the whole story. Even here we don't play fair, for we talk glibly about square waves and sine waves, and all the other sorts of waves, without explaining that these are functions, part of a general system of analysis of which our familiar audio problems are a very small part indeed. (Even the concept of a square—cubic?—wave in three dimensions seems a little difficult, and we do hear in three.)

The FS103 is designed to work with the "Ferrograph" type C88 stacked-head deck, now becoming available in the U.S.A.; and it has been demonstrated in conjunction with this deck at various Audio Shows in New York and elsewhere, where it appeared to arouse interest. For the amateur who wishes to experiment, Appendix 1 gives details of some possible modifications, one or two of which are in use on versions of the amplifier manufactured for specialized purposes. It is not proposed to discuss the theory of magnetic recording, as this has been fully covered in this journal and elsewhere.

Over-all Circuitry

In the over-all schematic *Fig.* 2, the figures and letters in the circles refer to the tag strips on the underside of the C88 deck. All function switching on Ferrograph equipment is provided on the decks themselves, which makes the task of the constructor considerably simpler than it would be if the switch units were incorporated in the amplifier. At the same time, it renders possible the provision of heavier and hence more reliable switch banks, those on the C88 being very substantial. The terminal strip locations are shown in *Fig.* 3, and the spare positions on the switches may be used for a variety of functions, as dictated by the will of the constructor. Where a letter and a digit appear in a circle, e.g. 3L, 0U, this is to be taken that the letter indicates "L" for the left-strip and "U" for the upper strip, the digit referring, of course, to the number opposite the tag. The circuit description of the amplifier proper will be of one channel only, the left one in the diagram, the second channel being a mirror image of the first. The transpositions are obvious.

On replay, the input from the head is taken, through a standard co-ax socket, to T_1, the head-lift transformer, and via J_2 to the grid of voltage amplifier V_3, a low-noise pentode. The output from the anode of this valve is by the way of C_{16}, C_{17}, R_{18}, and J_1 to the top of P_2, the gain control. C_{17} and R_{18} supply a small amount of treble lift, the significance of which will be considered later, and R_{21} and C_8 are an RC bass lift network, providing most of the necessary compensation for the tape losses. Further amplification is by V_4, another low-noise pentode, the output from which is through C_{11} and the tone-control network P_1-P_2-R_{15}-R_{24}-$R_{25.1}$-C_{12}-C_{13}-C_{15}-C_{14}. When the controls are at their mid positions, there is a boost of approximately 2.5 db at 50 cps. In theory, such a network should be fed from a low impedance source to avoid high frequency losses, but in fact, the difficulty does not occur, capacitor C_{13} compensating up to about 45 kcps. However, it is very easy to reduce the source impedance by the

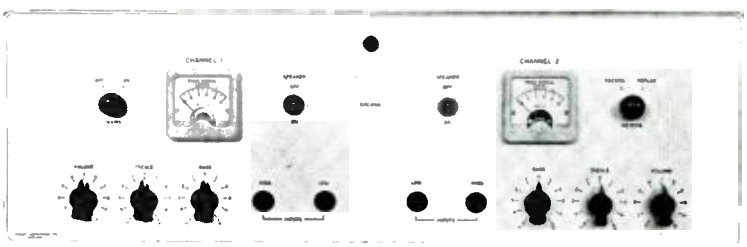

Fig. 1. Front panel arrangement of the completed stereo recording and playback amplifier.

* *Shirley Laboratories, Ltd., 3, Prospect Place, Worthing, Sussex, England.*

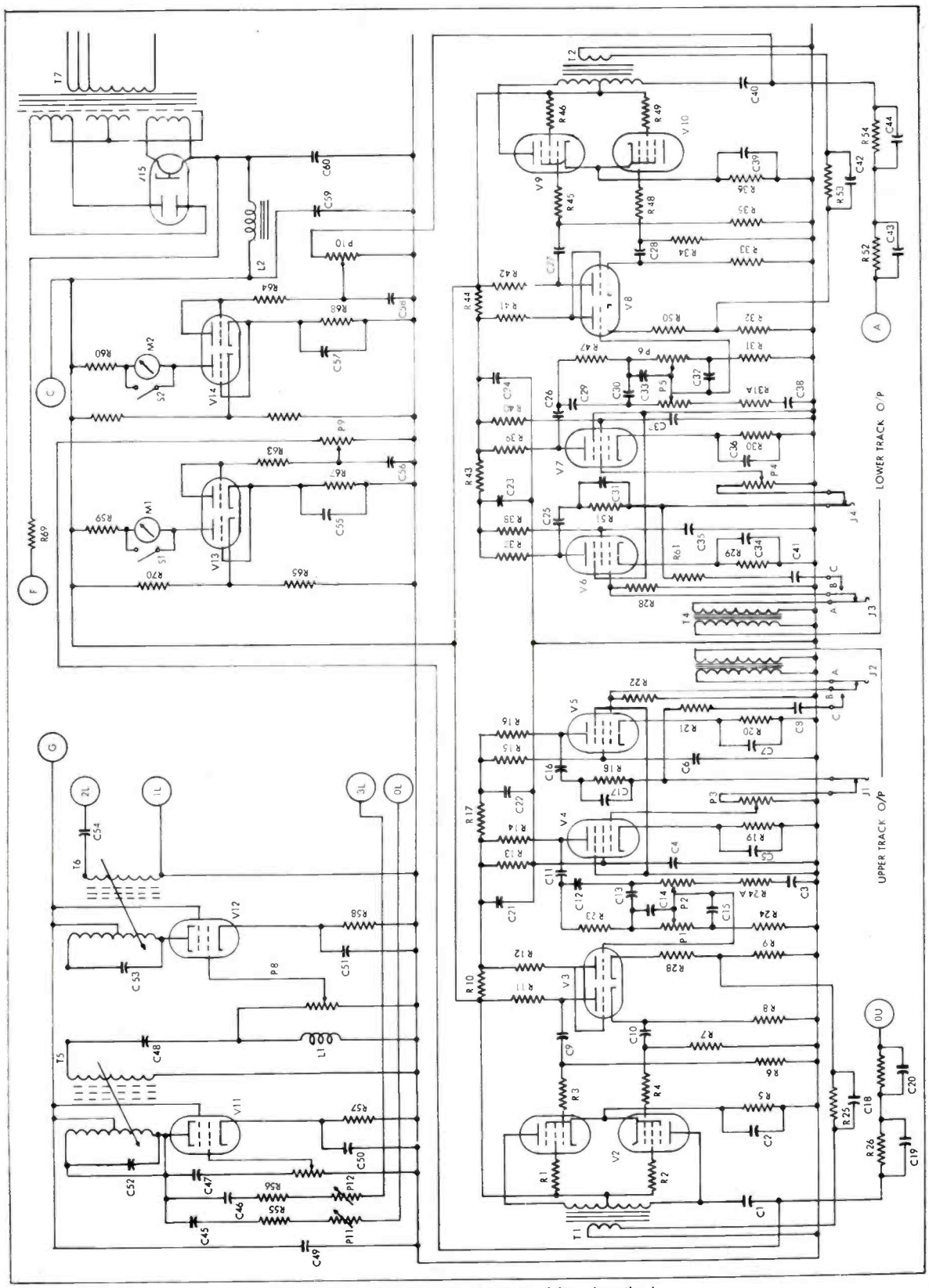

Fig. 2. Over-all schematic of the amplifier described.

simple expedient of connecting a 10-megohm resistor between the grid of V_4 and the junction of C_{11} and C_{12}. A 47,000-ohm resistor from the grid of V_4 to the arm of P_3 will tend to prevent any interaction with V_5. The maximum bass lifts and cuts are 18 db at 20 cps relative to 800 cps, the treble lift and cut at 20,000 cps being 14 db and 18 db respectively.

V_{3A} is another voltage amplifier, with feedback via potentiometer R_{25}, R_9 in the cathode circuit, phase correction being provided by C_{18}. Actually, C_{18} is more in the nature of an insurance against r.f. when the output tubes are viciously overdriven, it being quite superfluous under normal conditions. Additional feedback is obtained by the omission of a bypass capacitor for R_{28}. It is difficult to apply feedback over the whole of the amplifier because of (a) the provision of the two inputs at different levels and (b) the equalizing and tone-control networks; but the circuits of V_4 and V_5 are so calculated as to introduce negligible distortion in these stages. V_{3A} is d.c.-coupled to V_{3B}, the phase splitter, which operates with equal loads, R_8 and R_{11} in the anode and cathode circuits, thus providing the out-of-phase driving voltages for V_1 and V_2, feeds being via C_9 and C_{10} and the grid stoppers R_3 and R_4. For hair-splitting in addition to phase splitting, R_8 should be about 12 per cent lower in value than R_{11}, but in practice, very little difference in output voltage from the two sides will be observable. V_1 and V_2 are operated in class AB1 with common cathode resistor R_5, bypassed by C_3. Should it be desired to use the output valves in pure class A the anode-to-anode load must be altered to 11,000 ohms, R_5 dropped to 75 ohms, and C_2 omitted, when the valves will become self-balancing under most conditions, owing to feedback in R_5. R_1 and R_2 are screen-grid stoppers, to remove a possible source of unwanted r.f. oscillation on full drive, the stoppers being considerably more effective in this position than in the anode leads. Feedback to ensure valve balance may be attained by the inclusion of an undecoupled resistor of 150 ohms in the common H.T. feed between the junction of R_{10} and R_{11} and R_1 and R_2; but it is, however, unnecessary, unless the emissions of V_1 and V_2 are markedly different, in which case the valves should be changed, anyway.

T_1, the output transformer, must be chosen with care, as it is a very critical component, and only the best will do here. It should not be overlooked that it has to deliver up to 15 watts on continuous sine-wave drive, rising to 25 watts on peaks, and yet not lose its inductance under low-signal conditions; its coupling must be tight, its self-capacitance low, and its resonance points right outside both the audio and low r.f. ranges, this latter because of the inevitable stray bias appearing at the anode of the V_2, when recording: so it will be seen that no second-rate component from the surplus market will be satisfactory.

Power Supply

The power pack is perfectly normal, except for the provision of a 100-μf capacitor for smoothing. This is to prevent interaction between the channels at low frequencies, a point not to be forgotten if the constructor contemplates using existing stocks of different values off the shelf. The reservoir capacitor, too, must be chosen with care, that used in the commercial equipment being capable of handling a ripple current of 600 ma. As the total current drawn by the amplifier on RECORD is approximately 230 ma., it will be seen that the 600 ma. ripple requirement is not excessively high. The formulas for calculating both the impedance of the smoother and the ripple current in the reservoir are given in Appendix 1, as well as an alternative power supply section, to cater to the more impecunious reader.

R_{69} must be explained at this point. On the Ferrograph decks, a quick-release device is fitted in the form of a solenoid, the armature of which normally holds the switches and linkages "in" when operating. Depression of a small button on the deck control panel short-circuits the solenoid coil, so releasing the armature and stopping operations. R_{69} is the limiting resistor for the solenoid current, the minimum requirement of which is 30 ma., the coil resistance being 300 ohms.

On RECORD, movement of the deck control knob to that function automatically disconnects the heads from the input sockets, and joins the B+ lines to the oscillators, of which more anon. It also connects the anodes of the recording output valves to their respective heads, together with the bias inputs. On the amplifier, recording is done, in the case of low-level inputs, via J_2, which is a double circuit jack socket. Insertion of the jack changes over both the ground and live contacts, breaking the first, so disconnecting the bass equalizing chain

(*Continued on page 96*)

PARTS LIST

C_1, C_{10}	0.25 μf, 500 v. paper
C_2, C_5, C_7, C_{31}, C_{36}, C_{39}	25 μf, 25 v. electrolytic
C_3, C_{16}	3200 μμf, mica or ceramic
C_4, C_6, C_9, C_{10} C_{11}, C_{12}, C_{23} C_{46}, C_{47}, C_{48} C_{52}, C_{57}, C_{58},	
C_{59}, C_{61}, C_{63}	.05 μf, 500 v. paper
C_8, C_{41}	.012 μf, 500 v. paper
C_{13}, C_{28}	500 μμf, mica or ceramic
C_{15}, C_{30}	30 μμf, mica or ceramic
C_{24}, C_{25}, C_{56}, C_{57}	1000 μμf, mica or ceramic
C_{26}, C_{32}, C_{34}, C_{36}	.01 μf, 500 v. paper
C_{27}, C_{29}, C_{30}, C_{31}, C_{42}, C_{43}	200 μμf, mica or ceramic
C_{39}, C_{45}	1500 μμf, mica or ceramic
C_{37}, C_{44}, C_{53}, C_{55}, C_{60}	16 μf, 350 v. electrolytic
C_{47}	2200 μμf, mica or ceramic
C_{52}, C_{53}	3000 μμf, Silver Mica
C_{54}	100 μf, 450 v. electrolytic
C_{62}	60 μf, 450 v. electrolytic
L_1	2.5 mh.
L_2	10 Hy. 250 ma, 200 ohms
P_1, P_2, P_3, P_{12}, P_4, P_6	2 megohms, audio taper
P_7, P_8, P_9, P_{10}	50,000 ohms, linear, preset
P_{11}, P_{13}	10,000 ohms, linear, preset
R_1, R_2, R_{16}, R_{19} R_{21}, R_{23}, R_{24}, R_{31}, R_{33}, R_{38}	47 ohms, ½ watt, 10%
R_3, R_{36}	4700 ohms, ½ watt, 10%
R_5, R_{35}	130 ohms, 4 watts
R_6, R_7, R_{13}, R_{22}	0.47 megohms, ½ watt, 10%
R_8, R_{11}, R_{12}, R_{15}, R_{16}, R_{39}, R_{37}, R_{39}, R_{41}, R_{42}	0.27 megohms, high stability, 5%
R_9, R_{32}	47 ohms, ½ watt, matched to within 5%
R_{10}, R_{17}, R_{34}, R_{67}, R_{43}, R_{49} R_{53}, R_{51}	47,000 ohms, ½ watt, 10%
R_{13}, R_{15}, R_{28}, R_{30}	1.5 megohms, high stability, 5%
R_{18}, R_{51}, R_{59}, R_{60}, R_{63}, R_{61}	0.1 megohms, ½ watt, 10%
R_{19}, R_{20}, R_{40}	2200 ohms, ½ watt, 10%
R_{20}, R_{29}	2200 ohms, high stability, 5%
R_{21}, R_{55}, R_{56}, R_{61}	15,000 ohms, ½ watt, 10%
R_{26}, R_{28}	1.0 megohm, ½ watt, 10%
R_{27}, R_{47}	0.22 megohms, ½ watt, 10%
R_{44}, R_{61}	22,000 ohms, ½ watt, 10%
R_{45}, R_{52}	1000 ohms, high stability, 5%
R_{47}, R_{58}	470 ohms, 1 watt, 10%
R_{48}, R_{70}	0.33 megohms, ½ watt, 10%
R_{65}, R_{66}	10,000 ohms, ½ watt, 10%
R_{67}, R_{68}	10.0 megohms, ½ watt, 10%
R_{69}	10,000 ohms, 15 watts, wirewound
T_1, T_2	push-pull output transformer, 10,000 p-to-p/15.
T_3, T_4	Wright & Weaire type 969
T_5, T_6	Wright & Weaire type 579
T_7	Power transformer. Primary as required; secondaries: 300-0-300 v. at 250 ma; 5 v. at 3 amps; 6.3 v. at 8 amps, CT.
V_1, V_2, V_3, V_{10}	EL84
V_3, V_8	ECC83 (12AX7)
V_4, V_5, V_6, V_7	EF86 (Z-729)
V_{11}, V_{12}	6V6
V_{13}, V_{14}	ECC35
V_{15}	4Z34

Loudspeaker Damping

The author presents an interesting and thorough discussion of the effects of mechanical, electrical, and acoustic damping on frequency response, resonances, and transient performance.

EDGAR M. VILLCHUR*

ONE OF THE LESS widely understood subjects in audio, it would appear, is damping and transient response, particularly in relation to loudspeaker systems. The following is a general outline of the problem, and an attempt to clear up some of the more prevalent misconceptions.

Some of the material here presented, by virtue of the fact that it is contrary to many popularly accepted (and even published) ideas, may appear to be radical in approach. It is, however, entirely conservative. The subject has been well investigated in the literature; the main concepts in this article, for example, appear in a much more complete and mathematically rigorous form in Beranek's *Acoustics*,[1] and a motor engineer should easily recognize the lack of novelty of the basic ideas relative to electro-magnetic damping.

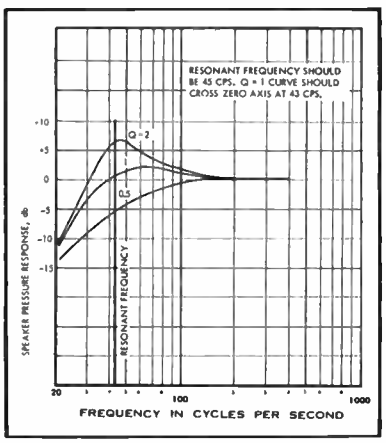

Fig. 1. Response of a direct-radiator speaker system, in the region of resonance, at different values of Q of its mechanical system, (After Beranek)

Terminology

Before proceeding further we must be clear about the meaning of our terms. Damping refers exclusively to the introduction of a *resistive* element into a vibratory oscillatory system. This resistive element may be electrical, mechanical, or acoustical.

If we introduce alternating energy into an electrical or mechanical system —we could apply a.c. to an electrical circuit, or vibratory force to a mechanical device—the system will respond, oscillating in the grip of the applied stimulus. The extent to which the system will oscillate, fondly referred to as its "response" by audiofans, depends on its impedance. Impedance may be thought of as mechanical, acoustical, or electrical intransigence—the unwillingness to be moved or to pass current under the particular conditions involved.

The *reactive* part of the impedance, associated with such characteristics as mass, elasticity, inductance, etc., allows the load to accept energy for storage only, not for absorption. A frictionless system of a weight on a spring would go on bobbing forever once it was started. The *real* or resistive part of the impedance, associated with electrical resistance, friction, and viscosity, permits the load to accept energy permanently, i.e., to absorb it (or, as in the case of radiation resistance, to accept energy for one-way transmission).

When we concern ourselves with how the system acts, not during the time when it is working steadily, but at the very start, on the "attack," and also at the end, after the stimulating and presumably controlling force has been removed, (the "decay"), we are dealing with *transient* rather than *steady-state* response.

Attack and Decay

It would be useful to consider concrete examples of the transient response of mechanical systems. Let us consider two such examples: the response of a kettle drum to the impact of the drumstick, and the response of a loudspeaker to a signal representing the drum's recorded sound.

When the drumstick falls it produces a deformation of the stretched skin. The velocity of the initial, complex movement of the membrane over the distance travelled will not be in step with the natural frequency of the drum's mechanical-acoustical system. The strike sound, instead of having the same pitch as that to which the drum is tuned, will exhibit fundamental components of much higher frequency.

The amplitude of the steady-state sound that will ultimately appear due to the blow will depend on the impedance of the drum's primary moving system, relative to the applied force. The amplitude and duration of the initial, higher-pitched attack sound will depend on the impedance of the drum to higher frequency stimuli, and the Q at these higher frequencies. The more amenable the drumhead is to moving at velocities and amplitudes corresponding to higher frequencies than its fundamental, the crisper will be the attack sound. The nature of the transient acoustical attack is therefore a function of the frequency response of the drum—the relative amount of sound it puts out when stimulated at different frequencies.

Once the drumstick bounces off, the drum is on its own. It can operate only on the energy that was supplied in the single stroke, as it will receive no more energy until it is hit again. We know, of course that the sound continues. If the drum were totally undamped it would continue to vibrate forever, but mechanical and acoustical resistance provide light damping to absorb the vibratory energy gradually, and the sound takes a relatively long time to die away unless it is checked by the player. This is the decay; the length of decay time depends on the amount of damping.

In the case of a loudspeaker reproducing the kettle drum's sound a similar

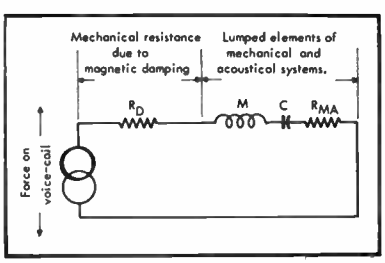

Fig. 2. Simplified electrical analogy to mechanical system of a speaker, including the mechanical resistance introduced by magnetic damping

* *Acoustic Research, Inc., 24 Thorndike St., Cambridge 41, Mass.*

[1] Leo L. Beranek, *Acoustics*, McGraw-Hill Book Co., 1954.

analysis applies. The initial stimulus is provided, not by an external blow, but by a surge of signal current from the amplifier, and the attendant magnetic field built up around the voice coil. And since the speaker should vibrate only when the signal so dictates, it must have a highly damped mechanical system. If the speaker cone, like the drumhead itself, continued to vibrate after the controlling stimulus had stopped there would be a hopeless confusion of sound.

The quality of the reproduced attack sound, as in the case of the drum, is a function of the speaker's response to higher-frequency sound components. Thus the attack sounds reproduced by multispeaker systems are controlled, not by the low-frequency performance of the woofer, but by the performance of whatever unit is assigned to reproducing the mid and higher frequencies, and may involve the woofer itself little or not at all, depending on how low the crossover frequency is. By definition, a woofer which covers only the low-frequency range cannot and is not intended to respond to most transient attack sounds. Its contribution to a crisp drum beat is to move, however lumberingly, in accurate reproduction of the fundamental and lower harmonic frequencies only; the sharper attack components are reproduced and contributed by other speakers.

So much for the general background of the problem. We may now turn our attention to the more specific question of loudspeaker damping.

Magnetic Damping in Speakers

Speakers are damped, in their main resonance region, in three ways: mechanically, through friction in the suspensions, acoustically, through various methods of applying acoustic resistance and through the air load resistance, and magnetically. In bass-reflex and horn systems acoustic damping normally predominates; in direct-radiator systems most of the burden of damping falls on the electro-magnetic system. Damping of cone break-up modes of vibration, at higher frequencies, also takes place in the cone material and in its edge termination, but this is not the subject of the present article.

Magnetic damping results in an additional mechanical resistance being applied to the moving system. This mechanical resistance can be investigated directly in a very simple manner—if one shorts out the terminals of a loudspeaker containing a fairly heavy magnet, and then tries to work the cone back and forth manually, it will feel as though the voice-coil has been immersed in a viscous fluid. The apparent viscosity disappears as soon as the terminal short is removed. When the speaker is connected to an amplifier with a low source resistance the amplifier source resistance replaces our experimental short. If the source resistance is raised in value (lower damping factor) the mechanical damping resistance is correspondingly decreased.

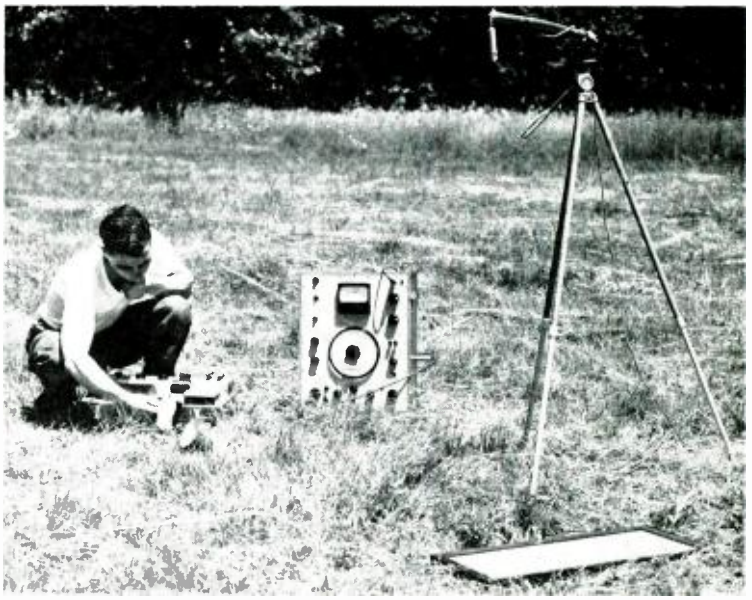

Fig. 3. Test set-up for measuring speaker performance. The speaker sees a controlled solid angle of 180 deg.

The effects of speaker magnetic damping are twofold:

1. It prevents cone vibration from continuing after the signal has stopped (hangover).

2. It controls bass response in the frequency region of resonance, perhaps an octave on each side.

The first of these effects is generally known and widely commented upon, while the second is not so well known.

The mechanical resistance introduced by magnetic damping may become the major element in the speaker's mechanical impedance in the region of resonance, where mass and compliance reactances cancel each other out. Actually, the influence begins at some frequency above resonance, when the mass reactance becomes equal to the damping mechanical resistance.

The extent of the influence of damping is a function of the value of moving mass in relation to the damping resistance, more precisely, on the mechanical Q of the system. Where the resistance is small relative to the mass reactance at resonance (a high-Q system) the effect of damping on bass response is small; where the value of resistance is large in relation to this mass reactance the effect on bass response is great. This is a simplified way of saying that which is described exactly by the well-known family of curves representing the frequency response of resonant systems for different values of Q. *Figure* 1 reproduces a set of such curves, specifically applied to the acoustic output of speakers.[2] All dynamic loudspeakers, of course, are mass-elasticity resonant systems.

The crux of the matter is that for that value of Q which will bring the resonant peak down to a flat curve, the damping will also be such as to prevent any hangover. For lower values of Q the hang-

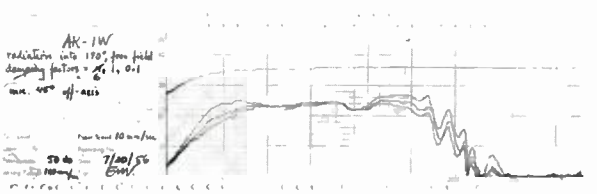

Fig. 4. Recorded speaker response curves for different values of amplifier damping factor, open field conditions. The calibration curve for the recording equipment, not including microphone, appears at the top. (See Fig. 5 for corrections).

[2] Ibid., p. 226. Also see D. E. L. Shorter, "Loudspeaker cabinet design," p. 382, *Wireless World*, Vol. 56, No. 11, Nov., 1950.

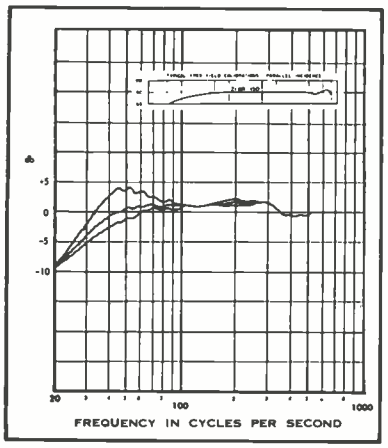

Fig. 5. Response curves of Fig 4, corrected for the calibrated errors of recorder and microphone (calibration curve for the latter appears in inset).

over will continue to be damped out in neither better nor worse fashion, but other things being equal, there will be an attenuation of bass response as indicated in *Fig.* 1.

The mechanical Q of a system is controlled by the relative values of mass and resistive elements at the resonant frequency, according to the relationship:

$$Q = \frac{\omega_R M}{R}$$

where M = mass
R = mechanical resistance
$\omega_R = 2\pi$ times the resonant frequency of the system. (Note that $\omega_R M$ is the mass reactance at resonance)

In the case of a loudspeaker this expression may be elaborated into:

$$Q = \frac{\omega_R M}{R_A + R_M + R_D}$$

where
M = mass of voice-coil and cone, plus acoustical mass reflected into the system
R_A = acoustical resistance
R_M = mechanical resistance of suspensions
R_D = equivalent mechanical resistance associated with magnetic damping. This is equal to $\frac{B \cdot l^2}{R_{vc} + R_{int} + R_x}$, where B is the air gap flux density, l is the length of wire in the gap, R_{vc} is the voice coil resistance, R_{int} is the amplifier source resistance, and R_x is any other d.c. resistance in the line.

The dynamical analogy to the mechanical system of a loudspeaker, including the mechanical resistance due to magnetic damping, is shown in *Fig.* 2. Since the amplifier source resistance determines the value of this magnetic damping mechanical resistance, a variable damping factor control can be used, particularly with a direct-radiator speaker, to control the Q over a fairly large range of values.

It can be seen in *Fig.* 2 that at frequencies well above resonance the equivalent electrical circuit is inductance controlled, that is, the net reactance is inductive, representing mass control in the speaker's mechanical system. As the frequency is lowered in the direction of resonance the net inductive reactance decreases, and current flow (velocity in the mechanical system) correspondingly increases. This is as it should be; the cone velocity of a direct-radiator speaker, for constant acoustical power, must double with each lower bass octave in order to offset the progressive decrease in air-load resistance.

At some frequency, depending on the speaker used—perhaps an octave above resonance—the net inductive reactance will become equal to the total resistance, R will thenceforth, as the frequency is lowered, act to reduce current progressively, compared to the rising value that would exist in a pure LC circuit. That value of R which produces a Q of about 1 gives an approximately flat curve, with neither resonant peak nor bass attenuation.

If R_D is swamped by large values of other resistive elements due to the nature of the speaker system, its effect will obviously be minor.

Below resonance the net capacitive reactance of the circuit begins to mount, until it is greater in value than the total R. An octave or so below resonance, then, R again loses its influence.

It should be clear at this point that the absolute value of the mass of the speaker's moving system has no relation whatever to damping or hangover. It is the mass-resistance *ratio* that influences the Q. The only exception to the former statement is provided by the new electrostatic units, where the mass of the very light diaphragm may be kept so low that the controlling resistive element is the actual air load resistance.[3] In such a case all system constants become tied to a fixed reference of resistance.

Nor does the absolute value of the mass influence attack performance. What is needed for the proper reproduction of attack sounds is: (a) the same level of system response at the attack frequencies as at the fundamental, however this is achieved, and (b) uniform response in the region of attack frequencies (corresponding to proper damping in this range), so that the attack frequencies themselves don't ring.

So much has been said and written contrary to some of the above conclusions that it was felt that a set of actual field measurements, illustrating the main points of discussion, would prove both interesting and informative. Accordingly a direct-radiator speaker system of known characteristics was fed by an amplifier with controllable damping factor, and facilities for measuring the speaker frequency response and decay characteristics were provided, as illustrated in *Fig.* 3. The test set-up in which the speaker is sunk into the ground in the middle of an open field, its face flush with the surface, have been described by the writer.[4] The speaker sees a controlled solid angle of 180 deg., and test conditions conform to ASA and RETMA specifications. Validation of the frequency-response curves of the speaker used as representing essentially fundamental output was also described in the article referred to.

The equipment used included the following:

AR-1W Acoustic Research speaker system (woofer only)
Fairchild 275 power amplifier, with variable damping factor
Bruel and Kjaer beat frequency oscillator BL-1014, mechanically coupled to:
Bruel and Kjaer level recorder (automatic) BL-2304
Electro-Pulse pulse generator 1310A
Bruel and Kjaer microphone amplifier BL-2601
Altec 21-BR-150 capacitor microphone

The acoustic output of the speaker over its frequency range was measured, using the automatic frequency-level recorder, at an input power of 20 watts. These curves were re-run on the same graph paper[5] with all conditions the same, except for a change of setting of the damping factor control (thereby changing the damping resistance and the speaker's mechanical Q). The results are reproduced in *Fig.* 4. It will be seen that the curves conform closely to the

[3] Arthur A. Janszen, "An electrostatic loudspeaker development," p. 89. *JAES*, Vol. 3, No. 2, April, 1955.

[4] Edgar M. Villchur, "Commercial acoustic suspension speaker," p. 18, AUDIO, July, 1955.

[5] Unfortunately, 30 db per decade (American standard) graph paper was not available, and 20 db per decade paper had to be used.

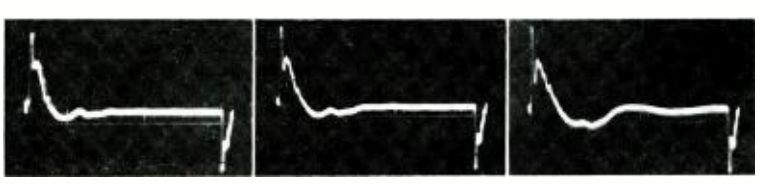

Fig. 6. Acoustic output of speaker, as monitored by microphone and oscilloscope, in response to step-front of low-frequency square wave: A (left), With amplifier damping factor of 6; B (center), with damping factor of 1; C (right), With damping factor of 0.1.

theoretically plotted curves of *Fig.* 1, especially when they have been corrected for the calibrated errors in recorder and microphone (*Fig.* 5).

The effect of the increased amplifier source resistance on the upper frequency range can also be seen: this is due to the rising *electrical* inductive reactance of the voice-coil.

Figure 6 is a series of three oscilloscope photos of the wave forms of the acoustical output of the speaker, in response to the step front of a low-frequency square wave. They represent magnetic damping conditions associated with each of the three curves of *Fig.* 5. Note that there is no significant difference between the recorded hangover associated with a properly damped and an over-damped system. Ringing at the speaker's resonant frequency is clearly seen, however, in the under-damped condition, as is a large increase in the slight initial secondary ringing, at a higher frequency, which shows up as a disturbance halfway down the first decay slope.

It should be possible at this point to see the error in that misconception about damping which denies ability to the amplifier source resistance to damp the speaker mechanically because of the latter's low conversion efficiency. Magnetic damping is, of course, powerless to control effects which take place in the course of energy transfer between the mechanical system of the speaker and the surrounding air, but it is of paramount importance in controlling the mechanical system itself. It should also be noted that the magnetic damping of the speaker is a function of the magnetic field strength and of the amount of copper in the gap. Since these two factors do not uniquely determine electro-acoustic efficiency (the mass of the moving system, and the method of coupling the diaphragm to the air are at least as important), there is no direct relationship between electro-acoustic efficiency and damping. The AR-1W used in these tests, for example, a speaker with very low over-all efficiency, has unusually high magnetic damping due to its heavy magnet and to the large amount of copper in the gap. It is, as a matter of fact, in danger of being over-damped when improperly used, as under conditions similar to those of the lower curve of *Fig.* 3 (180 deg. solid angle of radiation, high damping factor), in which bass attenuation can be seen.

Figure 7a is a recorded graph of the frequency response of the speaker in a living room, with the two extremes of damping factor used in *Fig.* 4. Note that the over-all shape of the curve is affected by changing the damping factor, in the same way as it was in *Fig.* 4, but that the irregularities due to the acoustical environment of the room are completely

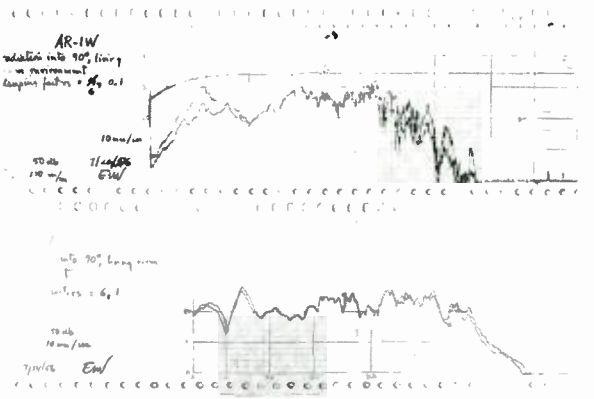

Fig. 7. A (top), Response curve of speaker mounted in two-sided corner of room. Lower curve is for damping factor of 6, upper curve is for damping factor of 0.1. B (bottom), Response curve of the same speaker in a different position in the same room at damping factors of 6 and 1.

uninfluenced. This illustrates the independence of room ringing—associated with peaks and dips in the steady-state frequency-response curve—from damping in the speaker system itself. The only damping that can have any effect here is that connected with the room surfaces; neither magnetic, mechanical, nor acoustical damping of the speaker's moving system can affect a cure. The latter point is further illustrated in *Fig.* 7b, a frequency response record of the same speaker in a different part of the same room.

Effect of Solid Angle Seen by Speaker

It may have been noted that the condition of high damping factor produced bass attenuation when the speaker radiated into 180 deg. in the open field, but that the same high damping factor is associated with essentially uniform response down to 30 cps in the indoor measurement (ignoring room-derived irregularities, and correcting for microphone and recorder). In the room the lower damping factor produces a somewhat exaggerated bass. The primary reason for this lies in the fact that the speaker in the room was mounted so that it faced into a reduced solid angle (90 deg.)—in a corner, off the floor.

Figure 8, also borrowed from Beranek's *Acoustics,* shows the change in bass response produced by restricting the solid angle seen by a speaker. Higher-frequency components are concentrated in the area ahead of the cone, and if the environmental solid angle seen by the speaker does not similarly restrict the non-directional bass, it will be thinned out relative to the treble. As might be expected, below the frequency at which the speaker's signal becomes essentially non-directive each successive halving of the solid angle doubles the bass power, or raises the response curve by 3 db.

It would seem to be a good idea for someone to design an equalizer network to produce variable bass boost to compensate for this effect on performance due to change in solid angle. In the meantime the closest approximation to such a circuit is a variable damping control, which gives the user additional flexibility in tailoring the low bass response of his system to the conditions of speaker mounting. Lowering the damping factor may also affect the mid and high frequencies, and a circuit which only varied the damping factor (from a high value down to one-half or so) over the bass frequency range would be useful.[6]

Other Misconceptions

I would like to add some further comments to this article in an attempt to lay to rest some of the old wives' tales about speaker damping. The insertion of a few numbers into the general rela-

(*Continued on page 84*)

[6] The writer has, since completing the draft of this article, learned of such an amplifier design available commercially—in the McIntosh MC-30*A* and MC-60*A*. Tests on a sample MC-60*A* showed it to perform precisely according to expectation.

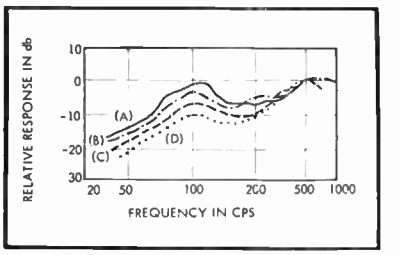

Fig. 8. Effect of restricting the solid angle seen by a loudspeaker. The top curve (A) is for a solid angle of 45 deg.; each succeeding lower curve represents an increase of the solid angle by a factor of 2. (After Beranek)

Low-Noise Transistor Microphone Amplifier

JAMES J. DAVIDSON*

A discussion of the factors involved in developing a satisfactory microphone amplifier using transistors, with thorough consideration of the effects of emitter current, source impedance, and volume-control placement to ensure low distortion, low noise, and over-all optimum performance.

THE DESIGN OF MICROPHONE AMPLIFIERS has a long and arduous history. Throughout the years, the major and absorbing problem has been that of noise. As the art progressed, the extraneous noise originating in the electronic equipment has been pushed close to the absolute minimum. In a well designed vacuum-tube amplifier, such as is generally used for professional applications, the limiting noise is that generated thermally in the microphone element resistance.

Since the advent of transistors, the question has often arisen whether transistors can equal, or even approach, this near-perfection of vacuum tubes. Before proceeding to a direct comparison of performance, it would be well to review briefly the concept of noise figure.

Noise Figure

Any resistor which is at a temperature above absolute zero generates a certain amount of white random noise. For convenience this noise can be represented as an imaginary voltage generator in series with a noise-free resistor. The generated voltage within a given bandwidth is completely defined in terms of the value of the resistance, the absolute temperature, and the equivalent noise bandwidth.

The expression for the rms generated noise voltage is:

$$\sqrt{\overline{e_n^2}} = \sqrt{4kTR\,B_{eq}}$$

where

T = Absolute Temperature (°K)
R = Resistance (ohms)
k = Boltzmann's Constant = 1.38×10^{-23} (joule/°K)
B_{eq} = Equivalent Noise Bandwidth (cps)

The equivalent noise bandwidth of an amplifier is defined as the bandwidth of the rectangle with the same area as the power response curve, and the same low-frequency gain.

Figure 1 shows a resistor connected to a completely noise-free amplifier. It

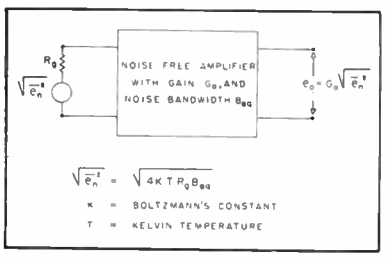

Fig. 1. A noise-free amplifier with resistive input termination.

is obvious that the output, in the absence of signal, is simply the gain of the amplifier times the thermal noise of the resistor. As a specific example, for

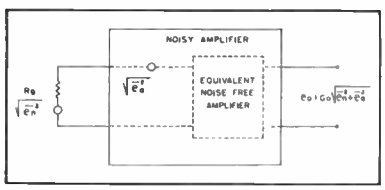

Fig. 2. Noisy amplifier with all noise sources referred to the input.

$R_g = 3000$ ohms, T = 300°K (27°C), and $B_{eq} = 20$ kc, the resistor noise is 1 microvolt. If the voltage gain of the amplifier is 1000, 1 millivolt of noise will appear at the output terminals. Since this noise voltage is the absolute minimum amount which could appear under the conditions outlined, the noise is zero db above theoretical minimum, or the amplifier is said to have a zero-db noise figure (or noise factor).

Figure 2 shows the more realistic case of an amplifier with some internal noise, here represented as an equivalent noise generator in series with the input of an imaginary noise-free amplifier. For the sake of discussion, this generator is assumed to have a noise voltage exactly equal to that of the 3000-ohm resistor. Thus, the rms input voltage to the noise-free amplifier is 3 db higher than in the first case, and so is the output voltage. Since the output is 3 db higher than the theoretical minimum, the real amplifier is said to have a noise figure of 3 db. In terms of signal-to-noise ratio, the same figures apply: a completely noise-free amplifier will have a S/N ratio only 3 db better than one with 1.0 μv equivalent noise input, under the above conditions.

From this point, let us see what we are up against in terms of vacuum-tube amplifiers. *Figure* 3 shows the noise factor of a 1620 tube *vs.* source resistance. The variable source resistance is generally obtained by a grid step-up transformer, and in practice it is possible to obtain noise factors of 0.25 db which is close enough to perfection (zero db) to be insignificant.

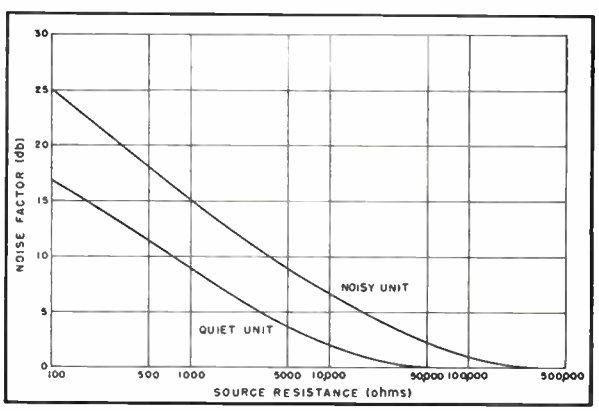

Fig. 3. Noise factor vs. source resistance for type 1620 vacuum tubes.

* *RCA Victor Radio & "Victrola" Division, Camden, N.J.*

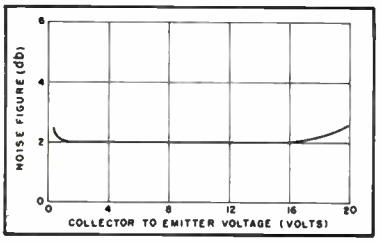

Fig. 4. Variation of noise figure with collector-to-emitter voltage.

Transistor Noise

The design of a transistor amplifier is not so straightforward. There are three major design criteria: proper operating point, optimum source impedance, and most important, the selection of low-noise transistors.

The variation of noise figure with collector-to-emitter voltage is a complicated affair. If the transistor is well made (clean surfaces, well ordered crystalline structure, etc.) the noise figure is practically independent of voltage, as shown in *Fig.* 4. Where these conditions are not met, however, the effect of voltage can be profound and often unpredictable, except that higher voltage always causes increased noise. Thus the collector voltage should be kept low, 3 volts being a reasonable rule of thumb.

The influence of emitter current on noise is much better behaved in normal transistors, as shown in *Fig.* 5. The reduction of noise figure in the region of 0.3 ma is of great importance in the design of low-noise amplifiers. As will be shown later, however, operation at such a low current has drawbacks in terms of signal-handling capabilities.

Once the operating point is chosen, the proper source impedance has to be considered. Vacuum tubes generally, because of their extremely high grid impedance, operate best from source impedance as high as practicable. Transistors, on the other hand, have a definite and optimum source impedance for minimum noise, as indicated in *Fig.* 6. It should not be surprising, considering the low impedance of transistors, that the minimum occurs around 1000 ohms. This is a great advantage of transistors in many applications, since the elimination of the bulky, weighty, and expensive grid input transformer is highly desirable. The 2:1 step-up transformer required to match a 250-ohm microphone can be small and light, and can even be eliminated in applications where the degradation in signal-to-noise ratio can be tolerated, since the loss is only 2 to 3 db. There are doubtless many applications where the reduction in bulk will be desirable or necessary.

The foregoing considerations have assumed that the transistor used has a good noise characteristic. The subject of noise sources in transistors has been well treated previously, so we will take a quick look at the noise mechanisms, and how to minimize them. *Figure* 7 shows the low-frequency equivalent circuit with noise generators. There are five noise generators shown, of which three can be considered "intrinsic", or functions of current flow within the transistor itself, ($I^2_{eb'}$, $I^2_{cb'}$ and I^2_{ec}) and two are "extrinsic", or functions of the construction of the transistor. The low-frequency generator is a lumped generator representing all of the low-frequency or "flicker" noise found in a transistor. Since it represents both surface and leakage noise, it is dependent on both emitter current and collector voltage. In particular, if the surface is contaminated or imperfect in other ways, the influence of collector voltage can be profound. Thus, as a matter of general principle, as previously mentioned, it is well to keep the collector voltage as low as possible without sacrificing other characteristics.

The base-lead noise generator is a function of transistor type, but is quite uniform within a given type. Once low flicker, or low-frequency noise is achieved, $r_{bb'}$ noise becomes a limiting factor. The minimum noise figure which can be achieved within the "intrinsic transistor" (the transistor less the extrinsic generators) is given by Giacoletto[1] as:

$$F = 1 + \frac{1}{\sqrt{\beta}}$$

This value of F occurs at an optimum source resistance of:

$$R_g = \frac{\sqrt{\beta}}{\Lambda I_e} \text{ ohms,}$$

$$\text{where } \Lambda = \frac{q}{kT} = 40$$

Thus, for $\beta = 100$, and $I_e = .25$ ma, the intrinsic transistor has a noise figure of 0.4 db, at a source resistance of 1000 ohms.

[1] L. J. Giacoletto. "The Noise Figure of Junction Transistors", Transistors I, RCA Laboratories, Princeton, N. J., 1956, pp. 296–308.

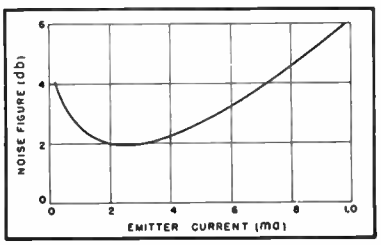

Fig. 5. Variation of noise figure with emitter current.

Representative values for the base-lead resistance in alloy-junction transistors are: for audio types, 300–400 ohms; r.f. types, 100 ohms; and "drift" type, about 40 ohms. Under the conditions listed above, the amount that $r_{bb'}$ noise will add to the intrinsic noise figure is:

$r_{bb'}$	Increase in F
350	1.3 db
100	0.4 db
40	0.2 db

If the β of the transistor is high enough to raise the optimum source impedance appreciably, the contribution of $r_{bb'}$ becomes of less significance, since it is a smaller fraction of the source resistance.

Figure 8 shows the lowest noise unit found in each of the three transistor types mentioned. The "drift" unit is anomalous due to its high β, but is probably a good indication of transistors to come.

Dynamic Range and Overload

One of the prime circuit problems in any microphone amplifier is the extremely wide range of input signals which must be handled without distortion. Assuming that the lower limit is set by the thermal noise of the microphone resistance, unity signal-to-noise ratio occurs at an input of −131 dbm

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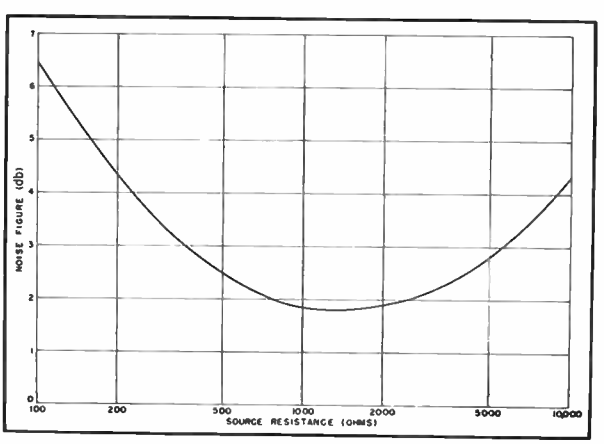

Fig. 6. Noise factor vs. source resistance for a selected 2N139 transistor.

Try this on for size—it might fit many of us!

Fidelity Perilous

GEORGE L. AUGSPURGER*

Author's Foreword:

The following is quoted from an advertisement in one of the hi-fi magazines: "We assembled a group of electronic engineers with knowhow . . . a group of designers with imagination . . . and gave them an order—'Create a line of High Fidelity Amplifiers that will produce breathtakingly realistic sounds.'. . ." This, then, is the courageous story of this group of unsung heroes.

THE ROOM WAS ALMOST FILLED when Joe Blakeson hurried in and took his seat in the first row. An aura of tense excitement dominated the dozen top-flight audio engineers who waited, smoking nervously and chatting in low voices. There was a sudden hush as a portly man with a bushy red moustache strode purposefully to the rostrum. This was Colonel Bertram Herbish, Commandant of Sales Strategy for Inert Sound, Inc. "At ease, men." Herbish laid his brief case on the rostrum. "We'll dispense with formality today, but I think we might sing one verse of the Inert pep song. Joe, will you lead the men while I get this material sorted."

Joe felt a flush of pride as he stood. He always thrilled to the strains of "Your Fi and My Fi Will Be Hi-Fi Someday," but leading the singing was an honor which the Colonel usually reserved for himself. Apparently Joe's seventeen years of devoted service to Inert, the last five as Chief Test Engineer, were finally beginning to pay off.

After the chorus, Herbish motioned the men to their seats. "Men," he said. "I guess it's no secret that this year we're out to beat the big boys. All the high fidelity manufacturers are planning new designs, new developments, for 1957. But only Inert has Project Bee-Tee." Herbish took a small folder from his brief case. "In this report I have the complete background of every one of you. Everything you've done, everything you've said for the past twenty years is written down here. We had to make absolutely sure of the loyalty of every man associated with this project."

Here it comes, thought Joe.

The Colonel picked out a slip of paper. "Here is an order forwarded to me from our beloved president, W. W. Inert himself. It reads as follows. 'You will assemble a group of not less than ten nor more than fifteen electronic engineers. Men will have a knowhow score of not less than 97.2 per cent. All men will be cleared for top secret information. In not less than three months this group will create a series of three high fidelity amplifiers. These amplifiers will produce breathtakingly realistic sounds."

The room was deathly silent. "I don't need to tell you that there's an element of risk involved. If any of you feel that you want to drop out for any reason, your decision will in no way reflect on you."

"Excuse me, sir." A feeble voice from the middle of the room. Blakeson saw that the speaker was Bradshaw McCreevy, one of Inert's oldest engineers. "Five years ago when we introduced the Infinitessimally Distortionless Hyper-Perfect Amplifier, I considered it an honor to conduct the final tests myself." The old man stared at Herbish defiantly. "That amplifier broke the sonic barrier—it attained the ultimate in dynamic excellence! But those three days of testing . . ." The quavering voice broke into a sob. "I can't go through agony like that again. I'm sorry, I just can't do it. I have a family, my wife, my children. . . ."

"That's all right McCreevy, we all understand." Herbish gently took the older man's arm and led him from the room.

"People without guts shouldn't get mixed up in this business." The scornful comment came from Ram Fischer, brash young design recruit.

The Colonel whirled around. "I heard that, Fischer," he snapped. "I won't stand for talk like that. None of you men—*none* of you knows what McCreevy went through five years ago. Those were the days before we had any of the safety devices we take for granted now. No automatic Power-Pilot, no parasitic suppressor, no self-stabilizing feedback loops. That broken old man has done more for Inert than you or I can ever do. Don't forget it."

Ram looked at the floor silently.

After a slight pause, the Colonel went on, "The reason for complete secrecy is this. Not only must these new amplifiers exceed even the most critical requirements. The order states specifically that their performance is to be 'breathtaking'." He stared at the men. "And that is precisely what it means. We are going to design a circuit that will literally *take your breath away!*"

THE FOLLOWING MORNING Joe sat at the breakfast table as his wife Elissa filled his coffee cup. Abruptly she said, "You don't need to pretend any longer. The other wives have heard about this new project. Oh, Joe, Joe, why do we have to keep on living this way?" Elissa knelt beside her husband and convulsively clutched his free hand. "What do you think it's like—watching the man you love go off every morning, not knowing whether he will come home or not? And what am I supposed to say when little Viscous tells me he wants to be a hi-fi engineer just like daddy?" She broke into incoherent sobs.

"There, there," soothed Joe, "We've been over all this before."

"But what point is there to this senseless search for absolute fidelity? 'High Fidelity' means only unhappiness and strife and sorrow. I can't stand it anymore, Joe. I mean that."

Blakeson gently took Elissa in his

* *2043 S. Holt Ave., Los Angeles 34, Calif.*

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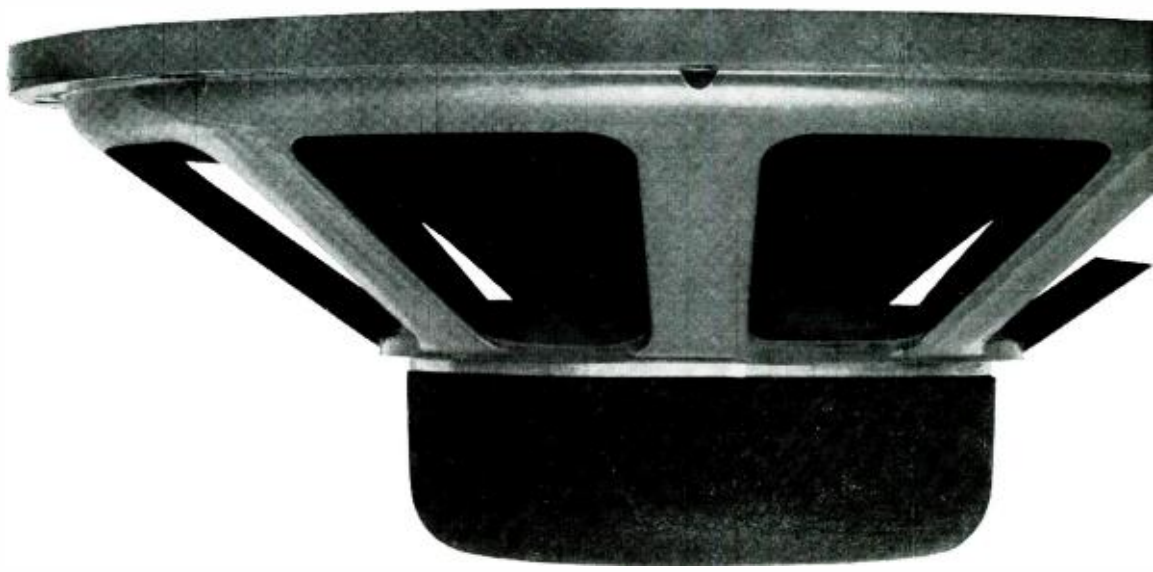

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specifications

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

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

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

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

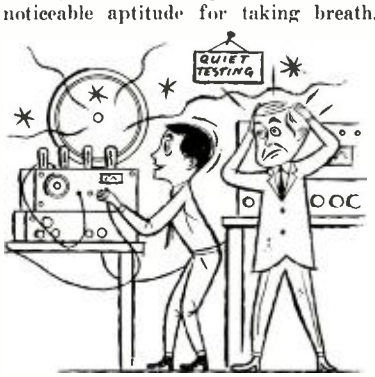
arms and soothed her hysterical outbreak with a kiss. "I'm sorry, Elissa," he said. "I have to go my own way—you know that. The way I look at it, I've got a responsibility to the future. I've got to try somehow to make this a better world so that you and Viscous and all the wives and children can enjoy a richness of reality which will make listening the extreme pleasure you have dreamed about but never experienced."

She pulled away from him. "Words, nothing but words. You'll never be any different—I can see that now. I never should have married you." She turned and ran blindly from the room. Joe heard the bedroom door slam.

Could she be right? Could there be something evil in his search for perfection? Joe squared his shoulders. No . . . his *was* the right way, he was sure of that. And someday Elissa would come to see it too.

EXACTLY TWO WEEKS before the new amplifiers were due to be presented to W. W. Inert, a catastrophe occurred which was to turn what seemed to be inevitable defeat into blazing success!

Ram Fischer was about to run preliminary curves on the thirty-seventh circuit developed by Project Bee-Tee. So far, none of the amplifiers had shown noticeable aptitude for taking breath.



Fischer plugged in the amplifier and was about to clip on the ground lead when Joe glanced in his direction. "Fischer! Hold it man, you've got the input polarity reversed."

But the warning came too late. The younger man clipped the ground to the chassis and there was a sudden "Whoosh" as the output tubes turned bright purple—then the room lights flickered briefly as a jet of sparks emerged from the filter capacitor. A plaintive wisp of green smoke crept out from beneath the chassis.

Joe tried to control his anger as he surveyed the charred mess. "That was inexcusable, Fischer." he snapped.

"Wait a minute." Ram's eyes were strangely bright. "Didn't you feel an odd sensation just before the thing blew up? Sort of like someone socked you in the stomach."

"I wasn't paying attention to my stomach. I don't understand how that excuses your mistake."

"Don't you see, We must be on the right track. I connected the amplifier incorrectly and it started to *take our breath away.*" Fischer was making quick notations on a sheet of graph paper. "There's only one explanation." he said.

"Wait a minute—I think I know," said Joe. "Shades of Hugo Gernsback," he breathed, "we must have stumbled on to contrapolar frequencies!"

"Exactly." shouted Fischer, "And we can duplicate the psycho-acoustic effect with a margin of stability by reversing the reactive angle of the cathode bias."

Joe placed a firm hand on Ram's shoulder. "I apologise for what I said before." He looked admiringly at the young designer. "I think you've got the answer." he said quietly.

JOE SAT in the comfortable leather chair facing Colonel Herbish's desk. Almost two weeks had elapsed since an unforseen accident brought new hope to Project Bee-Tee. "So, you see," Joe was saying, "Fischer must actually get the credit for finding the right approach. We've got stability, distortion, damping, and decor licked. All we have to do now is run an actual listening test to see how powerful this breathtaking effect is."

Herbish absently toyed with a pencil. "I know I should be proud of you boys, Joe, and I am . . . but . . ." he paused. "Frankly, I'm scared. We're on the edge of something we don't know how to control. I wonder if we're not playing with something that may ultimately destroy us." Herbish stood and gazed out the window. "I like this life." he said. "I like the feel of clean starched shirts and the happy innocent laughter of my children. I don't want to take a chance on destroying all that."

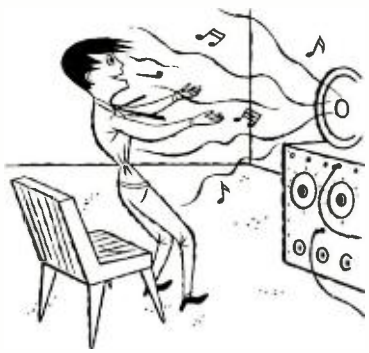
"I respect your feelings," said Joe, "but the way I look at it, I've got a responsibility to the future. I've got to try somehow to make this a better world so that you and your wife, and all the wives and children can enjoy a richness of reality which will make listening the extreme pleasure they have dreamed about but never experienced."

The Colonel pulled out a handkerchief and dabbed his eyes. "I'm ashamed of myself." he blubbered. "I'm a cowardly old man and I've just seen myself for the first time. Go ahead with the test son . . . and, good luck!"

JOE BLAKESON SAT ALONE in the simulated living room. The X-37b amplifier was installed in an adjoining control booth and a cluster of tense faces peered at Joe through the glass wall. The amplifier was connected to a simulated speaker system in a simulated corner of the room. Joe signalled for the test to begin.

He was engulfed in a torrential cascade of music. He fought to keep his critical judgment clear . . . it was awe inspiring, unbelievable, frighteningly real—all these were familiar reactions though he had never before experienced them in such lifelike splendor. Then suddenly it came: a white-hot agony that seemed to grip his chest in a vise. This was it! The X-37b was actually breathtaking! The sensation stabbed again. This time Joe felt a wild exultation, the mystic "pleasure-in-pain" of the ancients.

He was delirious with the wild agony which swelled within him. He motioned for the intensity to be increased still further. His shirt was wringing wet, his forehead was throbbing, but he had to experience the wonderful moment once again. The music built up in a wild crescendo, and suddenly Joe found a new dimension of glorious listening pleasure as the tightness around his



lungs constricted ever more mercilessly.

Then . . . all went black.

HE BLINKED and tried to focus his eyes. A white figure seemed to hover over him at some immense distance. He blinked again and the apparition smiled. A disembodied voice floated into his consciousness. "He's awake now, Mrs. Blakeson, he'll want to talk to you."

As the face of the woman he loved appeared, Joe realized he was in a hospital bed. Elissa was standing beside him. A white-clothed nurse was leaving the room. "What happened to the test? Did I just imagine. . . ."

"Quiet dear. The doctor said you

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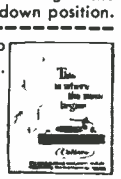

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Loudspeakers and Microphone for Auditory Perspective

A. L. THURAS

THE REPRODUCTION OF ORCHESTRAL MUSIC in a large auditorium presents a number of difficult problems, particularly when a requirement is that the audience shall receive an aesthetic impression comparable to that given by a personally-present orchestra. A solution of these problems on the scale successfully attempted in Constitution Hall in April, 1933, would have been impossible but for the careful laboratory measurements which had been made during previous years. These showed definitely the amount of acoustic power, the range of vibration-frequencies, and to some extent the amount and character of reverberation necessary to reproduce the music of a large orchestra without noticeable change. Accordingly, the loudspeakers were designed to radiate a total of 450 watts of sound power and to respond uniformly over the range from 40 to 15,000 cycles.

For radiating frequencies as low as 40 cycles per second efficiently, a horn of large dimensions is required. This horn, in order to be more compact is preferably of the folded type, but a large folded horn transmits high-frequency tones inefficiently. The loudspeaker was therefore constructed in two units; one for the lower and the other for the higher frequencies. An electrical network was used to divide the current into two frequency bands, the point of division being about 300 cycles per second.

In transmitting large powers at high pressure, it is essential to consider the distortion[1], in the form of higher harmonics, which may be generated in the air. At the low-frequency limit, each horn can radiate about three times the low-frequency power of the orchestra with a second harmonic generation 30 db below the fundamental. Three low-frequency units will then radiate power 9 db above that of the orchestra without noticeable distortion. At these high power levels no data are at present available on the detection of this type of distortion. Since it consists principally in adding tones an octave above the original tones, and since the ear itself generates harmonics at high pressures, it is reasonable to suppose that still higher power levels can be radiated without objectionable results.

It has been generally assumed that to avoid wide variations in output near the lower cutoff point, a horn mouth must measure across about one third the wavelength of the lowest frequency. The rule here would require a mouth diameter of ten feet, but with a high-efficiency receiver it is possible to use a much smaller diameter and smooth out variations by proper selection of the output impedance of the amplifier. Considering the acoustic impedance of the horn as transferred by the diaphragm to the electrical circuit, we have a generator with internal impedance—the amplifier and receiver coil—driving a variable impedance load. The problem then is to select an internal impedance such that variation of power output with load impedance shall be a minimum. This works out to be the square root of the product of the maximum and minimum values of load impedance. When this condition was met, a maximum change of horn impedance of 7.5 to one resulted in a sound output which did not vary more than 1 db.

The acoustic impedance into which a loudspeaker works depends to a considerable degree on the amplitude and phase of the reflected sound waves at the horn mouth. These will in turn depend on the size of the auditorium and its acoustic damping.

At high frequencies the damping is great enough to attenuate the reflected sounds to a negligible amplitude. This is not the case however, in the neighborhood of forty cps. A consideration of the phase changes with frequency in this vicinity shows that over a relatively short range of frequencies the returning waves are alternately in and out of phase with the outgoing waves. This means that the load impedance will vary according as the outgoing waves are met by aiding or opposing pressure from returning waves. Since it is still impossible to predict accurately the amounts and directions of reflected sounds there is no way of predetermining at just what frequencies the horn will be working into high or low impedances. Hence rather large variations in sound output would have to be tolerated were it not for the smoothing effect of properly chosen electrical impedance, as outlined in the preceding paragraph. An essential condition for this is the high efficiency of the low-frequency loudspeaker.

The receiver unit was similar in construction to the Western Electric No. 555 Receiver[2] but much larger in size. The driving coil was made of copper ribbon, as weight in the moving element was not an important consideration. The magnetizing coil, however, was made of copper ribbon instead of round wire which gave a considerably better space factor thus reducing the size and weight of the unit. One realizes that this is an important consideration after assembling one or two of these loudspeakers.

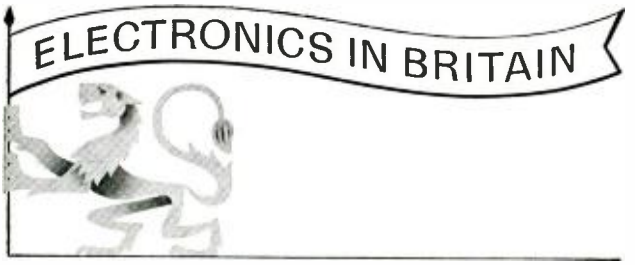
This receiver unit and horn when connected to an amplifier in the specified manner are capable of delivering three or four times the power of an orchestra in the frequency region between 40 and 400 cycles per second; with an efficiency of about 70 per cent and a variation in sound output for a given input power to the amplifier of not more than 1 db throughout this range.

The ideal distribution of sound from a horn is one in which motion of the air particles is the same in amplitude and phase throughout the solid angle

(Reprinted by permission from *Bell Laboratories Record*, Vol. 12, No. 7, March, 1934.

[1] This distortion, pointed out by Rayleigh but neglected in his equations of wave propagation, has recently been theoretically investigated by R. Y. Rocard and applied to exponential horns. He finds that the intensity of the second harmonic increases as the square of the fundamental frequency, directly as the fundamental power, inversely as the square of the cutoff frequency of the horn, and inversely as the throat area.

[2] *Bell Laboratories Record*: March, 1928, p. 205.



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MEV 51

subtended by the audience and so much of the walls and ceiling as are necessary for suitable reverberation. This is not realized by a tapered horn of the ordinary type, which is inherently highly directive at the higher frequencies. Juxtaposition of a number of horns pointed in suitable directions can produce at their mouths a spherical wave front of dimensions large in comparison with the shortest wave length of interest, and in which the particle motions are substantially alike in amplitude and phase. To this end, a horn was designed with separate channels whose acoustic axes radiate from a common center.

Each channel has substantially an exponential taper. Toward the narrow ends these channels are brought together with their axes parallel, and are terminated in a single tapered tube which at its other end connects to the receiver unit. Sound from the latter is transmitted along the single tube as a plane wave and is divided equally among the several channels. Since the channels have the same taper, the speed of propagation of sound in them is the same. The large ends are so proportioned and placed that the particle motion of the air will be in phase and equal over the mouth of the horn. This design gives a true spherical wave front at the mouth of the horn at all frequencies for which the transverse dimensions of the mouth opening are a large fraction of a wavelength.

As the frequency is increased, the ratio of wavelength to transverse width of the channels becomes less and the sound will be confined more and more to the immediate neighborhood of the axis of each channel. The sound will then not be uniformly distributed over the mouth opening of the horn, but each channel will act as an independent horn. In order to have a true spherical wave front up to the highest frequencies the horn should be divided into a sufficient number of channels to make the transverse dimension of each channel small compared with the wavelength up to the highest frequencies. If we wish to transmit up to 15,000 cps it is not very practical to subdivide the horn to that extent. Both the cost of construction and the losses in the horn would be high if designed to transmit also frequencies as low as 200 cps, as is the case under consideration, but it is not important that at very high frequencies a spherical wave front be established over the whole mouth of the horn. For this frequency region it is perfectly satisfactory to have each channel act as an independent horn, provided that the construction of the horn is such that the direction of the sound waves coming from the channels is normal to the spherical wave front.

The angle through which sound is projected by this horn is about 60 deg. both in the vertical and the horizontal directions. For reproducing the orchestra two of these horns, each with a receiving unit, were used. They were arranged so that a horizontal angle of 120 deg. and a vertical angle of 60 deg. were covered. These angular extensions were sufficient to cover most of the seats in the hall with the loudspeaker on the stage. The vertical angle determines to a large extent the ratio of the direct to the indirect sound transmitted to the audience. The vertical angle of 60 deg. was chosen purely on the basis of judgment as to what this ratio should be for the most pleasing results.

In the design of the low-frequency receiver one of the main objectives was to reduce to a minimum variations in sound transmission resulting from variations in the throat impedance of the horn. The high-frequency horn can, however, be readily made of a size such that the throat impedance has relatively small variations within the transmitting region. On the other hand, while the diameter of the diaphragm of the low-frequency unit is only a small fraction of the wavelength, that of the high-frequency unit will have to be several wavelengths at the higher frequencies in order to be capable of generating the desired amount of sound. Unless special provisions are made there will be a loss in efficiency because of differences in phase of the sound passing to the horn from various parts of the diaphragm. The high-frequency receiver was therefore constructed so that the sound generated by the diaphragm passes through a number of annular channels. There is a sufficient number of these channels to make the distance from any part of the diaphragm to the nearest channel a small fraction of a wavelength. These channels are so proportioned that the sound waves coming through them have an amplitude and phase relation such that a substantially plane wave is formed at the throat of the horn.

The high-frequency receiver unit was also similar in construction to the 555 receiver except that the channels connecting the diaphragm to the horn were redesigned so as to transmit frequencies up to 15,000 cps. By the use of iron having high permeability at high flux density, and a compact ribbon-wound magnetizing coil considerably higher flux densities in the air gap were obtained resulting in an efficiency of over 50 per cent.

The microphones used for the transmission of music in acoustic perspective have been previously described.[3] They are of the moving-coil pressure type. From their frequency-response characteristic as measured in an open sound field for several different angles of incidence of the sound wave on the diaphragm, it is seen that the response at the higher frequencies falls off as the angle of incidence is increased. This is, in general, not a desirable property, but with the orchestral instruments as here used, the sound observed as coming from each loudspeaker is mainly that which is picked up directly in front of each microphone; sound waves incident at a large angle do not play a great part.

At certain times the sound delivered by the orchestra is of very low intensity. It is therefore important that the microphones have a sensitivity as great as possible so that the resistance and amplifier noises may be kept down to a relatively low value. At 1000 cps these microphones, without an amplifier, will deliver to a transmission line .05 microwatts when actuated by a sound wave having an intensity of one microwatt per square centimeter. This sensitivity is believed to be greater than that of microphones of other types having frequency response characteristics of comparable excellence. Æ

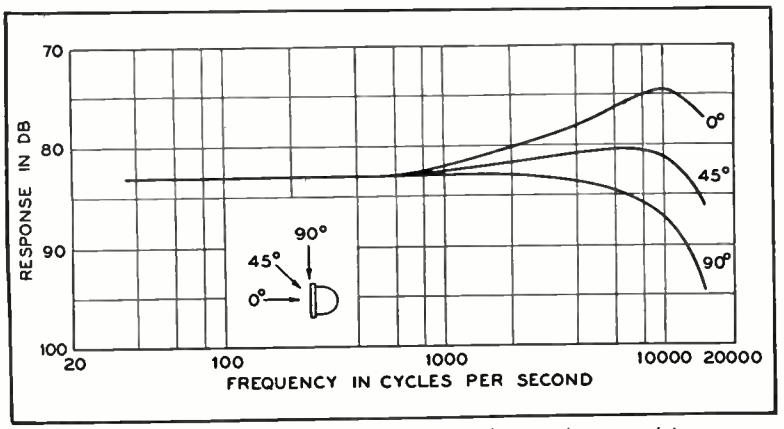
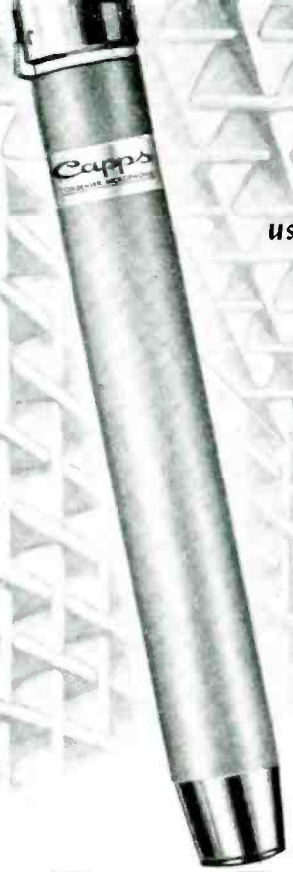


Fig. 1. Output-frequency characteristic of moving-coil microphone used in measurements on loudspeakers described.

[3] *Bell Laboratories Record;* May, 1932, p. 314.



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You simply set the indicator in 'SPEEDMINDER' position and automation takes over . . .

★ *with the standard groove stylus in play position, changer automatically operates at 78rpm.*

★ *with the microgroove stylus in position, changer automatically operates at 33 and 45rpm and . . . automatically intermixes and plays 33 and 45rpm records without regard to size or sequence.*

the new GS Seventy Seven† also offers you:

added record protection
Turntable pauses during change cycle. Resumes motion only after next record has come into play position and stylus is in lead-in groove of record. Eliminates record surface wear caused by grinding action of record dropping on moving disc – a common drawback of other record changers.

fastest change cycle
Duration of change cycle is only 5 seconds – fastest in the field.

damped, acoustically isolated arm
Shock suspension prevents vibration feedback through arm pivot. Resonance is negligible.

dynamically balanced arm
Has easily accessible vernier adjustment for stylus pressure. Stylus pressure ranges from feather-light to pressure necessary to utilize the best characteristics of any individual cartridge. Variation of stylus pressure between first and tenth record on table is less than 1 gram – lowest in the field.

arm has finger lift
Offers transcription-arm convenience. Permits manual raising and lowering of arm without stylus skidding across grooves.

arm has stylus position guide
V-shaped cut in arm head and raised indicator simplify placement of stylus in manual operation.

finger lift for 45rpm singles
Molded rubber mat slightly raises 45rpm record to permit easy removal from table. Mat designed to provide maximum traction with minimum mat-to-record surface contact.

foolproof, jamproof and trouble-free
Idler automatically disengages in 'off' position to prevent 'flat' spots. Arm movement may be restricted during change cycle without damage. Arm may be manually relocated on record during automatic play without tripping change cycle. Changer shuts off automatically after last record. May be wired to shut off amplifier, as well.

other GS Seventy Seven features include:
- Automatic *and* manual operation at all four speeds: 16, 33, 45 and 78rpm
- Automatically intermixes and plays all size records at any selected speed without regard to sequence
- Muting switch and R/C network maintain silence at all times except when record is being played
- 4-pole, hum shielded motor with balanced rotor for smooth, constant speed, shock mounted
- Single knob control sets all operations

Your high fidelity dealer now has the new GS Seventy Seven Automatic Record Changer. Be among the first to see and try it.

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OCTOBER 8 to 12, 1957

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†Patents pending

Integral Speaker Systems, Pro and Con

HERMAN BURSTEIN*

There are advantages on both sides of the question as to whether you should build your own loudspeaker enclosure—either from scratch or from a kit—or buy a complete system ready-built. The author presents arguments from either viewpoint.

THE INDIVIDUAL IN THE MARKET for a high-fidelity speaker system, either his first or an improvement upon his first, must make an important choice among two alternatives: (1), He can buy an integral system, that is, a speaker and enclosure sold as a unit—whether a built-up combination or a kit, a high-quality unit represents a careful attempt by the manufacturer to match enclosure construction and characteristics to the requirements and characteristics of the particular speaker used; or (2), He can buy the speaker of his choice separately and undertake for himself the task of finding a proper housing for it—ready-built, kit, or home-made.

The correct choice varies with the individual, with his tastes, skills, and circumstances. This article will discuss each alternative to help the audiofan decide whether in his particular case it is best to purchase an integral speaker-enclosure combination, or whether he should buy the speaker separately. Although integral units appear to be a safer bet, excellent results can be attained the other way too.

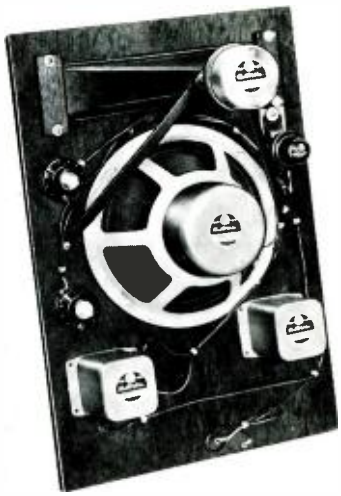
This article will consider first the advantages of buying the speaker separately. Then it will examine the merits of buying a speaker and enclosure as one. The audiophile possibly can profit from the latter discussion either by taking proper precautions when assembling his own system or by finding justification therein for purchasing an integral unit in built-up or kit form.

* *280 Twin Lane E., Wantagh, N. Y.*

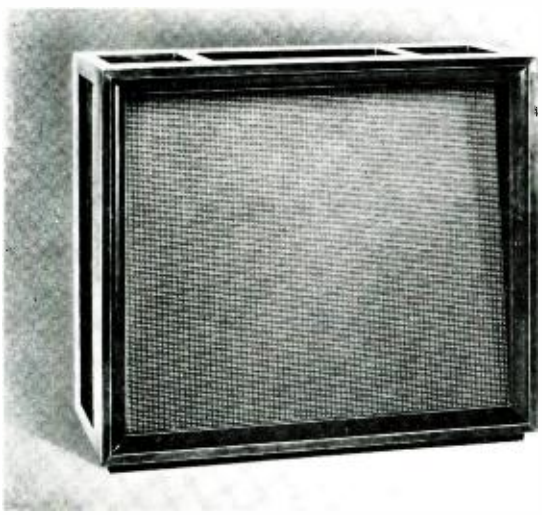
Speaker Separate

A fair to substantial sum of money can be saved by providing one's own enclosure, particularly if existing facilities serve the purpose. For example, one might utilize a closet as an infinite baffle or a boarded-up cabinet as a bass-reflex housing. If the audiofan must bring an enclosure into the listening room, the potential savings are still appreciable, for the cost of wood and finishing materials is a good deal less than the equivalent in a commercial enclosure. Even the person without advanced tools and skills can minimize his costs by assembling one of the speaker kits now available, which come in a variety of designs, such as bass-reflex, folded horn, exponential slot, and so on, and which require but a few simple tools.

Often it happens that the audiofan cannot find a commercial integral system that satisfies his (or his wife's) views on decor. More likely, he can be satisfied only by building the enclosure himself or having a cabinetmaker do this for him. Thus he can exercise his choice of exterior and interior design, woods, and fabrics. At the same time he can make sure that all is properly glued, screwed, sealed, and what not.



Simplifying the "build-your-own" speaker, this Electro-Voice system comes already mounted on a baffle and wired up.

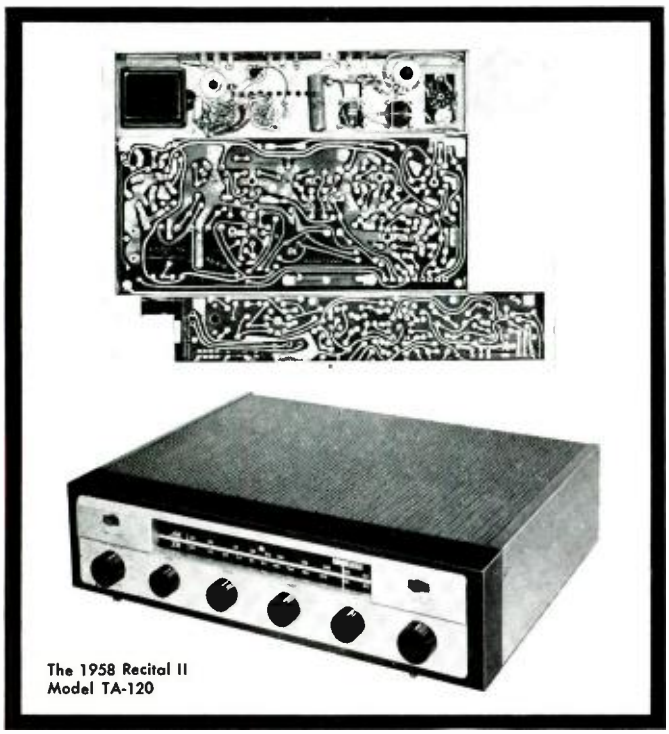


One of the newest Wharfedale Models — a complete system.

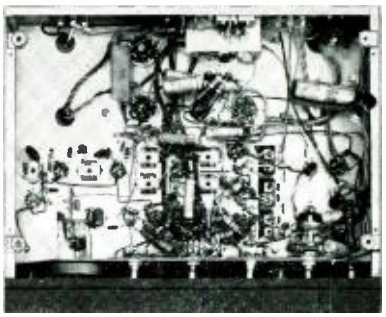
The incentive to build an enclosure may originate in the fact that nothing on the market meets the audiofan's acoustic demands. He may, for example, feel that he can obtain adequate bass or spread of sound only by a battery of speakers. Or he may have a particular horn design in mind. One of the finest bass-reproducers the writer has ever heard is built into a 12-foot wide artificial fireplace, using one 15-inch woofer and four 8-inch woofers, all horn loaded and working in push-pull. The owner is a TV audio technician.

The user may find it unnecessary to go to an integral unit because he hap-

(*Continued on page 81*)



The 1958 Recital II
Model TA-120



The Original Festival, Model D-1000
introduced in 1953

NOW and THEN

It wasn't too long ago that high fidelity was the exclusive property of the devoted few. In four short years, however, dramatic developments in technology and product design have stimulated tremendous public interest. Today — high fidelity is the new family entertainment center.

When the original Harman-Kardon Festival (*see above*) appeared, it created genuine excitement. Here was a significant new approach to high fidelity—an instrument unique in electrical design and exciting in its styling. The Festival was the first complete quality high fidelity system on a single chassis. It sparked the trend away from complicated "machinery type" instruments to the handsome coordinated units so popular today.

As most high fidelity products, the first Festivals were produced with conventional hand wiring. The precision printed wiring of the new Recital II (*see above*) contrasts sharply with the earlier maze of wires and parts.

Printed wiring, pioneered and proved in the U. S. Guided Missile and Earth Satellite programs — locks each critical component in its one best position and thereby assures exact reproduction of the engineer's design. Because this process virtually eliminates the human variable in production, each Recital II conforms to the laboratory standard in every detail. The opportunity for complete inspection provided by this technique is further guarantee of reliability and trouble-free performance. *The Recital II is guaranteed for one year from purchase date.*

Comparison of our two units reflects other significant advances. In a handsomer, more functional chassis, the Recital II incorporates a 20 watt amplifier, as did the original Festival, but with the exclusive, Controlled "II" circuitry, it operates almost 100% more efficiently. It actually creates less heat than a 10 watt amplifier of conventional design.

The Recital II includes greatly improved tone controls plus a host of additional features such as a speaker selector switch for multiple speaker systems, rumble filter and equalized high gain tape input. The FM tuner is more sensitive and more stable — the AM tuner is vastly improved.

The American Society of Industrial Designers recently selected the Recital II for official U.S. display at the Milan Triennale, world's most important exhibit of industrial design.

Further dramatic evidence of progress is its price. During a period when the price of high fidelity products has increased an average 12%, the Recital II. for $189.95, costs almost 10% less than the original Festival.

In short, today's Recital II provides more useful operating features, vastly improved performance and sensible price in a distinguished design.

Other fine features of the Recital II include: Automatic Frequency Control to insure accurate tuning automatically; sensitive AM with automatic volume control and built-in ferrite antenna; dynamic loudness contour control to provide precise balance for your own hearing characteristics; enormously effective bass and treble tone controls to adjust for the acoustics of your room, and selectable record equalization to assure correct reproduction of your entire library. Enclosure and control panel are finished in brushed copper, the knobs and control frame in matte black. The Recital II is 14-3/4" wide x 3-5/8" high x 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.

The Recital II Price is $189.95
Slightly higher in the West

P.S. Harman-Kardon's new Festival II, the Model TA-1040, is today's leader in single unit high fidelity receivers. It includes a magnificent preamplifier, an AM-FM tuner which rivals theoretical perfection and a 40 watt hum-free, distortion-free power amplifier.

FREE: *Beautiful, new fully illustrated catalogs. Describe complete Harman-Kardon component and package lines, include information on high fidelity and guides on how and where to buy high fidelity. Send for your copies to Dept. A-10 Harman-Kardon, Inc., Westbury, N. Y.*

harman kardon

The Violin and its Hi-Fi Analogies

ANTONY DOSCHEK*

Considered by many to be the most difficult instrument to reproduce properly, the violin and its construction may be compared to high-fidelity equipment. After reading this, it would seem that success in the construction of the instrument must be due to a combination of lucky accidents—almost.

PART II

THE VIOLIN BRIDGE is a curious dog. No one seems to know exactly why it is whittled out as it is, but any fiddle maker knows that it can stand practically no design change since, in reality, it is a mechanical or a structural filter as well as a transducer. I do not know enough about a pickup stylus shank and armature assembly to be able to list these as a possible HI-FI ANALOGY. But since it can be shown easily that changes in bridge design alter the harmonic structure of violin tone, it may also be possible to prove that a negative feedback effect takes place in the bridge due to a particular arrangement of the grain and design tensors. Nevertheless, the belly of the violin receives the string vibrations via the bridge and goes into a dance all of its own: which is determined by its arching, its graduation, its grain structure, its density, the position and configuration of its "f" holes, and the exact location of the bass bar and sound post. The ribs, as Borge says about the middle pedal of the piano, act to keep the belly and the back apart; having no easily defined vibratory effects of their own. But the back, which receives vibrations from the belly via the sound post, plays a very vital role in the tone quality of the instrument. Since it has no damping device, such as a bass bar, attached to it, and since its arching is flatter than that of the belly, the back is usually graduated thicker than the belly so as to inhibit its motional amplitude. Otherwise, the pressure of the player's shoulder on the back would have a much more pronounced tone alteration effect than it does. Therefore it is evident that here we have a somewhat different kind of phase-inverter resonator: one in which the sides as well as the air volume play a vital role in the production and shaping of the tone envelope. But the aforementioned elements are only the *prime* movers acting on violin tone production because, actually, *every* part of the instrument vibrates and thus contributes its own subtle and delicate effects to the composite tone.

"F" Holes

The "f" holes—HI-FI ANALOGY: Bilateral slot radiators—are very interesting in themselves since they serve the same purpose, and are subject to the same laws, as the ports in phase-inverter enclosures. Not only is their area critical but their exact shape and position affects the complex nodal patterns generated by flexures in the belly. Benjamin F. Phillips, one of a few great modern makers, winner of several international awards, neighbor, and friend of long standing, has investigated the nature of the "f" holes quite thoroughly and found that their area is indeed critical both to the character as well as the carrying qualities of the tone. He believes, on the other hand, that the port area on any given violin could be translated into rectangular slots with no effect on the quality of tone, *provided* that the nodal patterns of the belly were not disturbed by this change. Since it is impossible to make a scientifically credible demonstration of such a single variable change along the complex curves of the arching of a typical violin belly, we will have to rely on the intuition of a master maker for our "proof." Nevertheless, he does not believe that circular "f" hole ports of equivalent area would produce satisfactory results. It becomes quite clear, then, that, regardless of individual deviations from a norm of measurements, all the individual parts are mutually interdependent and, if the end result is to be acceptable, must be perfectly compatible—whatever that means relative to the art of violin making. The hitch is that no one knows how to preselect "perfectly compatible" measurements and materials when he starts out to build a fiddle or one could become "—— as rich as Stradivarius" without the inheritance. I blush to point out this HI-FI ANALOGY to those purists among you who seek the perfectly compatible audio system from jacket notes to decibels.

No one alive today who has ever heard Kreisler, Elman, or Thibaud in their prime will ever forget the sound of violin tone. In some respects it seems that the older artists valued tone quality for its own sake more than the great artists of our present generation do. Today, a concerto is too often played with a blinding heat and technical immaculacy rather than with a nobility and grand plan relying on the phrase and the aesthetic effect of gorgeously luminous tone. I do not mean to take anything away from our present artist violinists, since they certainly know fine tone and are perfectly capable of producing it—one only needs to hear Franceseatti's Mendelssohn, Stern's *Sibelius Concerto,* the Heifetz-Bruch *Scotch Fantasy,* Milstein's Goldmark, or Goldberg's Beethoven. It is the audiences at whom I point the finger, and who dictate what they want a fiddler to sound like: who take any adagio as a universally understood signal that herewith comes a splendid "coughing piece," fair prey to loud shushers and program leafers.

Tone

Violin tone as I have referred to it above is the product of the acoustical properties of the violin and the bow combined with the many, many factors influencing its subjective effect upon the listener: the artist's ability to create musical tone, the scoring and key tonality, the nature and perfection of the accompaniment, and the acoustical qualities of the concert hall. But we want a look at the fundamental nature of violin tone as well, stripped of as many influencing factors as possible. In short, we want to know about its wave envelope, its spectral distribution, its formants, and its power output. Many investigators have viewed its wave form and this data can be found represented graphically in the journals and texts on the physics of music. The wave form is so complex that it is not at all subject to visual analysis; and since it varies from note to note throughout the entire compass of the instrument it can not be said to "look like" any one thing—except itself. But a more definite picture of the tone can be gained by examining the spectral distribution of the various notes of the violin as the register varies from the lower strings to the upper positions. The lowest fundamental of which the violin is normally capable—the open G string at 196 cps—is down about 20 db from its 2nd harmonic and almost 20 db from its 3d harmonic; the 4th, 5th, and 6th harmonics are still a good 8–10 db louder than the fundamental and all harmonics up to the 13th are louder or

* *Pro-Plane Sound Systems, Inc., 1101 Western Ave., Pittsburgh, Pa.*

as loud as the fundamental. Did I hear someone say "doubling", by way of Hi-Fi Analogy? The open D string, at 294 cps, shows a fundamental some 3–5 db *greater* than the next most prominent harmonics, the 2nd and 3d, and 10 db greater than the 4th, 6th and 11th harmonics—due to the volume resonance of 270 cps, no doubt. The open A string, at 440 cps, resonates a strong fundamental and 7th harmonic, the other low-order harmonics being only about one-half to three-quarters the sound pressure of the 1st and 7th—here we also find the effect of the 450-cps secondary peak. The open E string—fundamental 659 cps—shows slightly greater amplitudes of the 3d and 8th, and appreciable amplitudes of the 2nd, 4th, 5th, 6th, 7th, and 9th. The question is sometimes asked, "What is the highest note on the violin?" There is no highest note—the fundamental E_7 at 2637 cps, quite conventionally used in Romantic and Modern scoring, has an equally strong 8th harmonic at 22,000 cps. And fundamentals of the order of 20,000 cps and more are possible by special skill and special techniques related to harmonic stopping—think where the upper partials must be. Hi-Fi Analogy: Flat to 20 kc. Haw! However, as unevenly distributed as the open string spectra seem to be, a wonderful thing happens when the chromatic scale is stopped throughout the whole compass of the instrument. The harmonic structure of each note changes form subtly and gradually so that a perfectly even gradation of timbre and sound level is the net result: something that many multiple speaker systems don't do, needless to say: Hi-Fi Analogy.

The directional pattern of the violin is quite irregular but it does not vary by more than about 10 db from any given maximum/minimum axis. Ten decibels is not an insignificant variation but some horn instruments vary by more than 20 db in this respect. The intensity level of the instrument varies from about 40 to a little over 90 db (re 10^{-16} watts/square centimeter), from usable pianissimos to fortissimos before tone break. By way of comparison, the organ dynamics vary from about 30 db to over 110 db. Since the inherent damping of a good fiddle is very high, transients and transient musical effects seem to be limited only by the expertness and facility of the performer: each generation brings someone who pushes the frontier of dazzling technique further and further, but no one has yet demonstrated that the violin was incapable of reproducing what he was capable of producing.

To return for a moment to the resonances, harmonics, upper partials, or what have you, generated by the violin: if one examines an accurately plotted graph of these it will be evident that they tend to cluster around prominent peaks. Furthermore, a very careful—and tedious—harmonic analysis will show that harmonics foreign to the exciting fundamental are also present in the clusters and must evidently affect the tone. Such clusters and their intruders are known as *formants,* and although we know that they are essential to musical sounds, and that they constitute the definitive criteria of "good" and "bad" musical tone, we know very little about how to place them into a position of influence—though Heaven knows we can't avoid them in the wrong places. We know, for example, that only the position of the formant series, or cluster, stands in the way of duplicating the finest Strads or Guarnieris—but all the technological skill and precision workmanship at our disposal can do nothing about it. It has been tried by experts!

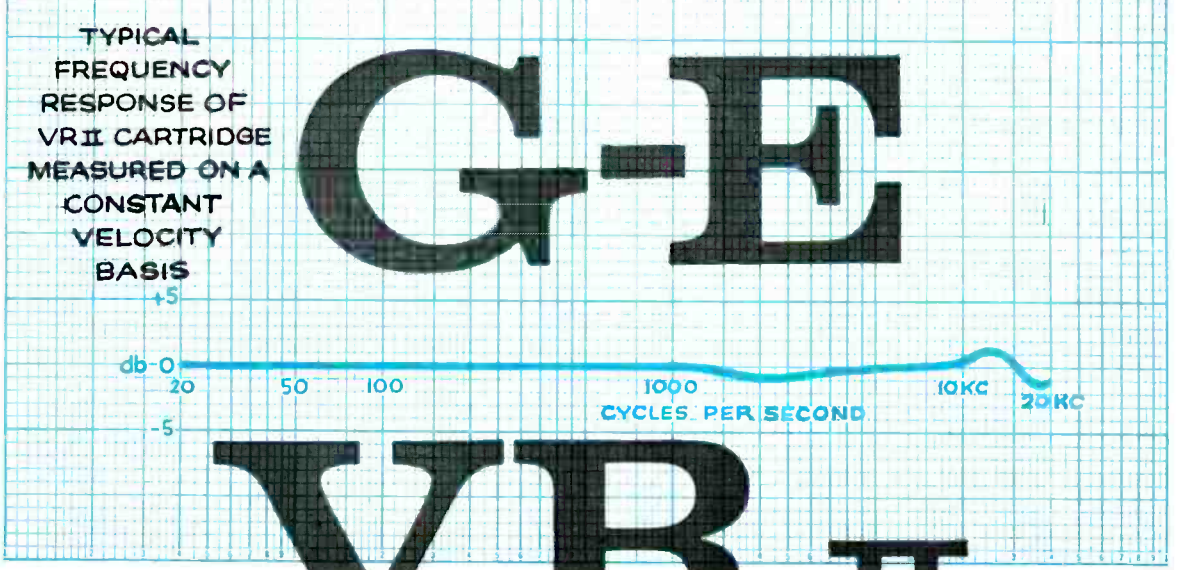
The Bow

And all this time that I have been scribbling away about the fiddle, the lowly "stick" or bow was laying by: if one can call something that costs as much as three thousand dollars "lowly." I said nothing about it not because I hope to ignore this indispensable item

of a fiddler's equipment but because I know that I know far less about the bow than I would like to believe I know about the fiddle. I know, for example, that there are "good" bows and "bad" bows—and that's it. But I also know that a nationally known pedagogue and teacher, Paul Sladek, (a one time pupil of Auer and Kreisler) and I spent several days with a collection of six or seven very fine bows, which had all been rehaired from the same shock, trying to discover why every one of them imparted a distinctly different tone quality to the same violin. We tried to equalize matters by tensing the bowhairs differently and by adding or rubbing off resin, but we learned nothing of scientific value. We did learn, however, that a bow fits a fiddle like—Hi-Fi Analogy—a cartridge fits a tone arm (for the purest of the purists, only). We know, of course—and all fiddlers know—that a bow must also suit the preference of the individual as regards its weight, balance, and school of technique with which it will be used; but, aside from that, the bow actually alters the tone of the violin and Paul and I still don't know why it should. Incidentally, all the bows with which we worked were made of Pernambuco wood, and we even taped the sound to see if it could be distinguished on the playback: it could. Can it be that

(*Continued on page 78*)

NEW G-E VR II



A dramatic new cartridge to bring you new heights in Hi-Fi performance!

New Full-range Reproduction General Electric's new VR II magnetic cartridge makes possible "faithful" reproduction from 20 through 20,000 cycles.

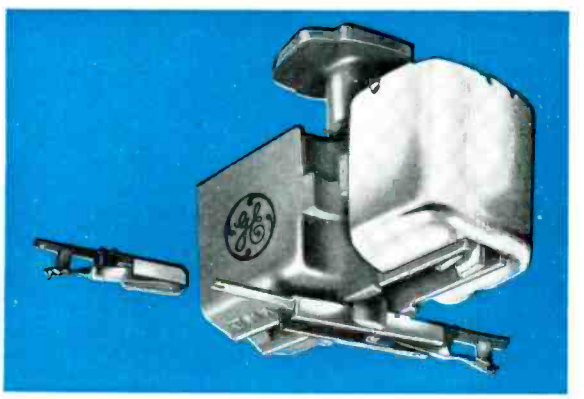
New 4-Gram Tracking Force Lateral compliance of the VR II has been extended to 1.7 x 10^{-6} cm. per dyne, permitting a tracking force of only 4 grams to minimize record and stylus wear.

Instant CLIP-IN-TIP Stylus Stylus replacements can be made instantly at home without removing cartridge from tone arm. There is no need to discard an entire dual assembly when only one tip is worn.

New Electrostatic Shielding In the VR II cartridge a new electrostatic shielding prevents pickup of electrostatic interferences and hum. This shield also grounds the stylus assembly, thus preventing the build-up of electrostatic charges from the surface of the record.

New Lightweight Construction The microscopic precision and strong, lightweight construction of General Electric's new VR II assures you continued pleasure and satisfaction under the most exacting conditions.

Hear the difference! Ask for a demonstration at your Hi-Fi dealer's, but be sure to insist on a *genuine* G-E VR II!



For further information write to: Specialty Electronic Components Dept., Section HFA1057 West Genesee Street, Auburn, New York.

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GENERAL ELECTRIC

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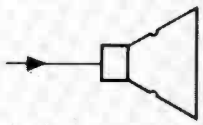
Now you can select your Jensen loudspeaker

New Performance Levels in New Price Ranges

UNAX* SINGLE ELEMENT



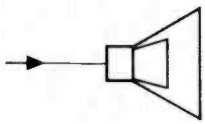
The new Jensen UX Series provides a new high in single-cone single voice coil loudspeakers at unusually low cost, actually outperforming comparable (and even more complex) units selling for much more. A listening test will convince you that this is a maximum value buy in hi-fi listening pleasure.

Of course, there are special design elements that enable us to give so much for so little. The cone is artfully dual acting, the center sector operating effectively for unusually extended highs, while the whole moves to reproduce the lows.

Withal, there is superb baiance and cleanness. And, if you choose, you can step up performance later with the inexpensive KTX-2 Step-Up Kit which substitutes a compression driver tweeter for the top.

UX-80. 8-in. Speaker. Net **$14.50**
UX-120. 12-in. Speaker. Net **$19.50**

DUAX* 2-ELEMENT SYSTEMS

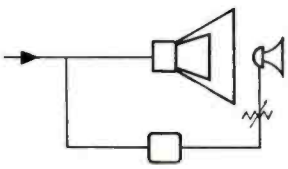


A step-up in the reproduction scale is the DX Series in which two carefully coordinated cones are driven by one voice coil. (Some call these "coaxials," but we reserve the name for still more elaborate systems and higher performance.)

The separate auxiliary radiator gives the designer a chance to attain a wider frequency range than with a single cone (albeit dual acting as in UX Series). The result is, with low cost, additional performance and added listening pleasure. We know of no similar speakers with equal sound, none with as high efficiency or as low distortion at anywhere near DX Series cost. Again you can step-up performance easily at anytime with KTX-2 Kit to substitute high-order compression driver tweeter operation at the high end.

DX-120. 12"; 1-lb. mag. Net **$25.50**
DX-150. 15"; 1-lb. mag. Net **$35.50**

COAXIAL 3-ELEMENT SYSTEMS



Still better than the "all paper" system with single voice coil is the use of a compression driver tweeter for the highs. The least expensive way to do this is to nestle a supertweeter coaxially inside the cone; it must cross over high in the frequency scale at 3500 to 4000 cycles. The third element is the diffusion radiator which shapes and disperses middle-high response. (Some call such speakers "Triaxial," though Jensen alone is entitled to use this registered name, applied by us to true 3-way speakers only.) Again, we guarantee more and better sound, cleaner hi-fi at lower cost, than all comparable speakers. And you can step up performance correctly and impressively with a real C.D. horn 600-4000 cps mid-channel (KTX-3 Kit) that leaves you with a *real* 3-way system.

12" Models. CX-120*.....**$49.50**
CX-225.....**$59.50**
15" Models. CX-150*.....**$66.50**
CX-255.....**$76.50**
*Denotes 1-lb. magnet; others 1¾ lbs.

SELECTING A HI-FI SPEAKER? YOU'LL WANT THESE HELPFUL, INFORMATIVE BOOKS

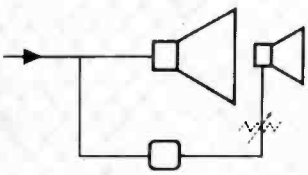
"How to Select a High Fidelity Loudspeaker?" A comprehensive, authoritative manual covering all types of high fidelity loudspeakers and systems, their operating principles, performance and relative advantages. 24 pages, profusely illustrated. Write for Manual 1061. Price 25¢.
"Guide to Jensen High Fidelity Loudspeakers." Complete specifications and detailed descriptive information on all Jensen high fidelity loudspeakers and accessories. 24 pages. Send for Brochure 1021. Price 25¢.

High Fidelity Loudspeaker Line

from this new complete range of types and sizes.

. . . All with Traditional Jensen Quality

COAXIAL 2-WAY SYSTEMS

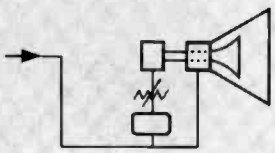


By using two completely independent (but carefully coordinated) speakers, each with its own magnetic system, voice coil and cone, the true two-way system spans the frequency range to obvious advantage in smoothness and extent, cleanness, low distortion and uniformity of angular dispersion.

Coaxial mounting makes them a convenient unitary package. Please note that we at Jensen use the term "coaxial" only in referring to a speaker with two completely independent systems.

Lowest in cost in the Jensen coaxial family is this fine group of speakers employing "cone" type direct radiator units for both tweeter and woofer. Available in 8, 12 and 15-inch models, they provide a maximum of value in true two-way system speakers.

K-80. Coaxial, 8-in. Net **$16.75**
K-210. Coaxial, 12-in. Net **$27.50**
K-310A. Coaxial, 15-in. Net **$39.75**



The highest type of performance in the coaxial two-way loudspeaker is attained by the use of a compression-driver horn-loaded tweeter for the high end. When properly designed, there results an outstanding clarity, realism and instrumental separation not achieved by lesser designs. By adopting the expensive "thru bore" construction, the tweeter horn can be made long enough to operate at the lowest practicable crossover frequency, a very desirable feature for the very best sound.

In this manner, the very popular Jensen H-222 and H-520 give you the "tops" in fine coaxial performance. Crossover is at 2000 cycles. Though many will see no need to, you can step-up performance to full three-way with KTX-1 Range-Extender Supertweeter Kit.

H-222. Coaxial, 12-in. Net. **$62.50**
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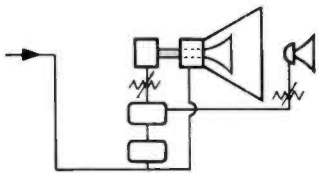
TRIAXIAL* & TRIAX* 3-WAY SYSTEMS



The true three-way speaker system divides the range in three parts with three electrically and acoustically distinct and independent elements, each designed to perform near-ideally in its portion of the range.

The famous G-610A TRIAXIAL was the first (and until our new G-600), *the only speaker made in accordance with this concept!* It employs a heavy woofer and two compression driver horn-loaded elements for m-f, and h-f channels. (The woofer cone acts as the final section of the m-f horn.) Its performance is so outstanding that it easily rates as the world's most wanted hi-fi speaker.

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BURTON BROWNE ADVERTISING

Equipment Review

Garrard TPA-10 transcription arm—Stephens FR-80 loudspeaker—Pilot AA-920 and AA-903B amplifiers—Metzner Starlight transcription turntable and arm—Electro-sonic Laboratories' "Dust Bug"—Tape-Indx and Perma-File tape logging system

GARRARD TPA-10 TRANSCRIPTION ARM

Two of the limitations heretofore placed on the user of high-quality transcription arms have been those of a fixed angle or bend in the arm and a fixed length from pivot to stylus tip. Both of these limitations have been removed finally, thanks to the design of the new Garrard TPA-10 transcription arm. This arm is sufficiently adjustable in over-all length to be accommodated in the smallest turntable enclosures that can be used with 12-inch records, and the head angle is adjustable over a range of about 260 deg. Not that such a radical change in angle should ever be required, but if ever a pickup manufacturer brings out a model in which the record-groove travel is perpendicular to the long axis of the pickup housing, this arm will accommodate it.

Aside from these features, however, which may be considered unnecessary in many instances, the TPA-10 incorporates a number of other advantages which are more tangible in effect. Among them, the most important are—in our opinion—a super-sensitive adjustment of stylus force, and low-friction bearings on both vertical and horizontal axes, neither of which ever requires any adjustment.

The horizontal bearing—probably the most important in the construction of any pickup arm—consists of two needle-point pivot pins which seat on miniature ball bearings. This is not in itself unusual, for many other pickup arms have been built using ball bearings, but so far most have required a rather accurate adjustment of the pressure of the pivot into the bearings. If the pressure were too light, there was excessive play, and if it were too heavy it was likely to cause rapid wear of the ball bearings and cup, with consequent loss in performance as the unit was used.

On the new Garrard arm, however, one pivot is fixed in the bracket while the other has a fixed pressure loading applied by means of a coil spring. This ensures the proper pressure being applied between the pivot and the ball bearings at all times, regardless of wear—which should be at an absolute minimum because of the hardness of both pivot and the balls. The vertical pivot is composed of a combination of a single ball thrust bearing, such as is used in the better turntables, and a ball bearing journal.

As will be noted from *Fig.* 1, the horizontal bearing is at an angle with the arm itself, a feature which gives a longer suspension between the pivot points and thus greater stability. As the arm is telescoped within itself to adjust length, a compensating spring maintains the balance of the arm quite closely—so close, in fact, that movement of the arm from maximum to minimum length results in a variation of stylus force, at a given setting, of only 1 gram from a starting setting of 6 grams. "Vernier" adjustment of stylus force is made by varying the tension of a hair spring enclosed in the horizontal pivot housing, and the range is such that a GE cartridge, for example, may be balanced to zero tracking force or increased to as much as 15 grams.

The pickup head is so arranged that it may be rotated over almost ¾ of a circle—far more than would ever be required. Yet with all the flexibility of arm length and head angle, even the most inexperienced user should have no trouble in adjusting the arm for optimum tracking because of the simplification provided by the mounting and adjusting templates.

Three such templates are furnished—one indicates the exact location of the base for given settings of arm length, a second is the actual layout of the opening to be made in the motor board to accommodate the arm, and the third shows the angle to which the head should be set for minimum tracking error.

The locating template has five slots, one for each of the marked positions of the telescoping arm. It is recommended that the longest possible arm be used that can be accommodated in the record player cabinet, and once having selected the arm length, the slot corresponding to that length is placed over the turntable spindle, whereupon the center point of the arm is located on the motor board. At the same time, a second template is placed under the first and lined up with its edge, and the holes may then be spotted from the second template. After the arm is mounted, the third template is placed over the center spindle and the stylus placed in a small eyelet which pivots a portion of the template on which is shown the outline of the head. When the head and the outline coincide, the tracking error for that particular diameter is indicated on the scale. Thus the head may be set for minimum tracking error at either outside or inside of the record, or at any intermediate point—one particular position being recommended and so marked on the template.

All in all the arm provides a high degree of flexibility together with excellent workmanship and intelligent design. For those who are inclined to experiment it is almost essential—for those who just want a fine arm it should be accepted readily. **K-20**

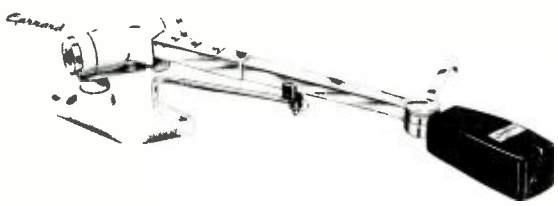

Fig. 1. Garrard TPA-10 transcription arm.

STEPHENS FR-80 LOUDSPEAKER

In this day of newer and smaller loudspeaker enclosures practically every other month, one soon develops a jaundiced eye since there is likely to be relatively little difference between them—most being notable for their lack of bass, or if they do have bass it is boomy. However, the new Stephens FR-80 speaker unit mounted in their 811 cabinet is a welcome change from many others we have heard—and declined to review—over the past six months. This model has clean, crisp bass response which is comparable with the speaker we consider our "Standard" and with a complete absence of any noticeable peak in the lower range so that it is possible to bring up the bass response without objectionable booming as the bass boost is added.

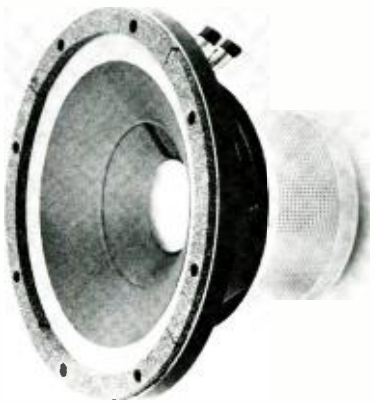

Fig. 2. Stephens FR-80 speaker mechanism—an entirely new 8-inch model

Now we do not mean to say that the bass response is directly comparable in *level* with the Standard speaker, but instead that the character of the sound is similar so that one might well describe the FR-80 bass as "solid."

Presumably, the quality of sound radiated from the new model is the result of construction features of the speaker mechanism itself. This unit, shown in *Fig.* 2, employs a plastic-impregnated fabric surround which holds the cone to the frame and provides strength, flexibility, and durability which—Stephens claims—has "never before been attained in any speaker of any size." Be that as it may, the results seem to indicate that this unit is unusually good in performance, and the surround may have something to do with it. In addition, however, there are some other features which may have something to do with it also. For example, the construction of the speaker includes an internal air damping system which introduces "controlled cushioning," and the magnet has a weight of one pound, in itself somewhat above average for an 8-in. unit. The cone is curvilinear in shape to provide graduated decoupling to reduce resonances, and the frame is die cast and provided with a cork-rubber compound gasket to provide a tight seal be-

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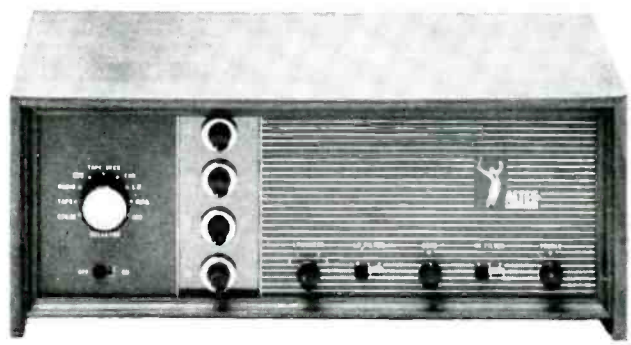

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Four Major Source Volume Controls allow you to *pre-set* the level of any major program material and change from input to input or turn the power on and off without the necessity for readjustment. D. C. powered program indicator lights for completely hum-free operation.

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

Four Position loudness compensation control... continuously variable wide range bass and treble controls...*Three Position* independent rumble and scratch filters—all designed to give complete flexibility to suit reproduction quality of individual tastes and material.

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

Equalization—4 phono compensation curves: European, LP, RIAA, and 78 rpm. 1 tape deck compensation.

Quality Construction—an example of the quality built into the "Quartet" is its "professional" printed circuit. Unlike common printed circuits, all components are attached through riveted eyelets making it possible to replace components without destroying the circuit.

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12-4

Fig. 3. The Stephens 811 enclosure, which was used for listening tests on the FR-80.

tween speaker and baffle. Still one more feature is the use of edgewise-wound aluminum ribbon for its 2-in. voice coil.

We had the pleasure of visiting the Stephens plant last February when the early development work was being done on this model—although we didn't know at the time what the final model was to be. We did see, however, something new in the method of winding the voice coil and we saw what a sturdy coil the new method made. This is apparently one of the times when theory is thoroughly borne out by practice. The speaker has a free-air resonance at 50 cps, and is claimed to reproduce from 40 to 15,000 cps.

The cabinet in which this model was tested is 23¾ in. high, 15¾ in. wide, and 11¾ in. deep—a rather small enclosure. It is simple and neat in appearance, as seen in *Fig.* 3, and might easily be described as unobtrusive. The important statement to be made about any speaker-enclosure combination relates simply to its quality, and this one we would unhesitatingly place high on the list.

Efficiency is slightly lower than some of the larger and much more expensive units—but not so much so that it would be considered a "low-efficiency" model—we would say it is about average for an 8-in. unit. But the final word is that it is good, for whatever contributing reasons. **K-21**

PILOT AA-920 and AA-903B AMPLIFIERS

Differing basically only in power output, these two amplifiers are equipped with features which add up to a good overall design, smooth control operation, and distortion commensurate with the output tubes employed. The output stage of the AA-920 employs two 6L6GB's working at a plate potential of 380 volts and a consequent power output (claimed by the manufacturer) of 20 watts. However, this rating is at an intermodulation distortion of 1.5 per cent, while AUDIO rates power output at the point where IM distortion reaches 2 per cent, and in the case of the AA-920 this measures 24 watts. The smaller AA-903B employs two EL84's with fixed bias in the output stage at a plate supply of 300 volts and a claimed output of 14 watts at 1.5 per cent distortion; it was measured at 16 watts for 2 per cent IM. The AA-920 uses a 5Y3GT rectifier, while the AA-903B uses an EZ81. One other difference is in the power amplifier section—the 920 employs a 6C4 as a voltage amplifier and a 12AU7 as a "Williamson type" direct coupled pair, the first section as an amplifier and the second as a cathodyne or split-load phase splitter. The 903B uses a 12AX7 with the first half serving as a voltage amplifier and the second as a paraphase type phase splitter. The remaining difference is in the rumble and scratch filters—the 920 has 3-position filters while the 903B has 2-position filters. The preamplifier and tone-control sections are identical, and even the appearances of the two amplifiers from the outside are almost identical—both measuring 4¾ in. high, 13¼ in. wide, and 9 in. deep, and both use the same protective cage housing. Both employ 21 db of feedback in the power amplifier section, and both have output impedances of 4, 8, and 16 ohms.

Starting at the phono input, we first encounter one feature that has been standard with Pilot amplifiers for several years—the variable load resistor for magnetic pickups. This consists of a 6800-ohm fixed resistor in series with a 100K-ohm potentiometer calibrated directly in ohms. This permits the user to select any value of load from 6800 ohms to 106,800. Actually, we have never been able to understand fully why amplifier manufacturers do not offer impedances of, say, 500K ohms, with the correct terminating resistor being placed at the pickup by the pickup manufacturer. On the other hand, of course, high-frequency rolloff for many types of pickups is specified to be obtained by the use of load resistors of given values, and when employed with preamps which do not provide any rolloff at all this method allows the user to set the rolloff exclusively by means of the load resistor.

The phono preamp consists of two stages, the two halves of a 12AX7, with passive equalization networks between them. This method has the advantage of reducing the possibility of overloading the second stage when using the high-output magnetic cartridges—a condition that often results in poor output quality with the cause being almost indeterminate. Another advantage of the Pilot circuits is the inclusion of a potentiometer *ahead* of the first stage of the preamplifier to permit lowering the voltage applied and still further reducing the possibility of preamp overload.

Equalization is provided for LP, AES, RIAA, and NAB curves, together with another position direct from a tape playback head. In this position the input is switched to a separate jack so that connections from phono and tape head may be left plugged in permanently.

The output of the preamplifier section is fed to the input selector switch, which also accommodates tuner, auxiliary, and tape amplifier inputs at high level. This switch is followed in turn by the first section of the two-section volume control, and it is followed by the loudness contour switch which has five positions and provides for flat response and for four different degrees of loudness compensation. While we have not always agreed in principle with the loudness contour type of compensation, it must be admitted that the user is likely to do his listening under conditions where he wants either full volume, with its attendant flat response curve, or at some other volume level dictated by neighbors, hours of listening, or whether or not the music is being listened to carefully or is employed as a background to other activities. Since the given condition is not likely to change rapidly, it does seem logical that the control might just as well be calibrated for these differing listening conditions, and when set to accommodate one or the other of the conditions it would remain so for an extended period of time. Be that as it may, some people will still not accept the loudness control, and they may easily leave the contour control on the flat position permanently. We still believe firmly however, that high fidelity can well date its acceptance into the home—as contrasted to the gadget room—with the introduction of the loudness control, for early hi-fi fans were criticized most frequently for playing their rigs too loud always. But that is philosophising again.

The tone-control section is located between the two halves of another 12AX7, and is of the "Sterling" type with lossers in both frequency-correcting networks. Range of the controls is ± 18 db at 20 and 20,000 cps. In both of these amplifiers the preamplifier and tone-control stages have their heaters supplied from a d.c. source consisting of a full-wave selenium rectifier and adequate filtering. In addition, the amplifier-and-phase-splitter tube is fed from this same source, resulting in a hum output of the order of 68 db below one watt, which is essentially inaudible.

In appearance and performance these amplifiers are rated excellent. One advantage of the circuit as described is that with the addition of either of these amplifiers and a stereo head to the tape recorder, one has the "makings" of a complete stereo conversion to an existing installation. The best way to choose amplifiers is to listen—and it is believed that either of these amplifiers would give a satisfactory account of itself. **K-22**

Fig. 4. The new Pilot AA-920 amplifier—a 20-watt unit. The AA-903B is similar in appearance.

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WEATHERS FM Pickup System is the only pickup designed and balanced at a stylus force of ONE-GRAM. For this reason, it perfectly traces all the minute record engravings which produce delicate overtones and represent sound with true fidelity. It causes no flexing of groove sidewalls, thereby improving response to high frequencies without increasing surface noise.

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Improper stylus force can ruin high fidelity qualities of your records at the very first play. WEATHERS, the lightest, professional touch, shows no record wear even after a thousand plays. Your favorite records, your valuable records will last a lifetime—and still sound new! A sapphire stylus on a Weathers pickup will last longer than a diamond stylus on ordinary pickups.

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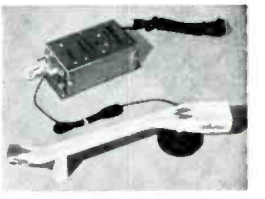
WEATHERS FM Pickup System is free of all common causes of sound distortion. It does not pick up hum from motors, it tracks perfectly even if your turntable is tilted to a 45° angle, no leveling necessary! Accidentally dropped, WEATHERS pickup floats with feathery ease onto your record. Weathers pickup is shock-mounted...eliminates mechanical vibration and acoustic feedback.



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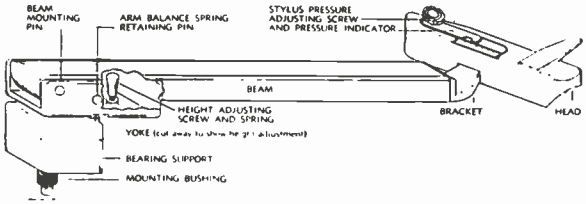

Fig. 5 (left). Metzner "Starlight" transcriptian turntable—a cantinuously-variable-speed unit adjustable fram 15 to 90 rpm. Fig. 6 (abave). Diagram of the Metzner arm. Vertical pivot is a ball bearing, while pickup head is pivated on end af arm, which also raises to change cartridges ar clean styli.

METZNER "STARLIGHT" TURNTABLE

There are still many users of high fidelity equipment to whom the need for a continuously variable turntable speed appears important—fortunately most of us who are not gifted with absolute pitch can get along with turntable speeds which are considered standard. However, when the need for continuously variable speeds does occur, it can only be filled by a machine that will provide any speed from, say, 15 to 90 rpm.

However, it is not necessary that one have some special use to which he would put a variable-speed turntable for him to select this type for a more normal installation, particularly when the unit under consideration has the features and characteristics of the Metzner Starlight, *Fig.* 5. It would seem that the only difficulty in using a variable-speed turntable for normal-speed operation would be the always present doubt that the unit were actually running at the correct speed. The stroboscope on the underside of the Starlight platter—illuminated by a neon lamp and visible from the top through a mirror—always keeps you reminded of accurate speed settings.

Many readers will not remember the old Brush automobile transmission in which a flat plate mounted on a fore-and-aft axis drove a leather-faced wheel which made contact anywhere from slightly beyond the center on one side (to provide for backing up) to the outer edge of the plate on the other side of the center for full speed ahead. The cross shaft ended at either side of the car with sprockets which drove, through chains, the two rear wheels. The Starlight is a modern adaptation of the same speed-change principle, and the range covers from 15 to 90 rpm smoothly and continuously. Otherwise it is much like conventional turntables. Flutter and wow are acceptably low, and rumble measures approximately 51 db below a 20-cm/sec signal. A calibrated scale gives approximate speeds (within 1 or 2 rpm) and the stroboscope permits setting the speeds accurately. The unit is attractively finished, with a satin finished mounting plate and cork-and-rubber turntable cover.

The Metzner arm is shown in diagram form in *Fig.* 6. The most unusual feature of this arm is the pivoted head at the end of an arm which also raises—when the arm comes to its stop, the head pivot takes over. The head itself is shown in *Fig.* 7 in cross section. A movable weight, which consists of a number of separate parts so as to provide a wide range of adjustment, is arranged to slide backward or forward, with a satin-finished mounting plate and scale. Typically, a cartridge would be installed and checked for balancing to proper stylus force with the movable weight at the center. If it did not come close to the normal force, the weight could be reduced by removal of one or more sections. Fine adjustment could then be made by moving the weight itself. The range of adjustment extended from 0 to 18 grams with a GE pickup installed, using the entire weight. The arm mounting position is arranged to be $9\frac{31}{32}$ in. from the center of the turntable spindle.

One interesting feature of the arm is the ease with which the stylus is lifted from the record groove—simply press down on the adjustment knob at the back of the head. This is easy to do without the chance of sliding the stylus over the surface for two or three grooves as the cartridge is lifted.

The Starlight and its matching arm provide an exceptionally attractive combination, and together they do provide variable speed operation when such a requirement exists. **K-23**

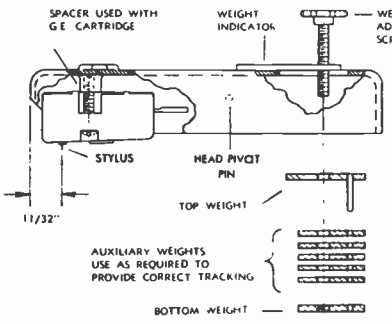

Fig. 7. Sectianal drawing of the head an the Metzner arm. Weights may be removed to accommodate even the lightest cartridges.

ELECTRO-SONIC LABORATORIES' "DUST BUG"

Simple and almost primitive in construction, the British-built "Dust Bug" provides a means for cleaning records easily and effectively while playing, and also gives an anti-static protection at the same time.

This device, *Fig.* 8, consists of a plastic arm on which are mounted a fairly stiff brush and a cylinder of what appears to be a piece of fine textured carpeting, the cylinder being pivoted so as to be able to rise and fall slightly. In use the brush is placed in the starting grooves of a record before the stylus is lowered to its surface. The cylinder of carpeting, having first been given a light dousing with an anti-static solution, follows the brush and very slightly coats the surface with the solution just after the brush removes the dust and lint from the grooves. The brush also has the function of tracking the Dust Bug across the record just as a stylus does with the usual pickup arm.

The anti-static solution is ethylene glycol—permanent anti-freeze to northerners—which is either dyed blue to identify it or else that is its normal color in England. In any case, it does remove—or at least reduce—the static charge on the record surface and after a half dozen plays the surface of the disc looks exactly like a new, unplayed record. Noise, pops, and clicks are gone also, which is, of course, the basic reason for the device.

The plastic arm is drilled in two places to accommodate both 16- and 12-inch turntables, and the entire unit is mounted on the motor-board by means of a rubber suction cup. Light, fairly inexpensive, and very effective is this device, a development of Cecil Watts, who is recognized as one of the authorities on phonograph equipment in England. This device is highly recommended and it seems to us as though it should be on every turntable—even though it does add a little work to getting a record played. From the clean record surfaces, though, it seems to be worth the extra trouble. **K-24**

Fig. 8. Electro-Sanic Labaratories' "Dust Bug"—a simple and effective device to remove dust and lint from record grooves and to destaticize the entire surface.

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And now, the new 604D has even smoother response and lower distortion.

It incorporates a more highly developed dividing network with smooth twelve db per octave attenuation, plus a new shelving control adjustable to every individual room condition.

Other outstanding design features of the new 604D Duplex are: improved bass cone and suspension, smoother high end quality, and redesigned pole-piece for a deeper magnetic gap and even less low frequency distortion.

The result is the most *faithful* reproduction of sound obtainable with a coaxial speaker. Transients are virtually eliminated.

Besides its new features, the 604D still has these time-proven elements: annular centering spider and viscous damped compliance . . . an edge-wound, double-insulated ribbon bass voice-coil which moves in an extremely deep magnetic gap in order to assure the same efficiency throughout its excursion . . . fatigue resistant tangential compliance high frequency diaphragm with exponential multicellar horn.

Power: 35 watts (50 peak); Guaranteed Frequency Response: 30 to 22,000 cycles; Impedance: 16 ohms; Magnet Weight: 5.6 lbs.; Max. Cone Resonance: 40 cycles; Distribution: 90° hor., 40° vert.; Diameter: 15-3/16; Depth: 11-1/8. Price: $177.00 (including network).

the 602B *Features NEW HORN and DRIVER*

The latest major development in the long line of ALTEC coaxial type speakers, the 602B nearly equals the 604.

The 602B features a newly developed 3000 cycle high frequency driver with an improved magnetic structure for increased efficiency coupled to an amazingly smooth exponential sectoral horn. This type of horn, consistently used by ALTEC, produces the most *natural* reproduction of sound of any high frequency speaker so far developed.

This outstanding high frequency unit and horn are mounted asymmetrically within the frame of the base speaker to form a two-way speaker capable of reproducing a guaranteed range of 30 to 22,000 cycles.

Power: 25 watts (30 peak); Impedance: 8 ohms; Magnet Weight: 2.4 lbs.; Max. Cone Resonance: 42 cycles; Distribution: 90° hor., 40° vert.; Diameter: 15-3/16"; Depth: 7-1/4". Price: $135.00 (including network).

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The 601B is designed with all of the professional features found in the larger ALTEC duplexes.

Like its larger brothers, the 601B has an improved bass cone for even smoother response and lower distortion and an improved high frequency driver of much greater efficiency. It also has a new heavy cast frame like the 604D and 602B which provides a rigid suspension for the bass cone making it impossible for the voice coil to become uncentered in the magnetic gap.

Power: 20 watts (30 watts peak); Frequency Response: 40 to 22,000 cycles; Impedance: 8 ohms; Magnet Weight: 1.8 lbs.; Max. Cone Resonance: 55 cycles; Distribution: 90° hor., 40° vert.; Diameter: 12-1/4"; Depth: 5-5/8". Price: $114.00 (including network).

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The new Fairchild E/D achieves an almost incredible quality of performance. Completely independent of power line variations, its speed is precisely regulated and controlled by means of an electronic power source. Rumble, wow and flutter are virtually non-existent. There isn't a trace of distortion or noise to mar the flawless reproduction of the finest modern recordings.

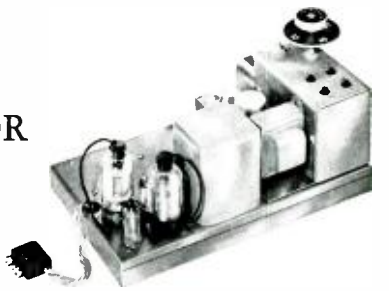
THE MOST IMPORTANT SINGLE ADVANCE EVER MADE IN TURNTABLE DESIGN

Never before has there been a turntable of such precision and quality of performance. Through the combined, effective use of modern electronics and acoustical filtering techniques, Fairchild engineers have succeeded in isolating, and virtually eliminating all of the principle causes of turntable distortion. Here are some of the quality-contributing factors:

- precision machined, Densite-damped cast aluminum turntable coupled to a
- hysteresis-synchronous motor by means of a
- specially designed, 2-stage belt drive which
- reduces motor-to-table transmission of noise and vibration by more than 40db.
- speed is selected, controlled and regulated electronically to an
- accuracy and constancy of ±0.15%
- regardless of variations in power line voltage and frequency.

HOW IT WORKS...

In conventional turntables and in record changers the motor operates at one speed. Changes in turntable rpm are effected mechanically – by step-pulleys, gears, cams, rubber wheels, and other moving parts. In the new Fairchild E/D turntable speed is changed by changing the speed of the motor. And the speed of the motor is changed by altering the frequency of the operating current.



THE ELECTRONIC CONTROL-REGULATOR

is a variable frequency, voltage-regulated oscillator-amplifier with an unusually high order of stability. It can be operated from any AC power line from 85 to 135 volts without regard to frequency. It can be operated with DC, using a simple AC converter, and from storage batteries with an ordinary vibrator-type inverter. The quality and stability of the output are the same in all instances.

The ECR is connected directly to, and operates the turntable motor. It delivers current at any one of four frequencies: 30, 60, 81 and 141 cycles. With the turntable speed selector set for 16⅔ rpm, the ECR output frequency is 30 cycles. At 33⅓ rpm, the frequency is 60 cycles – and so on through 45 and 78 rpm. Each speed also has its own electronic vernier control of ±5%.

THE TURNTABLE UNIT

consists of the hysteresis motor, the belt transmission, the turntable, and the enclosure for the Electronic Control-Regulator, all mounted on a unitized chassis. Without the ECR, the Turntable Unit is a complete, high quality, single speed 33⅓ turntable, and can be operated directly from a 60-cycle power line. The Turntable Unit can, in fact, be purchased separately, and the ECR obtained at a later date. It is easily mounted in the enclosure with an ordinary screwdriver.

FAIRCHILD E/D *performance ratings surpass all industry standards*

RUMBLE CONTENT	100% better than NARTB standards
FLUTTER CONTENT	100% better than NARTB standards
SPEED REGULATION	100% better than NARTB standards

(These ratings surpass specified standards for primary professional recording equipment.)

FAIRCHILD E/D Complete 4-speed system	$186.50
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HARDWOOD BASE (shock-mounted) walnut, mahogany or korina	31.50

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CHARLES A. ROBERTSON*

The Magnificent Thad Jones, Vol. 3

Blue Note 1546

Already firmly established as a challenging figure on trumpet, Thad Jones gains considerable stature in his third LP on this label as the leader of a small group. The deep-rooted vigor of the Basie sideman flourishes on four numbers with a sextet and reaches prime state in his solo interpretation of *I've Got a Crush on You*. His unfolding of some latent beauties in the verse and chorus of the Gershwin tunes bids fair to make this record a jazz classic.

It is also representative of the work optometrist-engineer Dr. Rudolph Van Gelder does for several companies in the studio of his Hackensack home and elsewhere. A jazz enthusiast and electronics hobbyist since high school days, he began to make a career of his two avocations in the early days of L.P. When interviewed at his home, on a comparatively calm day set aside for mastering, he recalled: "The new medium brought about a big change for the jazz companies. Though there were many problems they were not equipped to handle, the opportunities for those with foresight were great. It became possible for the independent to make records that really meant something. I was fortunate enough to be in a position to grow with the industry and help some of the companies develop."

Like many a youth who grew up in the 1930's, Van Gelder, now thirty-two, followed the swing favorites and collected their records. He played trumpet in the school band and tried to emulate Bix Beiderbecke and Bobby Hackett by way of the phonograph. He still holds the radio amateur call letters W2TMD, which he earned at the same time as he began to make home recordings of local groups. Most of these interests went with him to the Pennsylvania State College of Optometry in 1942, along with an early Rek-O-Kut 12-inch 78-rpm recorder.

When he was graduated soon after the close of World War II, his father allowed him to design a huge studio room as the central portion of their new home. Shortly before he opened optometry offices in Teaneck, N.J., he made his first professional recording in 1946 for the Carousel label. "Joe Mooney was playing at Sandy's in Paterson," Van Gelder said, "and it featured him at the organ as he sang *We'll Be Together Again*. Al Collins was just starting with WNEW and took a liking to it. It was a great thrill to hear it on the radio nearly every day."

He continued to record for countless small companies and social functions in his spare time, while putting his spare cash into equipment. "I acquired one of the first Ampex tape recorders," he related. "The old Rek-O-Kut was presented to Stevens Institute and replaced by a Fairchild lathe. But it was not until LP got underway that my schedule was reversed. Three-hour sessions stretched to nearly six, and there is still a backlog of remastering. I am in my Teaneck offices only on Saturdays now, mostly for a change of atmosphere and to see old patients.

"Mine is a one-man operation and I don't have time for all I would like to do. I devote a minimum of one day each week to Blue Note, Prestige, and Savoy, my three oldest clients. The jazz labels I have recorded are too numerous to mention. They include Atlantic, Coral, Debut, King, Pacific Jazz, Riverside, and ABC-Paramount. My latest is Signal and I just finished a Lee Konitz date for Norman Granz' Verve label.

"Then I master everything pressed for Westminster by the Abbey Record Manufacturing Company in Newark. Also the Music Treasures of the World, a classical mail-order firm. I do considerable work for Vox. I went to West Point for their recording of the organ, besides dates with George Feyer and others. I recently recorded the organ in Madison Square Garden in the quiet, early morning hours for ABC-Paramount. These are the sorts of things I am always willing to fit into my schedule. I would like to do more of them, along with classical engagements, as I don't want to restrict myself to jazz. As it is, I am usually busy six days and four nights."

The control room, adjacent to the studio, is a compact workshop for the completion of a disc through the cutting of the master. Though it was set-up on a temporary basis for stereophonic sound some time ago, the new control console was completed last January, after a year spent in designing and building it. "It is a real bit of craftsmanship by Rein Narma," said Van Gelder. "I first became acquainted with his abilities as a design engineer when I acquired a Grampian cutterhead. I think mine was the second in this country, the first going to Reeves Sound Studios. I thought the companion amplifier was inadequate and suggested that he design and build one of 150 watts. It is the one I still use. He also designed and installed the control console in the home studio of Les Paul and Mary Ford."

An array of four Ampex tape recorders consisting of two 300's and two 250's, line one wall and are interconnected for the varied requirements of stereophonic sound and mastering at 30 ips. Two portable Ampex 350's are kept ready for field assignments. For the past two years, Van Gelder has owned a Scully automatic lathe for mastering. Two bass-reflex cabinets fitted with Altec Lansing 604C speakers are fixed to the wall near the ceiling for monitoring in the control room. For playback in the studio, there are two back-loaded-horn cabinets with Jim Lansing 15-inch woofers and acoustic lens tweeters.

Air conditioning keeps the studio at a temperature of 70 deg. the year around. Focal points are a Steinway concert grand piano and an impressive marshalling of microphones, including six Telefunkens. "There is no universal microphone," he said, "and I wouldn't want to describe one of my set-ups as it might seem to commit me to one particular technique. As for some of my theories, I think learning the sounds a mike can give is of first importance. Then it should be utilized to fit the music, with the same care a photographer employs in selecting a lens. Of course, the Telefunkens are likely to appear in a photograph of a date, but that reminds me of the story of the company which recorded with one make of microphone and then brought out another make for pictures.

"Just to keep abreast of the times in equipment is not enough. It must be used creatively and I find more than twenty years of listening to jazz musicians a help and inspiration. I know what they are trying to do and the way they like to sound on a record. And I pride myself on the attention I give new talent. It often happens that a young musician comes to his first date as a last minute replacement. I like to think my experience is valuable in determining his proper balance in a group he has not regularly played with. Should he fail to come through on his first record, it will do him more harm than good. He might better stay home.

"When one mike will do the job, I never use two. Much of my planning today involves stereo. I have an echo chamber and use it when necessary. Like the microphone, it is a tool that can be put to good or bad use. I try to avoid anything that seems artificial."

When asked to cite an example of the importance of knowing musicians, Van Gelder considered a moment and said: "Thelonious Monk, Horace Silver and Mal Waldron all come under the general classification of modern pianists. Yet each has an individual touch, a different sense of dynamics and distinct ideas as to the use of the piano in a group. If they are all recorded the same way, an exact comparison of their sound might be provided, but the result would be fair to only one of them. I try to give their separate styles full value, according to the framework of the music. I may also vary my set-up from track to track, not treating rhythm numbers and ballads the same way.

"I worked many years before I first felt satisfied with a record. It was the Walkin' date with Miles Davis. When transferred to 12-inch this year, it was listed among the first ten in the jazz bestseller list for a time, an unusual distinction for a reissue.

"It is my wish not to become set or sterile in my approach, though I seem to have formed a style of my own from my sense of how a record should sound. Or so some of the words of my critics would lead me to believe. I am more interested in the opinions of the artists on the date. Happily, I am still able to relax and enjoy the work of other engineers. Should it ever come about that we all think and operate alike," Van Gelder said with a

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

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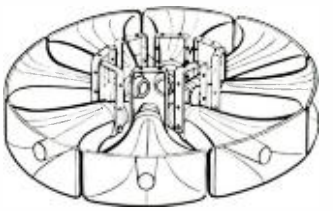

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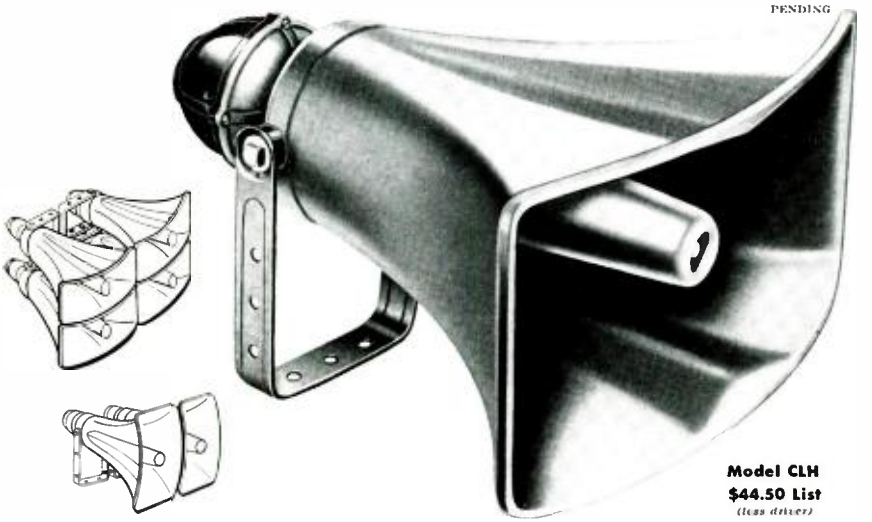

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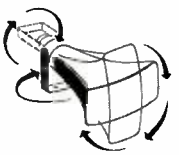

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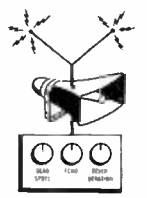

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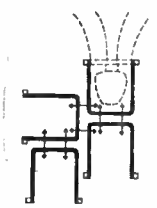

The 'U' mounting bracket of the Model CLH is specially designed to link two or more projectors into *any* configuration, achieving *exactly* the sound distribution pattern required. Even diagonal or alternating projections are just as easy to achieve as "standard" patterns.

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chuckle, "it would be a dull day for the record buyer."

The shift to LP brought a special set of problems and a series of crises to the independent jazz producer. Classical companies had a backlog of longer works, or could turn to European tapes. But the new medium saw the collapse of many of the small jazz concerns which mushroomed after the war. That Blue Note was among the more fortunate stems in part from the fact that its first session in 1939, with Meade Lux Lewis and Albert Ammons, resulted in the first 12" 78-rpm jazz piano discs. Alfred Lion, its founder and head, believed jazz should not be confined to 10-inch space and assembled an imposing catalogue of five-minute sides. These proved economically attractive on 10-inch LP's, and served as a stopgap until new methods of production could be established.

As Lion tells the story of those days: "With several otber companies, we used a Broadway studio employing as engineer Doug Hawkins, who has since gone to Mercury. Around 1952, I learned it would not give its engineers tbe modern equipment needed for high fidelity sound on LP. I had liked the sound on a Gil Melle record and this led to Van Gelder. I found that, like Hawkins, he combined technical skill with a good feeling for jazz. He also bad top-notch equipment and was intent on making better LP's. If there was anything new in the wind as to equipment, Rudy would get it, no matter what the cost. In that respect, he is still a pioneer and tries to be a step ahead. But Rudy is more than an ordinary engineer in his knowledge of jazz, and the way he applies it to the recording of different musicians puts him, to my mind, in the class of a creative artist.

"The association has been happy in every way. Even the news that the 10-inch LP was on the way out, turned out to be a boon. There were 120 of them in our catalogue and a program of remastering was started. It is enabling us to get rid of early LP sound as, thanks to Rudy, the 12-inch reissues are a big improvement."

Prestige, another of Hawkins' clients, soon followed. Its head Bob Weinstock, wbo remembers that trying period well, recalled, "It was discouraging to have a good date spoiled by poor sound. I was thinking seriously of getting out of the business when we tried Van Gelder. Not only did he give us good engineering, but he has a thorough understanding of how a session should be handled. I always feel he has personal interest in what we do." On the recommendation of Marion McPartland, Savoy became a client soon after.

As the oldest jazz label in uninterrupted operation, Blue Note still reflects the perspective of the record collector. For Alfred Lion began to delve into the archives of jazz in Berlin, where he was born forty-nine years ago, when the Sam Wooding band paid a visit in 1925. He began recording with the idea of preserving something that might otherwise be lost. The first sessions with Ammons and Lewis were made with just enough money to pay the musicians and the studio. The capital for the pressings came later. Since then, he has presented an impressive list of artists, from Art Hodes to Horace Silver, on their first dates as leaders. Many were recorded when tbey were known only to other musicians, often Lion's best talent scouts. But the final criterion is his own judgment, based on a knowledge gained as a collector who has owned or heard every worthwhile jazz record.

Francis Wolff, a boyhood friend of Lion, joined the firm in 1940 and has made good use of his hobby of photography. He takes his Rolleiflex to every session and all cover photos are his. As art director, he consults with various typographers on the layout. A design by Reid K. Miles for the George Lewis album, Vol. 2, won the current Billboard award as the best jazz cover of the year.

As for the future, Lion intends to go along uncovering new talent and giving established musicians a platform to speak from. "We have firsts by pianist Sonny Clark and trombonist Curtis Fuller coming up," said Lion. "Horace Silver is now under contract, along with Jimmy Smith, Johnny Griffin, Hank Mobley, and others. The Art Blakey percussion date was a little out of the ordinary for us. If the opportunity develops, we will do more things like it. Personally, I am devoted to the small groups." With Van Gelder and Lion teamed togetber, a dull day for the jazz collector seems remote.

Illustrative of the benefits of giving a jazz musician his head on his own session are the three collections by Thad Jones on this label. They are uncensored expressions of the progress he has made in bis three years with the Basie band and as sideman on numerous recording dates. Such estimable training grounds can be stagnating for the bright student, unless he is allowed to do some original research, as here, and turn in a thesis or two. His fluid improvisation and rounded tone indicate that the big band is still an excellent school for a trumpeter.

On four numbers, Jones is joined by trombonist Benny Powell, an associate in the Basie brass section, altoist Gigi Gryce, pianist Tommy Flanagan, bassist George Duvivier and drummer Elvin Jones, bis brother. His originals *Slipped Again* and *Thadrack* are bright exercises for all, taken at a fast clip, as a warmup for inventive choruses on a rhythmic theme in close to nine minutes of *Let's*, where his powerful horn extends the microphone. *Ill Wind* is a melodic introduction to the sublime *I've Got a Crush on You*. Accompanied by Max Roach, Percy Heath and pianist Barry Harris, Jones gives it a classic sweep that is not to be missed.

Mose Allison: Back Country Suite
Prestige LP7091

Memories of a boyhood spent among the byways of the Delta are distilled in ten pithy sketches, all carrying the essence of the blues, which form the long *Back Country Suite*. Mose Allison was born in Tippo, Mississippi, in 1927, and reached maturity with recollections of a generation of down-home blues artists. After graduating with a B.A. in English from the University of Louisiana, and service in the Army, he turned to music. This February, he became pianist in the Stan Getz Quartet, whose auditors may have been fortunate enough to hear parts of the suite. His is a lean, economical style, at its most revelatory reminiscent of the flashes of light found in the solos of Eurreal "Little Brother" Montgomery, and he moves knowingly through many aspects of blues piano. Though some of the sketches might benefit from further development and it is possible the suite would be strengthened by fewer of them, it is a most astonishing and rewarding composition to come from a young pianist. That his first LP should please both traditionalists and modernists makes it all the more encouraging.

Taylor La Fargue, bass with the Getz group, and drummer Frank Isola give him secure support. Allison shows a more contemporary style on *Blueberry Hill*, *I Thought About You*, *You Won't Let Me Go*, and his original *In Salah*. On *One Room Country Shack*, and one number in the suite, he sings in a southern version of the Hoagy Carmichael twang.

Lee Konitz Inside Hi-Fi
Atlantic 1258

The album title comes from the cover photograph of the artist taken through a foreground of equipment in Rudy Van Gelder's sound salon. The look inside Lee Konitz, provided by the eight pieces, shows him to have mellowed considerably since his Lennie Tristano days. His alto has lost much of its anemic quality and sounds almost well-fed. His recent experiences with the tenor saxophone are detailed for the first time on records, and its tone is so full that it becomes gorged with riches for a politely-honked burp near the end of the concluding *Indiana*. Altogether, his is a warmer, more human personality, suited to the father of five children.

Gathered about him are Tristano graduates: Billy Bauer, guitar, and Arthur Fishkind, bass, on the alto side; Sal Mosca, piano, and Peter Ind, bass, on the tenor side. Twenty-year-old Dick Scott is drummer throughout. It is an improvised session and the Tristano influence is felt only when it fits in the constantly evolving flow of ideas. Rather than a base it is applied, especially by Bauer, as a pastel coloration of a stronger pulse. The Konitz originals are *Kary's Trance* and *Cork 'N' Bib*, named for the nitery where he was playing when the record was released. Ind has a cogent solo in his *Nesuki's Instant*, and the standards *All of Me*, *Star Eyes*, *Everything Happens To Me*, and *Sweet and Lovely* complete the bill.

Art Pepper Meets The Rhythm Section
Contemporary C3532

West Coast altoist Art Pepper was introduced to the rhythm section of the now disbanded Miles Davis group in the Contemporary studios last January. Pianist Red Garland, bassist Paul Chambers and drummer Philly Joe Jones have the benefit of having played together nearly a year and a half and are well equipped to inspire the former Kenton star. For this is a spontaneous session and Pepper did not know it was arranged until the morning of the date. At thirty-two, he bridges the swing-era with more than seventeen years of playing and is appreciative of dixieland. Few musicians of his age have as many resources to draw on, and it is a substantial bag of goodies which he strews throughout the nine numbers, following a relaxed *Jazz Me Blues* with the intricacies of Chano Pozo's *Tin Tin Deo*.

Garland collaborates with him in *Red Pepper Blues;* Chambers in *Waltz Me Blues*. His own *Straight Life* is an unmitigated shout. In the standards *Imagination*, *Star Eyes*, and *You'd Be So Nice To Come Home To*, he shows a talent for playing upon a phrase, dropping a reflective touch into an emotionally positive statement. The concluding *Birks' Works* is another proof that West Coast men should meet this sort of rhythm section more often.

Gigi Gryce and the Jazz Lab Quintet
Riverside RLP12-229

As contrasted to the established unit or a pickup group, the Jazz Lab Quintet is described as a cooperative. In this case, it means that compatible musicians are banded together under a nominal leader, and have made reasonable preparations before the recording date in the hope it will help in getting bookings. Altoist and leader Gigi Gryce joins with Donald Byrd, the rising young trumpeter from Detroit, in a reworking of the basic bop formula, freshening it with well-thought-out, well-arranged passages designed to give impulse to the rhythmic and melodic ideas of the soloists.

The increasingly popular practice in these circles of taking an old tune and showing how much inventiveness can be applied without straying too far from the melody is used in *Zing Went the Strings of My Heart* and *Lore for Sale*, which is put into 6/8 time. Pianist Wade Legge contributes the ballad *Geraldine*, and has a highly individual blues solo in *Straight Ahead*. Gryce's *Minority* and Lee Sear's *Wake Up!* are uptempo romps. Drummer Art Taylor knows how to make himself felt without intruding on the soloists, and is helped by Wendell Marshall, former Ellington bass.

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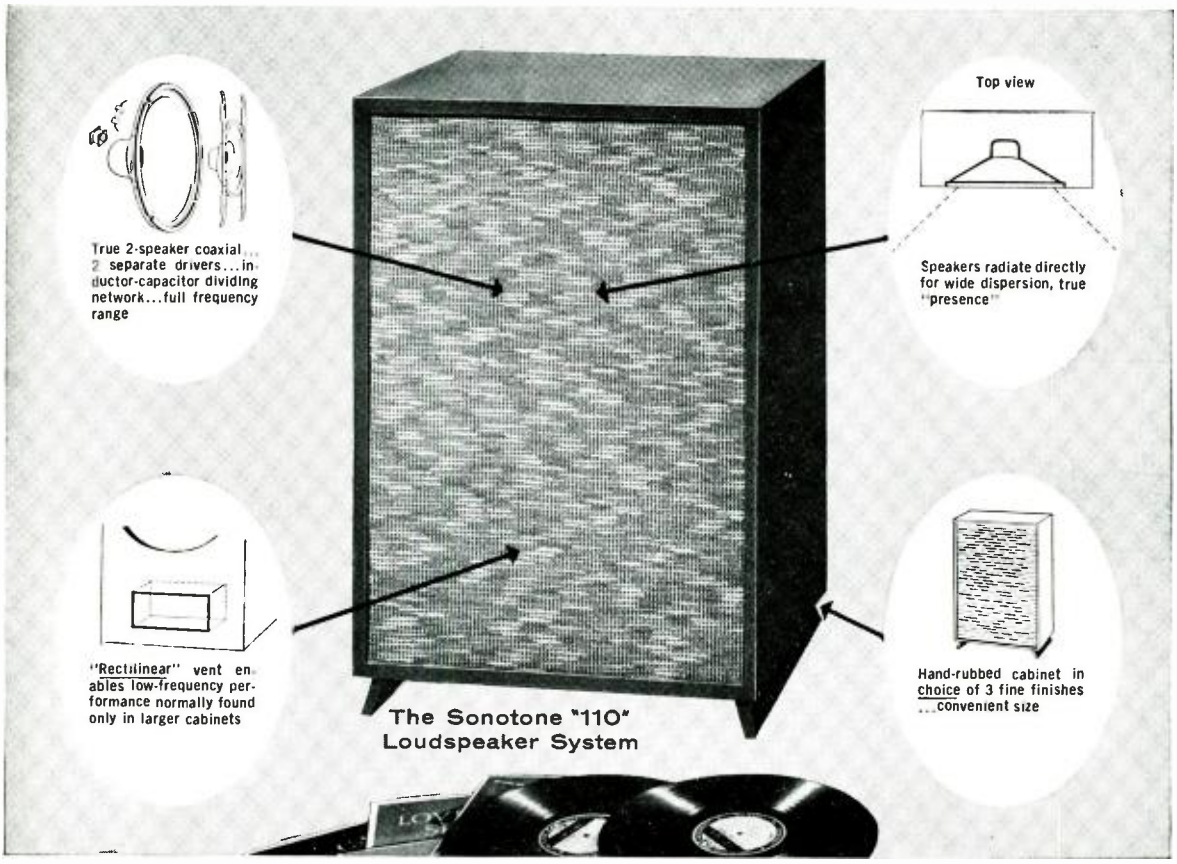

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Frank Sinatra: A Swingin' Affair
Capitol W803
Joe Mooney: Lush Life **Atlantic 1255**

Two graduates of Frank Dailey's renowned and lamented New Jersey spot are presented in albums purveying the lyrical vocal phrasing which started when the Meadowbrook was in its heyday. Frank Sinatra gives able treatment to fifteen swing-era tunes, supported by the Nelson Riddle strings augmented by some of the jazz notables used on a recent Nat Cole date.

Alumnus Joe Mooney now owns his own small club in Florida and favors the more intimate chamber style. He accompanies himself on the Hammond organ, aided by guitarist Lee Robinson, bassist Milt Hinton, and drummer Osie Johnson. His thorough musicianship is conveyed in a well-balanced program of ten numbers from the title tune to *Have You Met Miss Jones*.

June Christy: Fair and Warmer
Capitol T833
Judy Garland: Alone **Capitol T835**

Two eminent vocalists change styles as the Misty Miss Christy lets a little sunlight in, and Judy Garland turns to the aloneness of *By Myself* and *Me and My Shadow*. Pete Rugolo provides a light, airy backing for June in a dozen radiant selections such as *I Want To Be Happy* and an appealing *Beware My Heart*. Judy is supported by the Gordon Jenkins strings in eleven numbers, but her voice hardly needs to travel so far through Capitol Tower's subterranean echo chamber.

Robert Mitchum: Calypso—Is Like So
Capitol T853
Alberto Calderon: Calypsomania
Tropicana 1203

Before Belafonte upset the applecart, part of the charm of the calypso fraternity was that so few bothered to try to sing, preferring a town-crier sort of recitative. This is the trail Robert Mitchum follows in twelve characteristic numbers, accompanied by an admirable chorus and a strong beat. He listened to local champions while spending ten months on location in Trinidad and picked up a few new items.

Pepe Bilyeu's originals for the Alberto Calderon conjunto orchestra are more in a danceable Latin-American vein. Norma Calderon, the Liat of South Pacific, shares vocal duties with Tony Martinez in a dozen numbers. Calderon features the timbales in *Mary Cuebell*.

Eddie Barnes: Honky Tonk Piano
Audio Fidelity AFLP1827

One time accompanist for Texas Guinan and man about the theater, Eddie Barnes has specialized in dusting off the old-time pianola style for the past five years. He has acquired a facility of invention, and coupled it with the vaudevillian's sense of dramatic timing, to recreate the day of the barbershop ballad, minstrelsy, and the free lunch. His world is still inhabited by *My Gal Sal*, *Little Nelly Kelly* and *Peggy O'Neill*.

In a dozen atmospheric tracks, he affords the opportunity to clog to *Tuck Me to Sleep*, waltz to *Sympathy* and *Three O'Clock*, and harmonize to *I Ain't Got Nobody*, *Moonlight On the Ganges*, etc. Worth having on hand to slip into the breech at that party where the pianist gives out early in the evening. Skilled practitioners of ragtime are well represented on LP, but only Barnes has rewired the nickelodeon for today's sound.

Sabicas: Volumes One and Two
Elektra EKL 117 and 121

Long an integral part of the Carmen Amaya troupe, Sabicas is not unknown to those who have observed him in public performance, or heard him on recordings against the counter rhythms of clicking heels. As presented here, he is the great flamenco artist known to other guitarists who match wits and technique with him on tour, or in his Mexico City home, as he plays for himself and their amaze-

ment. They have the expert's respect and awe for his ability to invent new variations on the traditional patterns. But one need not be versed in flamenco to catch the fever of his emotion as his flying fingers delineate the dynamic subtleties of the instrument.

The first volume is a representative collection of these modes: Bulerias, Fornica, Fandango, Alegrias, Soleares, etc. It is also available on stereophonic tape.

In Volume Two, his gypsy imagination is to work on arrangements of more familiar themes. As he cannot read or write music, his improvisations are those of the moment, though his choice of selections permits him to apply an insight as valid as that of the composer. There are Lecuona's *Malaguena*, Monti's *Czardas*, Oyanguren's *Fantasia Inca* and Rimsky-Korsakov's *Capriccio Espanol*.

Five of the eleven numbers have an additional guitar track through multiple recording. In *Milonga Flamenco*, his own composition based on an Argentine theme, he is joined by his brother Diego Castellon. His variations on *Gran Jota* by Tarrega includes a startling snare drum effect, obtained by crossing the two bottom strings.

Leonard Ripley recorded the first volume in the Esoteric studios and moved to Steinway Concert Hall for the second. There is little difference in the excellent sound on both. If a choice must be made, it should be based on a preference for the fiery gypsy flamenco of the first as opposed to the more readily apprehensible second volume.

Pit Stop **Riverside RLP5003**

After releasing two albums of the sounds of sport cars, Riverside flew its equipment to the Bahamas to tell the story of the Nassau Trophy Races of December, 1956, by means of the tape recorder. Against a background noise of tortured metal and rubber, some of the drama behind the scenes is conveyed by means of interviews and the eavesdropping microphone. Detailed are the technical inspection and practice race, a hectic driver's meeting, the LeMans start, the tension in the pit as red coral tears tires to shreds, followed by the anticlimax of the post mortem.

Bill Grauer, Barrett Clark, and Ray Fowler made the trip with the experience of Sebring behind them, and are able to take the mikes to the side of the cars as they come in. They had anticipated the availability of 60-cps current, but ended by hitching their powerline to the generator in George Tilp's traveling machine shop. Phil Hill, Stirling Moss, Carroll Shelby, and the late Marquis de Portago are among the drivers interviewed. Full length LP's on the experiences of each have been taped and are in production, though the Portago has been withdrawn for the preparation of a memorial album.

Susan Reed **Elektra EKL116**

Of the nineteen songs sung by Susan Reed, the majority are familiar to her friends as she has delivered them across the country in more than a decade of touring, accompanying herself on harp and zither. Previous recorded versions are supplanted by the superior sound. Now are three Louisiana folk songs from the documentary film *The Pirogue-Maker*, made in celebration of the 200th Anniversary of the migration from Arcadia, Nova Scotia, to the Bayou. *Michie Banjo*, *Zelime* and *Gué, Gué* are all welcome additions to her repertoire. She arranged them for harp and sang them as background music in the film, the object of prizes awarded at the Venice Film Festival and the Edinburgh Festival.

Bobby Hackett: Gotham Jazz Scene **Capitol T857**

When Bobby Hackett returned with his cornet to the jazz scene last November, he found an eager audience at the Voyager Room of the Henry Hudson Hotel. That his new band enjoyed a hearty success is due in no small way to the breadth of material and styles also heard on its first record. There are toothsome freshenings of *At the Jazz Band Ball*, *Wolverine Blues*, *Cornet Chop Suey*, and *Tin Roof Blues*, kicked along by the solid tuba of John Dengler. Dick Cary plays

(*Continued on page 104*)

AUDIO ETC.

Edward Tatnall Canby

1. FM/Q

Some readers may have noted an ad in this magazine for a new and highly efficient FM antenna system with the above title. I did—at a moment when I was in a very receptive mood; the old TV antenna on my Connecticut rooftop had developed a short somewhere in the transmission line which by a disastrous oversight had been buried behind a complete insulation job. So I wasn't getting my own radio program, 100 miles away on WNYC in New York; I had to check it on AM and was able, through the hiss and roar and explosions, just barely to recognize the faint mid-range sound of my own voice and so know, at least, that my weekly tape had arrived safely.

Couple of months later the FM/Q was delivered to me by its chief proponent in the Apparatus Development Co., of nearby Wethersfield, Conn., Mr. L. F. B. Carini—but I was away; next time he dropped in, weeks later, we got as far as figuring out I needed so much transmission line (perforated 300-ohm) and so much new guy wire, galvanized, to replace the rusty stuff that still managed to hold my TV mast more or less up. And the visit after that, though we got a good start on tearing things out and re-installing, a providential rainstorm (providential for our parched crops) halted operations just as we hooked the line up temporarily to the antenna—which we left lying lop-sided on my semi-flat roof.

Now you-all know what's usual with FM reception in respect to distance-getting. When FM first came along, we were told that it was strictly limited to 100 miles or line-of-sight (whichever was nearer), that effective reception was in effect local and immediate-surroundings, that stations on the same frequency could thus be placed geographically fairly close since the stronger station would blank out the weaker one very nicely if there happened to be any unlikely overlap area. No static, no fading, etcetc.

That was before FM sets started to climb on the increased-sensitivity bandwagon. A few years back, I reported what it was like to have one of the new higher-sensitivity FM tuners on hand in the country, well away from any metropolitan district. My early Fisher had me amazed, bringing in various stations 'round about, pulling my own station, WNYC, out of the distance on most days, and all this on my TV antenna, which though it had the necessary two connections was obviously not intended for my particular use, receiving the FM band.

That tuner was replaced by Fisher's 80 series AM-FM model, the one with the two meters, and after something like two years—it has never been serviced or aligned or tinkered with since the day it arrived—it is now picking the most extraordinary things out of thin air, thanks to the FM/Q antenna, which we finally got properly installed a few weeks back. The combination is crackerjack.

FM/Q is a highly directional antenna, a broadband yagi, and it is more than just bi-directional—it is dead at both sides and rear. Darned close to it, anyhow, as far as I can tell; in the rear area I can't get a thing, not even a scattering of local FM stations around in Western Massachusetts just North of me, and not a trace of the batch of stations in the Boston area, which is some 100 miles to my rear, at a guess. The sides are feeble too; my pet local station for daily weather and news, WTIC at Hartford, an hour's drive off to the left, is pushed right out of the running by the well-known and usually un-gettable WQXR in New York city, which is right in my beam, a channel or so down from "TIC." "What? WQXR?" That's what people say around here, with envy; but it's much more important to me that my own far feebler station, WNYC, comes booming in with full limiting and only an occasional shush-shush, as a plane or a cloud sails by.

It's quite safe to bet that I'm the only WNYC listener within 50 miles of me. Up here, nobody's even heard of any such station.

Now this isn't the half of it. Seems that we aimed my FM/Q a bit too far to the right to hit New York on the nose, though I now receive every single New York city FM station, large, small, and microscopic, with perfect clarity. How did I figure out that I am aimed to the right of Manhattan (looking South, that is.)?

Well, first time I tuned in, with the antenna lying loose on the roof and sort of pointing in the general direction of South, I heard a voice a couple of feet from my chair casually announcing that he was Norfolk, Virginia. Yep, 'way down there.

I know, of course, that our Western readers have an *idée fixe* in their heads that Norfolk, Va. and Boston, Mass. are about a half-hour apart in the train, and maybe it'd take a good two hours in an old jalopy to drive from Charleston, S.C., to that nearby resort of Bangor, Maine. (Just you try it, I suggest.) . . . Anyhow, I got Virginia on FM, up here in northern Connecticut, and thereby violated the 100-mile rule by four or five times.

Next, almost as strong as my own WNYC, New York and next to it, was a li'l old local station called WDEL, "here in Wilmington," Delaware. And there was Baltimore—couple of stations—Washington, D.C.—that W-Good-Music-Station, WGMS, of which I'd heard, but never heard before.

If you have a map of the Northeast, maybe you'll begin to see what gives. And so you will understand that, though I can't get Pittsfield Mass., which is only an hour's drive to the North of me and

the nearest big town, I now find myself figuratively spread out in a fine narrow beam right down across Eastern Pennsylvania, a couple of hundred miles away.

In fact, I think I'll set my compass by my FM/Q antenna; it is quite clear that I am beamed exactly and directly upon the city of brotherly love, Philadelphia—for I get every Philadelphia station that I happen to tune in on, come identification time, and mostly with full limiting and only occasional freakish fades and swooshes—the inevitable penalty for outer-limit FM tuning. In Philly (from up here in Northwestern Connecticut) I'm already hob-nobbing in hi-fi with WIP, WCAU, WFIL, WPEN, and a slightly zany station with shouting disc jockeys and lots of gospel and hill-hilly stuff called WHAT. What? Yep, WHAT.

The narrow edges of my long FM beam are conically determined very nicely on the one side by a batch of New Jersey stations and Maryland locals, WCAO in Baltimore, WJEJ in Hagerstown, Md., WJLK in Asbury Park, WSNJ in Bridgeton, N.J. . . . and, on the Western edge, such unlikely items for a Connecticut yokel like me as the two Easton, Penn. stations WEEX and WEST (sort of East and West-like), Lebanon's WLBR, a station at York, Penna. called WNOW and one at Sunbury called WKOK. Quaint call-letters, these funny stations have, out in the styx. There is also a Bloomsburgh outlet, wherever that may be, a certain WALM. And off in adjacent New York State I listen to Cortland, WKRT, and think it's next door. Real hi-fi.

Now all of this doesn't yet make me a confirmed station-chaser or DX hound. These FM stations have turned up in rather casual attention to signals that are generally listenable and intelligible, without ear strain or eye-popping. True, there is a good deal of sudden swooshing and fading; very often two stations at a distance pop in and out, first one and then the other—for at this outer fringe of sensitivity, intervening space can do strange things to FM signals. There are slow fades, a gradually rising hiss and throb, that sometimes drowns the signal out altogether; but when it fades back a few moments later the noise often goes right down to zero, and there you are with full-hi-fi sound right in somebody's studio off in space. If your announcer speaks up right then, you don't have to break your ear drums to hear what he says! If not, he's likely to come thru on the next break.

I used to fuss around with distance-getting, back before the war with an old home-style AM long-and-short-wave set and I'll admit that these FM distances aren't quite in the same league. (How annoyed I used to get when that dim, faint, unintelligible short-wave outlet I'd been hounding for hours on the theory it must be Moscow turned out to be New York City!) The listening was exhausting, the signals lo-fi at best, the hiss and static frightful. I soon gave it up, Moscow or no.

Chasing FM stations is much more interesting and much easier, because no matter how distant, the fi is always hi and the speech ultra-intelligible; the background noise doesn't pop or blast, is usually dead-smooth or gently billowing, so to speak, and a large part of the time you can listen with real enjoyment and complete quality reception to your distant stations.

It's odd, come to think of it, how very "local" most FM stations manage to sound. Distant FM reception is still so unlikely that most of them act as though a ten-mile radius were the practical limit—if that. They forget to say where they are.

Take it for granted. "Here" is the favorite word, or "here in town." The temperature "here in town" is 65 degrees. Or they mention call letters but mumble the town so you can't even get it, hi-fi or no. Why should they bother—nobody out of town is listening. Except me.

I've got so I can spot a station by the local news and the ads. Big supermarket sale, rush quick down to Chestnut and Filbert Streets . . . call LOcust so-and-so number . . . , where else but Philadelphia, with its famous nutty streets and insecty telephone exchanges. (Come to think on't, that Locust is probably a locust *tree*, not a bug.)

Frederick Street—must be Maryland. Names like Susquehanna put you into interior Pennsylvania. Odd little local bits come through that make you jump—like, this morning, a newsman who said something about a nice day, quite a bit of sunshine *here on the hill*. What hill? He didn't say. Anybody recognize his home town, somewhere along my beam? Natch, I haven't bothered to wait for about half the stations I hear to get around to self-identification. Takes too long and I get awful tired of local ads and Elvis Presley.

Which brings me to a final observation, before I get back to that FM/Q antenna, the cause of it all. It strikes me as rather interesting that, in this day of big-time expansion, of large-scale and costly TV, of shows that are essentially on a national scale aired for local viewing, radio itself is getting back, slowly but surely, to the grass-roots.

Radio networks still have their nets, but TV has taken over the big-time. Radio is going local, and a darned good idea it is, too. We need *something* on the air that has at least a trace of our own local life in it, even if it boils down to an endless string of local ads, Filbert and Chestnut streets or the corner of Main and East First.

Don't forget (you radio people) that everybody likes to hear himself, or his own home locality, right out loud on the radio. The local appeal will never cease to be a big, pridefnl thing, and radio's very best future, AM or FM, highbrow or low, is in the local-enterprise sound, pinned down to one and *only one* place—not Hollywood's and Madison Avenue's quaint idea of all our towns rolled together! Not Main Street, America, if you please, but THE Main Street, the one that matters, the one right around the corner and our own.

* * *

And so, back to FM/Q, for some details. It's a broadband Yagi, i.e. designed to cover the full FM band, not too wide, not too narrow in respect to frequency. It beams as already explained, dead in the rear and fairly dead at the sides. Being flat, horizontal and very light in weight it is quite easy to install and is inconspicuous to the public gaze. Even two of them, stacked (I haven't tried that), don't take up much sky-room over your roof. The makers claim it to "approach perfection" and I suggest that this is an excellent and apt term. Everybody else's product is perfection itself; this one merely *approaches* it—and thereby rates a new high in honesty!

Moreover, the statement implies what I find to be important, that there is a practical limit to FM sensitivity which is here very closely approached. At extreme distant reception you pull in so many stations on so many close-together channels that the returns begin to go down, as on the old AM band. Interference mounts, in the peculiar FM form—the sudden shifting from one station to another, back and forth.

And your nearby stations, with high sensitivity in the FM receiver and the antenna, become so strong that they actually blanket a number of channels on each side. In the extreme range of sensitivity, a half dozen strong stations can grow to a dozen or more, effectively covering up most of your FM band and pushing out the distant stations. Self-limiting.

Yes, a rotator is the final step in this procedure, and that will be my next one. With a turntable beam I'll be able to explore other huge cones of receptivity; with the rotator I'll more easily favor one or the other of the competing stations that periodically kill each other off. A rotator is almost a necessity, out of sheer curiosity, for many who will want to tackle this sort of distance FM.

The FM/Q (back once more . . .) is most happily put together for permanence and I must heartfeltedly commend its builders on this score. My old TV antenna, a cumbersome conical affair, was installed by an earlier owner of my house, about five years ago. It was a mess, when we looked at it. The guy wires were almost rusted through, every bolt was rusted to the freezing point—we had to break some of them to get the thing loose. The insulators were plastic, but the arms were fastened onto them with rusted bolts; I tried to silver-paint these, for preservation, and got paint all over the insulators. Moreover, the antenna arms were merely rolled, with a seam, and the Connecticut winds of five years had bent virtually every one of them out of shape; they won't bend back straight but tend to buckle in the middle.

Now this sort of thing is inexcusable, at any price. Cheap stuff that's *easily replaceable* is one thing. But a device that is put up to stay, which is dangerously exposed and could easily do serious damage if it fell down, should be built with at least a minimum of common-sense concern for the buyer's safety. It takes a good day's work to set up a big TV antenna like that one, and by everything that makes sense, it ought to be able to *stay* up indefinitely. I have no patience with callous manufacturers who use ordinary rustable wire and bolts and screws for any such device, at *any* price.

The FM/Q antenna, you'll be glad to know, is made of solid, seamless lightweight aluminum—and it is equipped throughout with stainless steel bolts, nuts, and fastenings. The insulators are a red plastic, a particularly good material, I'm told, and the leads are carefully "stood off," two individual copper wires separated by air and given a single twist en route. The entire unit is built rigidly so that it cannot come loose. In other words—once up, this one will stay forever, barring hurricanes, vaporization by a lightning bolt (use an arrestor) or maybe being hit by a helicopter. All of which makes this a worthwhile piece of equipment for conservative and long-range improvement, long-range in both space and time.

An extra word, probably unnecessary for most readers but anyhow . . . FM reception, even long-distance, is governed mainly by the line-of-sight pattern familiar in TV. Reception varies greatly according to location and can be plain lousy in some places, even with the best of antennas. My own hill-top situation happens to be ideal, at least in the Southerly direction where my antenna is now beamed. People in cities and in deep valleys won't do so well. But I suspect that an antenna of this type, especially if it can be mounted high up, should do relative wonders even in a poor location. It might bring in that one extra

fully-limited station that makes all the difference between listening and not.

There's a larger super FM/Q model, if you really want to clutter your roof for special types of sensitivity, and for city noise reduction there's the complete 72-ohm kit, for use with shielded wire lead-in in place of the usual 300-ohm plastic transmission line. The makers, Apparatus Development Co., Drawer 86, Wethersfield 9, Conn., even stick their necks out and offer free counsel to anybody on his particular FM reception problems. For a quarter, you can have a useful booklet ("Theme and Variations") covering the whole subject of FM antenna reception and giving a list of FM stations in every state. I've already picked up three stations that aren't on the list.

2. EICO

Since last month, as anticipated, another new small speaker has come in, adding one more push to the new trend towards small-sized systems in the middle-high price brackets. The new Eico "standard" speaker system costs around $135 (averaging several models), stands up against your wall, occupying maybe a square foot of space on your living room floor (it is waist-high) and produces sound that to my musical ears rates as excellent, from high top to clean low bottom. Its special feature is highly non-directional radiation of the highs, both straight upwards and outwards, from the open-work (grill covered) top section.

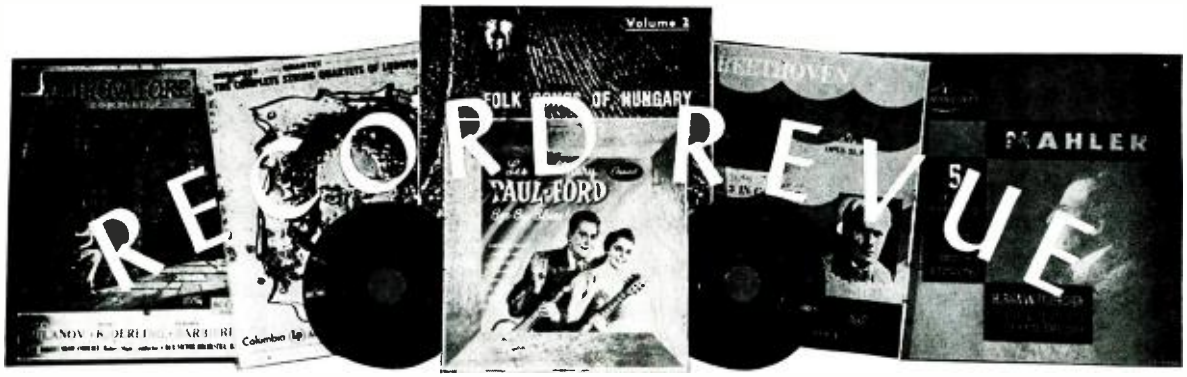
If you will imagine a short-hauled grandfather clock, you'll get an idea of this new system. It is a foot or so taller than the RJ-AR-University type of small speaker box, but stands up in even less space, being somewhat flattened so that it fits comfortably up against a wall. 3 feet high, 11½ inches deep. The upper eight inches or so consist of grill material, on three sides and the top as well, and inside this space is the business end, a speaker array that is decidedly out of the ordinary, along with the double conical slot-loaded horn inside the lower portion.

The Eico Standard uses a Hegeman tweeter set coaxially within an eight-inch cone woofer, edge-damped with silicone, pointing straight upward; crossovers are both electrical and mechanical. The tweeter is the oddest thing you've seen, a pair of projecting paper "flower pot" cornucopias, one within the other, sliced off at a slant and brought to a lovely, graceful point, the whole standing straight up out of the middle of the woofer. The inner is stationary, for loading, the outer one radiates highs, non-directionally and without resonances due to the special fluted shape.

The grill plastic more or less hides this elegant arrangement from the eye and just as well—I'd likely be pouring in water and setting a flower display into it. (More of this in a moment, on a more serious note.)

You can look into the top of the woofer through the grillwork, but what counts more lies underneath, in the lower part of the small box. The woofer "sees" what isn't there at all, an infinite horn minus resonances, thanks to a very carefully thought-out and quite elaborate horn system. Note that it is conical, not exponential, with gradual cut-off, and note further that this double horn, folded to each side, is loaded at the bottom, next to the floor, by two slots of *unequal* size, one on each side. At first I thought somebody had measured the side panels wrong—but this is how the bass comes out and the slots are intentionally that way, for smoothing.

(Continued on page 104)



EDWARD TATNALL CANBY*

STEREO CORNER

Solid

Dvorak: Wind Serenade, Op. 44. Los Angeles Woodwinds, Raksin. **Stereotape 8**
Stereo Rating: 5

This is a first-rate stereo of a close-up sort, not unlike those of Mozart but written in a meltingly lovely romantic idiom, beautifully set for the wind instruments (plus string cello and bass). The eleven instruments are spread evenly across a smallish hall, but with nicely intimate liveness; each man is personally evident, chamber-style, each solo color is on its own, yet the whole sound is big enough for an orchestral impact. Fine balance between middle and ends, closeness and distance.

The L.A. performance is not as melting as the music itself, but I found it thoroughly musical and a good modern interpretation of the work. Not available on disc.

Prokofieff: Symphony #7. Philharmonia Orch., Malko. **RCA Victor DCS-38**
Stereo Rating: 4

The last symphony of this great musical humanitarian and it is a movingly simple, direct, unaffected piece, not afraid to be "old fashioned" in melody and harmony, yet actually as modern as the day. If you are musically inclined at all towards the symphony orchestra, you will not be able to help liking this gentle, sweet, expertly written work.

The British performance by the great Philharmonia is as warm and sensitive as the work itself. The stereo effect is appropriately modest, excellent for its purpose though not sensational. Hard to know just how to rate it. Strings a bit on the edgy side, from the audio standpoint—could be slight distortion, or perhaps merely an effect of miking; or both.

Toch: Symphony #3 (1955). Pittsburgh Symphony, Steinberg. **Capitol ZF-7**
Stereo Rating: 5

This is, first, an unusually fine stereo of a full-scale orchestra. Stereo is still not easy to describe in absolute terms—each new achievement adds perspective to those already familiar. This one is rather strikingly unlike the big RCA stereo recordings, those with Reiner and the Chicago Orchestra; but I find it fully as good—better at this moment as I listen. (But the RCA product will seem better when I return to it, probably.) There is less of a huge space behind this orchestra, though it sounds plenty big; the orchestra itself is less close, more blended, more solid and, I think, perhaps in a more natural perspective than the somewhat ingenious RCA orchestra sound. No criticism intended—as I say, both types of stereo recording are useful, important, pleasing, and add to our growing ability to interpret music into stereo.

Toch is an older composer who was fairly often heard 'way back, then not so often; now he has suddenly burst forth in a series of mature works of which this is a prize winner (Pulitzer). As with others of his generation of older moderns, Prokofieff (above) included, he has mellowed, deepened, concentrated, and simplified. This piece is a fine work, skillfully set for the orchestra, written in an effective modern idiom that seems to combine a taste of Hindemith with strange reminiscences of Shostakovitch in his mellower moods. Only a few traces of the older, more didactic (and now rather dated) Toch remain—as of, say, his "Chinese Flute"—and they are good traces, well modernized and streamlined. A good new hi-fi piece—it makes good sound and fine listening.

Haydn: Trumpet Concerto; Italian Overture in D. Vienna Philharmusica, Swarowsky. Adolph Holler, trumpet. **Urania UST 1203**
Stereo Rating: 3

This was reviewed in its disc form as a first-rate recording and performance of these two fine Haydn pieces. It is the same here, including the excellent big sound in a warm liveness. But I've given it a strictly neutral stereo rating of 3—not good nor bad—because, oddly, I can't hear a very great difference between the stereo and "monaural" playings, both of course heard through the same speakers. The tape sounds just fine both ways.

Saint-Saëns: Symphony #3. Vienna Philharmusica Orch., Swarowsky. Franz Eibner, organ. **Urania UST 1201**
Stereo Rating: 4

Same orchestra (though more players, of course), same conductor, perhaps virtually the same miking as the Haydn above, but in this one the stereo seems more effective. Again—this is a fine sound either way, stereo or not, but the stereo effect adds more noticeably to the immediacy and clarity of orchestral sound and to the sense of hall space. I'd guess that this one is better stereo than the Haydn mainly because of the music itself, which has a more complex texture with much more in the way of solo and color-group elements to stand out in stereo relief.

This is a mild and rather Germanic version of the Saint-Saëns warhorse-with-organ, not bad but minus a good deal of French get-up-and-go. The familiar old (once-hi-fi) Columbia disc version makes it go a good deal better, with more excitement.

Variety

Ravel: Bolero. Rimsky-Korsakoff: Capriccio Espagnol. Hollywood Bowl Orch. Slatkin. **Capitol ZF-4**
Stereo Rating: 5

This is another of those smooth, professional jobs, turned out admirably to order and note-perfect, slick as marble and cool to the touch. It's all there, all of the music, but the spirit is missing.

Can one make old Rimsky's show-stuff into warm music? Matter of fact, I'd just as soon not have to hear Rimsky played by a virtuoso conductor who tries to make him sound like great art! And the Bolero, too, benefits by straight playing, minus extra heroics. Still . . . these both leave me mildly chilled and that is that. Guess I do prefer a warm-hearted reading, be the music good, bad, or just neutral.

It's a very fine stereo, and no doubt about it. Big hall, but not cavernous; instruments nicely and evenly distributed, not too close, never falsely magnified. This is one type of sound that rates a full 5, the top, though other kinds also rate it.

Breaking the Sound Barrier—Vol. 1: Percussion. Am. Percussion Society, Paul Price. **Urania UST 1204**
Stereo Rating: 5

Percussion men are getting to be as persistently enthusiastic about percussion as hi-fi men are about hi-power amplifiers and home-built tweeter horns. This group, led by Paul Price, plays five fiendish items here, large and small, including music of their own, until your ears are ready to bust. Some of it is real nice, though, and good listening.

The Varèse "Ionisation," the original hi-fi percussion piece (1926) and well known now to most of us, is rather inconclusive here, stereo or no. I still like the old EMS disc better for sound. A long Canticle by Lou Harrison is the most imposing work; it is too serious for me, with its ocarina solo and other somewhat pompous effects and organization, but the sound will interest. "Four Holidays," by one Bartlett, is very amusing, taking us from New Year's Eve (sad New Year horn and hiccups) through the Glorious Fourth (nice little slightly cockeyed tunes and

STEREO RATING

Mr. Canby rates stereo tapes on a scale from 1 to 5 (5 being the highest value) as to specific stereo effectiveness, over and above the general values of recording and performance as heard in comparable monaural reproduction.

The rating is personal, includes both musical and technical features that contribute to stereo value. It is designed to measure the stereo worth of the recording in terms of the greater cost of stereo tapes and of stereo playback equipment.

All tapes were reviewed in the stacked (in-line) form. Some, but not all, are available for staggered heads as well.

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

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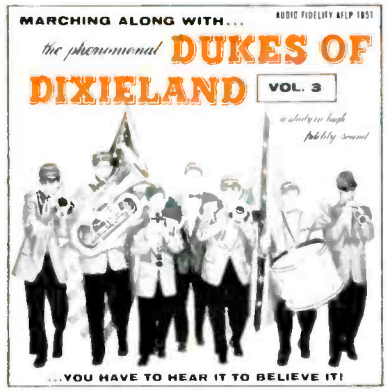

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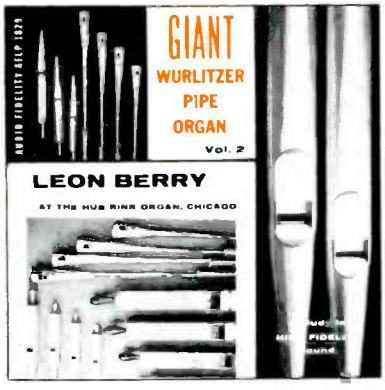

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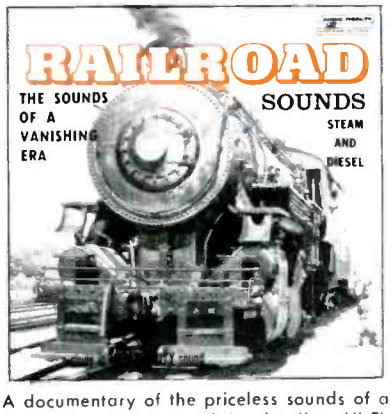

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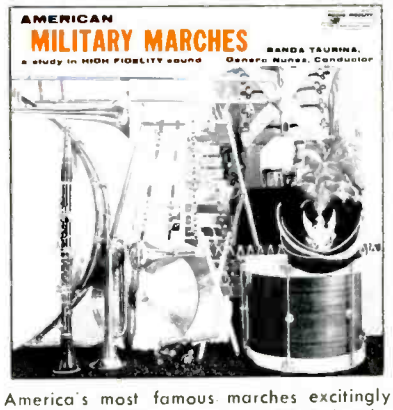

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THE EMOTIONAL IMPACT OF HIGH FIDELITY

by Sidney Frey

PRESIDENT, AUDIO FIDELITY RECORDS

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Let's be basic for a change. Let's not confine ourselves merely to music. Music is just one of many kinds of sound. Let's make an attempt to understand what takes place when we listen to a *prepared* series of sound or tonal variations.

Time was when the phonograph record was the *weakest link* in the entire process of sound reproduction. Assuming that the live sound was of a high order, there was – and still is – many a slip between this live, vibrant sound and a finished recording. The original sound frequently turned out to be weak, distorted, filtered or unnatural in one way or another, when heard on the record.

Today, however, the process of sound recording has undergone a sensational and dramatic change. Through better understanding of the science of acoustics, through special microphone technique and resulting better balance, and through the application of the latest electronic engineering skills the present day record can be the *strongest link* in sound reproduction. Properly produced, a fine record is the sum of all of the factors that enter into transferring live sound to disc.

By today's Hi-Fi standards music or sound need not be loud in order to be impressive. For those who enjoy soft music as a happy undercurrent of sound to accompany their work and for those who like to listen to the quiet dignity of a dramatic performance, soft background music of the whisper of a human voice can be equally moving. The thrill of an exciting performance is not in its loudness or softness, but in the realism and purity with which the original sound is captured on a record.

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There is nothing like hearing sound reproduced in its pure, unadulterated form. Whether it's the sound of a passing train, the crisp rustle of castenets, the opulence of a brass band, the fragile beauty of a solo violin or the richness of the human voice, each has great appeal in its own right. And, if this sound is crystal clear, powerful, commanding, packed with the original dynamics and *reinforced* to command added attention, you have not merely High Fidelity, but something which contains the impact of an atomic age marvel – the *miracle of High Fidelity combined with an overwhelming emotional experience.*

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Another successful Audio Fidelity series are the records featuring *The Dukes of Dixieland*, a sensational jazz combo which is chalking up one triumph after another across the nation. These records have such "presence" that one has the feeling of actually hearing The Dukes in a live, literally earth-shaking performance. We're also mighty proud of a release which features the sensational Patachou, female personification of Paris and one of the world's leading contemporary chanteuses. The thrilling "goose-bump" producing style this internationally famous singer boasts is readily apparent in a truly outstanding recording.

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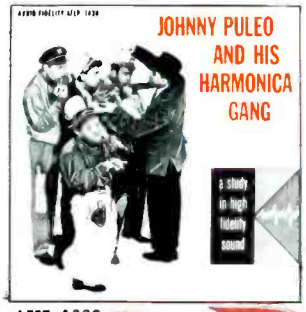

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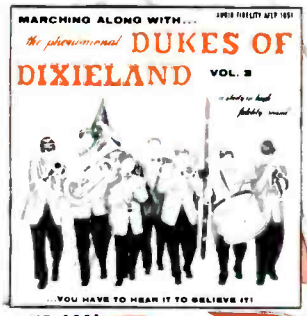

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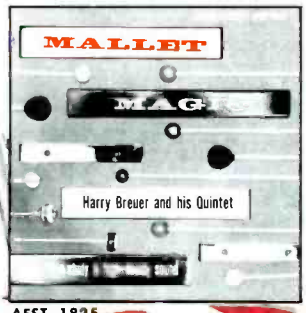

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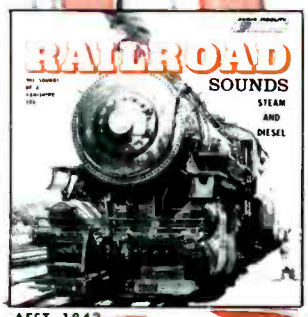

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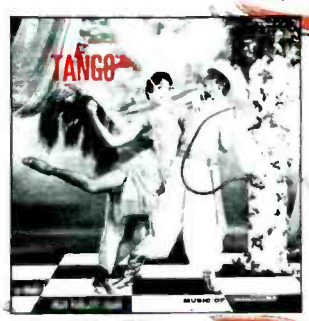

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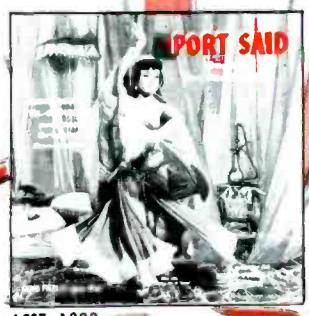

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marches). Two other pieces got themselves more or less merged in my mind on one hearing; won't try to describe them at this point.

This is good close-up stereo, very clearly in a small, well-defined room, with point-source sound at both sides yet a fair amount of middle as well. The tonal variety, from tom-toms to tam-tams and cowbells to buffalo bells, is gratifying to the ear. The stuff is hardly of the background music sort and as hi-fi demonstration material you'll likely want to skip around. As music, try the Holiday items first, if you can locate them in mid-tape.

Kenton in Hi-Fi. **Capitol ZD-10**
Stereo Rating: 4

If you like to jump to big-time modern jazz, this is the usual product and stereo merely adds a bit more shriek and bang. Nope, I don't dig Mr. Kenton myself, but maybe you do. Dig in, then, for this is probably as good as he comes, as to sound.

Bob Florence Trio. **Stereotape 7**
Stereo Rating: 5

Piano on the right, bass left, drums just behind; that sums up this kind of stereo, which is 100 per cent effective in these terms and so, I guess, rates 5. My apologies to Mr. Robertson, who is 100-odd miles from me now where I can't toss these items over to him. I just get curious, and might as well toss 'em in here while I'm at it. This trio is very mildly modern, with harmonies that are out of the old jazz, and a dry, intimate style that is, I think, of the new. Two or three items were enough for me; then it began to be background night-club music. A very muted, highbrow piano, incidentally, surely a well polished grand.

2. FI-ING AROUND

Honegger: Pacific 231; Rugby; Mouvement Symphonique #3; Prélude pour "La Tempête"; Pastorale d'Eté; Chant de Joie. Philh. Symphony of London, Scherchen. **Westminster XWN 18486**

Well, well . . . shades of the past. "Pacific 231" was a very celebrated piece of derring-do in its day—it had the critics by the hair; concert audiences were shocked and outraged at the deliberate imitation of a mechanical monster. This was the ultimate in rude modernism . . . 1924. It was a scandalous piece, musically, and became at once very popular—everybody wanted to hear the aesthetically naughty music.

Now? It's a noisy piece all right and it makes for some quite effective fi in the process. It is hardly Brahms-like and you won't find any sweet tunes. But as for being shocking—no. For one thing, who wants to hear anything so quaint and old fashioned as a *steam* locomotive. For another, the imitation isn't very literal, by our standards. (It was just the *idea* of imitating a mechanical monster that shocked people.) It huffs and it puffs and it goes faster and slower, in jerks; the strings go scrunch scrunch and the brass gives big whopping blasts and everything is dreadfully dissonant, and quite old fashioned. Nobody in the dim future is going to swoon over the musical message of this work.

"231" is significant, I think mainly, in that it now is so clearly of its own time, the brassy ultra-mechanical Twenties. You'll recognize the sound in an instant—it follows after the "Sacre de Printemps" (which started most of the fuss, earlier) and matches "Adventures in a Perambulator" and "An American in Paris"; it goes along, too, with countless labor-style murals in public buildings where big mechanical gears mesh together and factories spew out molten steel. Man, the master of the mechanical age! The electronic age, you see, hadn't yet begun. We don't compose mechanical music these days; we turn out electronic music. That's the current theme. Locomotive art is dead.

As for Honegger's Rugby game, it is more of the same—might as well be another locomotive as I hear it. And the "Mouvement Symphonique #3" is interesting because it was a relative flop—the composer made the mistake of omitting a fancy title and so nobody paid any attention to it. (If he had called it "Burlington Zephyr 1933" it probably would have gone over big.) Of the three, I find it much the most musical and so will you, title or no title.

More earlier Honegger on the other side, an interesting round-up of this man's work in the Twenties.

Music of Johann Strauss. Minneapolis Symphony, Dorati. **Mercury MG 50131**

Antol Dorati has a remarkable ability, used on some occasions, to inject hard, mechanical exactitude into music that is decidedly not out of the Mechanical Age. In a sense he is merely being modern and of today—we do, after all, live in the electronic, if not the mechanical age. And yet, if you're going to play the music of the past you must in some degree adjust yourself to its demands—I should say to a very great degree.

These waltzes (Voices of Spring, Artist's Life, Roses from the South, etc.) and polkas are beautifully hi-fi and you'll enjoy them, as background or foreground music. But in comparison to the similar recordings now coming out of Vienna (Vanguard's series with Anton Paulik, for example) they are played with a hard, unyielding beat and a too regular, too unsentimental expression. Chances are this won't bother you much, but it has to be mentioned, even so.

Bach on the Biggest. Robert Elmore, Atlantic City Convention Hall Organ. **Mercury MG 50127**

This is an interesting item and, if you'll stop to think a moment you can see why. The world's biggest organ here, 1250 stops, 33,000 speaking pipes, in a convention hall something like four blocks long. The biggest pipe is huge (64 feet long), and emits a completely silent tone of tremendous power at 8 cycles per second!

So—what happens when all this gets on a record? Not, of course, what Aunt Mamie might think, nor what many an adwriter would surely claim—literal reproduction of this giant! That, of course, would propel you feet first out of your chimney with the fireplace and the rest of your house following at supersonic speed.

No—the tricky thing is that, in recording, all levels come out the same, within relatively small tolerances. A good loud puff on an ocarina can be recorded to generate just as much reproduced noise as this monster does in your home, via Mercury's single mike technique. The big question is, what happens when you compress the world's biggest organ to the same dimensions as all the other recorded organs, big and little?

With that in mind, I can observe that it is astonishing how much sense is preserved in this outsized Bach, in the big echo. I would hardly say that the music is crystal clear. What is surprising is that you can somehow follow most of the notes, through the general acoustical fog; the sound is recognizably Bach and, all in all, comes through more or less as music. Mr. Elmore, playing staccato as though the keys were red hot, gets through enough of the huge, triple-swimming pool echo to make musical sense.

Was it musical sense Mercury had in mind? That I could not say! I suggest that there are other recordings of these Bach works—dozens—in which Mr. Bach is more successfully coped with. If hi-fi is your interest, I can't even tell you (Mercury doesn't) whether that 8-cycle tone figures in any of the music here recorded. My speaker doesn't reproduce 8 cycles and my ear can't hear that low. (*Then how do you know it doesn't?* Ed.) If it's any indication to you, my living room plaster has yet to fall down.

Franck: Symphony in D Minor. Boston Symphony, Munch. **RCA Victor LM 2131**

The ti consideration here is musical. This was the symphony that first hit me, a schoolboy, as music that could knock you over with its emotional punch; I fairly swooned. Franck-ly, I don't think any schoolboys or schoolgirls are going to swoon over this new version. It has lost its magic—for the players and for the conductor himself. It seems to me

all modern efficiency, curiously speeded up, made outward and routine in a brisk, workmanlike fashion; it fairly talks to you -let's get this warhorse out of the way, brilliantly, and move on to something with punch in it.

In a word, the symphony sounds plain dated—old fashioned—and the fault is in the playing, not the music. If you can dig up an old pre-war low-fi rendition of this music, from the days when people still thought it the ultimate and when orchestras played it as if it were *meant* to bowl you over, you'll hear what I mean by musical fi.

George Russell and his Smalltet. (RCA Victor Jazz Workshop.) **RCA Victor LPM 1372**

Well, darn it, they will keep sending me these jazz items and I can't help listening, out of curiosity. For good reason though—the Canby musical subdivisions very seldom follow the standard lines and I see no particular reason for *not* listening to a disc like this merely because it sports a black label instead of a red one.

Truth is, jazz is on the way to becoming our own special "classical" music, and this sort of disc is a vinylite straw in the wind. Egg-head jazz, this, and the composer (he *is* a composer mind you, who writes down his improvisations) says things like this in his own written notes:

"The Lydian Concept of Tonal Organization acknowledges the existence of a central tonality and an underlying tonic tone (or primary axis) for a whole area regardless of the degree of dissonance used in the area."

The guy is definitely eggy, but what he says in words makes a lot of sense—in part, that the best written-down jazz *sounds* improvised, that therefore in effect composed jazz can retain the musical expression that jazz has developed. Good! This is simply restating what music as a whole has gone through in Western civilization these thousand years. Improvisation—music made up, like speech, at normal speed—has always come first; writing it down is a more elaborate and artificial approach since it's done, so to speak, at a crawl; but it does allow greater freedom to develop big music, in the end, in jazz as anywhere else. Who could improvise a whole novel, without writing it down?

The Russell sound? I sort of like it though it has the dry, somewhat self-consciously intellectual feel that is now in vogue. It's not nearly as intellectual in the listening as it makes out to be and the best thing to do is—as with all music—just to listen. Excellent for sound, with neat, close-up recording of the half-dozen-odd players.

Tchaikowsky: Nutcracker Suite; Chabrier: Espana; Ponchielli: Dance of the Hours; Suppé: Morning, Noon and Night in Vienna (Overture). Royal Philharmonic, Beecham. **Columbia ML 5171**

If you're going to have fi, you might as well have it like this. Sir Thomas Beecham is a sheer genius at polishing up war horses—especially old-fashioned ones—to make them shine like—well, like war horses. There is, now, a sort of Beecham stable of these, a batch of familiar items like the Nutcracker Suite, and a brace of Beecham specialties, old fashioned but out-of-the-way, like the von Suppé overture here. Beecham just loves to trot out these horses and put them through such musical paces as can delight the soul of every listener who longs for impeccable playing and doesn't often hear it.

I'll listen to Beecham conduct almost any war horse and like it. And the recorded fi is generally up to the music, too. Solidly British.

Finlandia (Sibelius, Grieg, Alfven). Phila. Orch., Ormandy. **Columbia ML 5181**

Ormandy is another favorite war horse man. He, too, can make a war horse shine but his is a more showy, big-sounding sort of horse. Where Beecham relies on superbly impeccable phrasing, neatly turned expression, with a twinkle in the eye and a serious overtone of dedication, Ormandy is an expert showman who can persuade his orchestra to play the big horses with real conviction. Most of the time, anyhow—and this is one of those

times, Finlandia never sounded so bleak and magnificent and Northern, the Swan of Tuonela isn't one little bit apologetic and neither modernized nor streamlined. That's exactly right—Sibelius must be all-out or not at all, these days.

The fi here is magnificent—no less. Just play the first few notes of Finlandia, those big, brassy chords, and see what Columbia has done.

Hi-Fi Fiedler. Boston Pops, Fiedler. RCA Victor LM 2100

Gotta mention this small masterpiece—for here is still another war horse man, in a slightly different category. I can't get over the really nice cover picture on this one; it tells the Boston Pops story in terms of Mr. Fiedler himself.

He sits on a silly stool, in tails and with long baton in hand; next to his head, suspended in space, is a speaker and around his feet, also in space—no shadows, no background, of course—there are zany amplifiers, tubes, power supplies, Zany, that is, as an accompaniment to Mr. Fiedler himself, who wears a quizzical expression that tells you exactly why his Pops music is so wonderful.

The impeccable musician again, hi-fi or no, but not the musician with nose in air, disdaining audio!

William Tell Overture, Le Coq d'Or of Rimsky-K., Tchaikowsky's Marche Slave. A real hi-fi program and it sounds good. Also in stereo tape.

Dvorak: Symphony #5 ("New World"). Vienna Philharmonic, Kubelik. London LL 1607

This is a companion to the Second Symphony, reviewed recently and with pleasure; this version of the New World is superb, for my ear, warm and lyric, splendidly big in both the hi-fi sound and in the performance.

Just goes to show, if you can let the old composers speak in their own terms and values, they'll sound as modern as you please; but once you try to "modernize" them beyond the breaking point, they'll sound merely dated and worn out. It's happened more than once to this familiar symphony, but in this version all is well and the musical gods are in their heavens!

London's familiar ffrr sound might have originally been designed to fit Dvorak himself, so beautifully does it complement the music here. Excellent.

Beethoven: The Five Piano Concertos. Artur Rubinstein; Symphony of the Air, Krips. RCA Victor LM 6702 (5)

No doubt about it, a certain modern sense of symmetry in us makes this sort of recording—of a complete cycle of big works—unusually attractive. Five concertos with one performing design are, in a strictly practical merchandizing way, a better "offer" than the very same five done separately by different artists and sold by the piece. In fact, you can offer this type of package right alongside other individual recordings of parts of it, all on the same label.

This is a "limited edition at a special price." That, I suppose, is a not too happy relegation of the former NBC Symphony to a lower level of appeal under its present name, Symphony of the Air. Considering that it was once supposed to have been put together from the very cream of the world's best players, this might seem unfair; the truth is, as you may guess, that an orchestra is a plastic, living thing, which like an individual performer not only rises and falls in fame but may well change, from month to month and year to year, in its effective musical abilities—up, down, or sidewise. The Symphony of the Air has had to start all over again since Toscanini and its struggle to be a top-rank orchestra is not yet by any means over, musically or financially.

It is hard to have to say, therefore, that the best thing in these recordings is Arthur Rubinstein, who shows his best old-trouper qualities of sure-fire technique and basically sound musicianship, in spite of an old tendency towards whanging and banging in the louder fast movements. He is far from the in

trospective, humble student of the greatness in Beethoven that Schnabel was and his playings are more outward, both more brilliant and more casual. But in his relaxedly powerful way he gets over the main sense and design of the concertos.

The orchestra, playing well in many spots, nevertheless sounds not well enough rehearsed. It is possible that in its present brave struggle to stay in business it really does not have time to polish off a sure, unruffled, accurate playing of such works as these. It may be that it wasn't given time to adjust to another new conductor—one of dozens who have lately led it. In any case, there are many small evidences of unevenness here and, in particular, some sour string chords that don't go down well at all.

Finally, as to style, the joint Krips-Rubinstein interpretation tends towards a lot of crescendo, a largeness of sound and a rounding of contours that is effective but, I'd say, anachronistic. It represents the over-all concert hall "concerto style" of today, applying to almost any old concerto on the books, centering not on Beethoven but, rather on a later, Brahms-Tschaikowsky axis. As I say—effective. But some of this Beethoven, especially in the earlier concertos, is weakened in its Beethovenian message, rather than strengthened, by this outward largesse of audible effect.

There is close-to recording here, in a large and oddly confusing liveness, that blurs many quick details.

Schumann: Piano Concerto. Weber: Konzertstueck in F Minor. Friedrich Gulda, piano; Vienna Philharmonic, Andreae. **London LL 1589**

Here's a dilly, and mainly because these now rather difficult works—difficult to play convincingly in our modern age—are really beautifully turned out by the versatile Mr. Gulda, who just happens to be a jazz pianist as well. He plays night club dates between Schumann recordings.

Could any two kinds of music be further apart than Schumann and jazz? No- not by ordinary conventions. But conventions break down when they are tackled by people: life, if you wish, is made up of people and what they do and, thus, when human beings wish them otherwise, conventions simply do not exist.

And so jazz and Schumann, in terms of Gulda at least, are related and equally understandable. That's all you need to know. Except that, after you have enjoyed these two excellent performances, you should go right out and ask for London's Gulda jazz recording. That'll show you. .E

COMING EVENTS

HI FI SHOWS

Oct. 7–12—New York High Fidelity Show, Trade Show Building, New York City (*IHFM*).
Oct. 18–20—Miami, Florida: McAllister Hotel (*Rigo*).
Oct. 25–27—Cleveland (*IHFM*).
Oct. 30–Nov. 2—Toronto: Park Plaza Hotel (*Independent*).
Nov. 8–10—Seattle: New Washington Hotel (*Rigo*).
Nov. 8–10—Detroit: (*IHFM*).
Nov. 15–17—Buffalo (*IHFM*).
Nov. 22–24—St. Louis: Statler Hotel (*Rigo*).

OTHER EVENTS

Oct. 7–9—National Electronics Conference, Hotel Sherman, Chicago, Ill.
Oct. 8–12—Audio Engineering Society, 1957 Convention. Trade Show Bldg., New York. Banquet on evening of Oct. 10, Terrace Room, Hotel New Yorker.
Oct. 16–18—IRE Canadian Convention, Exhibit Park, Toronto.

BOOK REVIEW

ACOUSTICS FOR THE ARCHITECT, by Harold Burris-Meyer and Lewis S. Goodfriend, 126 pp. New York, Reinhold. $10.00.

It is a truism that music cannot sound any better than the acoustics of the space in which it is performed, recorded, or reproduced, will permit. The door which leaks in outside noise, the vibrating floor, the playroom which is so live that you cannot understand the words of the television program, are deplorable but common phenomena. And we suffer these ills because someone took a chance rather than planning the acoustics, often because he didn't know any better. **ACOUSTICS FOR THE ARCHITECT** undertakes to rectify this lack.

The authors provide the architect with the tools requisite to handle acoustics and noise control in the structures he designs without requiring him to examine the complex physics fundamental to the science of acoustics. Charts, tables, and check lists (containing new material presented for the first time) simplify the necessary acoustical calculations. The architect can now plan accurately in his own shop that part of the design traditionally left to chance. The book discusses the method by which acoustics is integrated into architectural design; various architectural elements and their acoustical characteristics, and electronic sound systems. Design procedures are given for demanding situations: concert halls, coliseums, theatres, and studios.

So now that the architect and builder have an acoustical handbook unencumbered with mathematical derivations, there may be some attention given to the acoustics of the home as has been to the theatre, the office, and the sound studio.

Included with the book is a copy of the Acoustical Materials Association Bulletin which lists the characteristics of acoustical materials currently available.

—*C. G. McP.*

Bauer Joins CBS Labs

Appointment of Benjamin B. Bauer to head the section for audio and acoustical research of CBS Laboratories Division has been announced by Dr. Peter C. Goldmark, president.

Prior to joining CBS, Mr. Bauer was vice-president in charge of engineering and research for Shure Brothers, Inc., where he was responsible for the development of many electro-acoustical devices such as microphones, phonograph pickups, and tape recording heads. He also has numerous inventions to his credit in the fields of audio and acoustics.

He is a Fellow of the Institute of Radio Engineers, the Acoustical Society of America, and the Audio Engineering Society. Also he is associate editor of the Journal of the Acoustical Society of America, and in 1955 as co-founder and past national chairman of the IRE Professional Group on Audio was recipient of the group's Achievement Award. As an active member of the American Management Association, Mr. Bauer has conducted seminars on various phases of research and administration.

VIOLIN

(from page 11

the "tiny resonators" to which I referred earlier with such slighting attention contribute their fair share, and that the bow actually radiates sound?

Playing

To the layman, the incessant practice needed by a violinist may seem to be a reflection on his mentality. I won't argue the point. But I would like to state that two problems aside from appreciation and memory are involved: that of training, conditioning, and strengthening the musculatures taking part in the "stance" and the manipulative techniques of violin playing, and the establishment of sanguinary and lymphatic circulatory paths around and through muscles, tendons, and tissues that are forced to function in a highly unnatural position. This latter item becomes painfully apparent to the older ex-violinist who hasn't the time to play for more than a few hours each month: namely, me. Not only do vigorous exercises bring on pain in the hands, wrists, and shoulders but they can produce numbness and even paralysis in extreme cases. The "stance" of the violinist is the groundwork around which his technical abilities center: but this same "stance" varies widely for persons of different build and nervous temperament. The fingers should fall like miniature forging hammers—and the thuds can be heard on any good, close-up recording; the left wrist should flexibly and surely anticipate and lead the shift of the hand; the elbow provides the power for moving the upper arm; and the shoulder stabilizes the entire arm as well as the instrument itself. All this is done in what the layman soon finds to be a highly cramped and uncomfortable position when he is shown how to hold a fiddle.

As for the bow-arm, the fingers of the right hand lock—I repeat, lock—onto the bow. This to me is the most marvelous holding attainment of man: even greater than that required of surgeons. It is virtually impossible to wrest a bow from a violinist's grip without breaking it or his fingers, and yet the bow is held with the utmost delicacy and sensitivity. It can be moved at great speed—over 300 inches per second—or cling interminably. It can barely graze the string so that virtually only the overtones are audible or it can excite the string into violent oscillations. It can brush gently like a neophyte's kiss or bite the string like a terrier. It can

change strings much more quickly than the eye can follow the change, or it can play all four strings simultaneously. You may ask what governs this amazing development of control and the answer, of course, is *feedback*: Hi-Fi Analogy. Even the neurologists and cybernetists call it feedback—and have for a good many years—so the audiofans need not feel that the word belongs to them. The cybernetists define feedback, in the act of picking up a pencil, for example, as the estimation and reactive adaptation of the amount and direction of movement by which you have not yet picked up the pencil. I've tried for years to figure that one out.

Have you ever watched a very young lad trying to learn to play a fiddle?

I can conceive of no picture more excruciatingly amusing and pathetic, at the same time, than the picture of a small boy in the proemial stages of violin practice. Despite a bull-dog determination and an intense sincerity, the sounds emanating from the object under his chin are withal so mournfully inauspicious as to be virtually unbearable. But this is only because he has not yet learned how to apply the right kind and amount of feedback to the movements that he had been taught to make; nor do his reflexes yet supply this automatically. This is what takes incessant practice!

There are so many ways in which the technique of the artist affects the tone of the violin, and so many variations of tone, color, and projection that, happily, can be explained by reasonably credible engineering theory, that it would require at least one other paper to discuss them. Suffice to say, nevertheless, that the violin is not a simple, strung-up box, nor are its players simple minded nuts who get so good at it because they can not learn to do anything else. Although the average violinist in this country lives in a perpetual state of apology for his profession, and takes a moral beating from the engineering and scientific worlds, I wonder if he is any more naive than the eager-beaver audiofan who buys a fifty-dollar loudspeaker and fully expects it to sound like a $50,000.00 Strad—played by a man with a $50,000.00 education. And if it doesn't, then it could only be the fault of the five dollar record, or the twenty-five dollar cartridge, or the hundred dollar amplifier, or the two-hundred dollar specially designed Bilingual-Phase-Perverting-Alp Horn Kit—maybe the manufacturer forgot to pack everything.

This last by way of a final Hi-Fi Analogy. Æ

NEW LITERATURE

• **Pilot Radio Corporation,** 37-06 36th St., Long Island City 1, N. Y., has just published an attractive 16-page booklet entitled "High Fidelity in the Home—a New Approach by Pilot," as a guide to the consumer in understanding the broad personal enjoyment which can be realized from authentic high fidelity. The booklet describes the history and development of high fidelity to the present day, and includes a useful glossary of high-fidelity terminology. It is available free through written request direct to Pilot or from any authorized Pilot dealer in the U. S. or Canada. **K-1**

• **Apparatus Development Company, Inc.,** 115 Main St., Wethersfield 9, Conn., has recently published an interesting booklet titled "Theme and Variations," devoted to the subject of FM antennas and their usage and installation. The book is written by L. F. B. Carini, for many years an outstanding authority in the field of FM antenna design. Various types of FM antennas are evaluated to performance and special attention is given to 72-ohm systems and fringe installations. There is also included in the booklet a complete directory of FM broadcast stations and other useful data. Requests for copies must be accompanied by 25 cents to cover mailing and handling, and should be sent direct to Apparatus Development Co., Inc. **K-2**

• **Magnetic Products Division, Minnesota Mining & Manufacturing Co.,** St. Paul 6, Minn., covers "Physical Limitations of Magnetic Tape" in the latest issue of "Sound Talk." Written on a practical level by A. H. Persoon, the article is exceptionally informative and will be of exceptional value to persons engaged in the design and manufacture of tape-recording equipment. Requests for copy should specify Bulletin No. 35, and should be addressed to Dept. M7-21S, 900 Bush St., St. Paul 6, Minn. **K-3**

• **Ampex Audio, Inc.,** 1620 Kifer Road, Sunnyvale, Calif., in the most handsome booklet to cross this desk in many months, describes the nature of stereophonic sound and how it can be most fully enjoyed in the home. Lavishly illustrated in four colors, the 16-page publication features an inclusive article which explains, in practical terminology, what is meant by stereophonic sound and how it is reproduced realistically by the new Ampex line of stereo home music systems. The background of Ampex Corporation, of which Ampex Audio, Inc., is a wholly-owned subsidiary, and its contributions to the magnetic tape recording field are briefly outlined. Copies of the new Ampex booklet are free on request. Write to Dept. SF, in care of the address shown above. **K-4**

• **General Electric Company, Semiconductor Products Department,** Syracuse, N. Y., announces publication of the second edition of the "Transistor Manual," which contains basic information on transistors and their use in electronic circuits. Included in the 112-page manual is material on basic semiconductor theory, construction techniques used in making the various types of transistors now on the market, explanations of transistor specification symbols now in common use, and specifications with outline drawings of all transistors registered with the Electronic Industries Association (formerly RETMA). The new edition also includes circuit diagrams for 29 different pieces of equipment ranging from a simple code-practice set to a sun-cell-triggered relay and a completely transistorized high-fidelity amplifier. Requests for copies should be addressed to Section PR8, General Electric Company, Syracuse, N. Y., and must be accompanied by a remittance of 50 cents. **K-5**

• **J. J. Powers Company,** 1317 S. 5th Ave., Maywood, Ill., illustrates and describes the firm's complete line of loudspeaker baffles in a new 8-page catalog. Included in the listings are wall and ceiling styles in hardwood, hardboard and metal, along with portable models, hi-fi enclosures and accessories. Specifications required by contractors, architects and sound engineers are featured. Requests for copy should specify Catalog P-100. **K-6**

SPEAKER SYSTEMS

(*from page 40*)

pens on a specific speaker and a specific cabinet, made by different manufacturers, that make good music together. An example is the James B. Lansing D130 15-inch single-cone all-range speaker in a Cabinet Model 27 bass-reflex enclosure. Discriminating listeners, particularly musicians, have found this combination realistic, smooth, excellent in its definition. (On the other hand, persons enamored of locomotives, drums, keys, castanets, waterfalls, and so forth may consider such a system less satisfactory than other combinations in the same price class.)

The individual who acquires a speaker separately knows exactly what he is getting in the way of components. There have been cases where relatively high-priced combinations have represented an inferior buy on a component-by-component breakdown. Sometimes small, mediocre speakers have been hidden inside a massive enclosure. In other instances there has been an undesirable compromise with quality of a component, such as the use of electrolytic capacitors instead of paper ones in the crossover network. This sort of thing does not unwittingly happen to the person who assembles his own speaker system.

Finally, one should take account of the creative satisfaction derived from building or assembling a speaker enclosure. High fidelity as a hobby is, to many, not only a matter of listening pleasure but also of playing an active part in bringing the system to life. The time and effort spent in planning, constructing, and checking various parts of the system are rewarding in themselves.

Integral Unit

On the other side of the coin, essentially, is the fact that many factors can prevent a speaker and enclosure from operating in the hoped-for harmonious manner. If the audiofan buys a speaker on the basis of reputation or how it sounds in an audio showroom and buys an enclosure on the basis of decor, he is asking a good deal to expect this sort of blind date to eventuate in a happy marriage. If he elects to build an enclosure of his own design, seldom if ever does he have the test equipment, engineering talent, and other resources not only to try the embodiments of good engineering sense but also to explore extensively a wide variety of cut-and-try approaches.

Following are examples of factors that can stand in the way of an effective speaker-enclosure match.

Resonances of the speaker (woofer) and enclosure may fail to complement each other properly, resulting in an undesirable bass peak, as can happen in a bass-reflex cabinet with a fixed port. A speaker may have imperfections, such as buzzes or rattles, which do not become apparent until it is mounted. A warped panel to which a cone speaker is firmly bolted may warp the speaker and cause malfunction. The enclosure may have rattles or panel resonances because of inadequate bracing or construction. A horn-type enclosure may not be sufficiently airtight for good loading.

Dividing-network components may depart excessively from nominal values, particularly if assembled by the audiofan without recourse to measuring instruments, causing a hole or peak in response. Midrange frequencies may be absorbed inadequately by interior padding, producing ragged response. Speakers in a multichannel system may be phased improperly, creating a hole in the crossover region. Phasing refers not only to polarity of the speaker leads but also to the fore-and-aft position of the tweeter with respect to the plane of the woofer; that is, the tweeter may have to be moved forward or backward a few inches for optimum phasing; also, the design of the crossover network affects phasing. High-frequency response may be excessively beamed or excessively diffused because of choice of tweeter, type of horn used (if a horn type), or tweeter placement.

The woofer may be insufficiently damped in a given enclosure, resulting in muddy bass (hangover); even an amplifier with a high damping factor or with variable damping may be unable to correct the situation adequately. On the other hand, a particular speaker-enclosure combination may require a small amount of damping; excess damping by the power amplifier will cause an appreciable loss in bass response. The tweeter, if of the cone type, may be adversely affected by back radiation from the woofer if mounted in the same enclosure without proper separation. The efficiency of the woofer may be extremely low in a given enclosure, too low for the power amplifier used. The level of the tweeter may not be balanced to that of the woofer unless an attenuator for the tweeter is added. On occasion the woofer may be more efficient than the tweeter, so that the former requires attenuation. And so forth.

It bears emphasizing that given a speaker of excellent construction and an enclosure of good design and workmanship satisfaction is still not guaranteed. There have been many instances, as audio salon personnel can testify, where a speaker has sounded fair to miserable in a given enclosure, although

both components were individually of high quality and operated at least moderately well with other units. On the other hand, mediocre speakers have at times risen to creditable heights in certain cabinets. On the whole, it is difficult to predict accurately how a given speaker and given enclosure will sound.

The audiofan might therefore consider whether in his particular circumstances the best course, though often more expensive (perhaps not in the long run), is to buy an integral speaker-enclosure combination, presuming that the reputable producer has shouldered the task of choosing compatible elements and eliminating obstacles to good reproduction. Today, most manufacturers of quality speakers offer integral units. In addition, other producers, including some of the leading audio salons, are putting high-grade generally-available speakers into enclosures of their own design and are marketing these as integral systems.

Conclusion

Beyond question, purchase of a speaker or an integral system is a very subjective matter. Two persons with equal taste and means, presented with like choices, exercising the same caution, and having the same dedication to life-like audio reproduction, may well choose differently. Fortunately, the fine speakers and systems are numerous enough and range sufficiently in price so that almost every individual, with due effort, should be able to find one that pleases him not only on first acquaintance but over a period long enough to justify its cost.

The listener who has assembled a high-quality speaker system or purchased one as an integral unit should not expect it to turn dross into gold. Rather, it quite completely reveals dross as dross and gold as gold. It throws a white light upon the qualities of the program material and of the audio chain preceding the speaker. In terms of frequency range, balance, and clean sound, one hears more readily the differences among disc recordings, among tape recordings, between discs on the one hand and tapes on the other, among various radio stations, and among various audio components.

As a matter of fact, on program material of inferior quality an inferior speaker system may sometimes sound as good or, if its frequency response is limited, even better than a quality system. But as program material—on FM, disc, and tape—continues to improve, the advantages of a high-quality speaker system are becoming ever more apparent. The audiofan will find it eminently worthwhile to direct his efforts and budget toward the best speaker system within his reach. Æ

DAMPING

(from page 27)

tionships that we have discussed should help in this connection.

1) Let us study the case of a speaker whose nominal impedance is 8 ohms. The d.c. resistance of its voice-coil will be of the order of 6 ohms. Thus the total d.c. resistance that the speaker sees, looking back at the amplifier, is equal to the sum of the amplifier source resistance, the d.c. resistance of any series choke from a crossover network, and its own d.c. resistance. (The representation of internal resistance by an external resistor of equivalent value is standard practice for generator diagrams.)

The d.c. resistance of the series choke is likely to be about 0.5 ohm. The source resistance of the amplifier, with a damping factor as low as 4, will be 2 ohms. The total resistance seen by the speaker is then 8.5 ohms.

Eliminating the choke (a component which is sometimes severely frowned upon) gives us a reduction from 8.5 ohms to 8 ohms. Doubling the damping factor (halving the source resistance) gives us another sweeping reduction, to 7 ohms. In brief we must remember that, even with the speaker terminals shorted out by heavy copper wire of .001 ohm resistance, the smallest braking resistance we can ever achieve is 6.001 ohms. There is thus little to be gained by worrying about small resistive components in the speaker line, or by increasing the damping factor to astronomical values.

2) If we connect a second, identical speaker in series, the total internal d.c. resistance is increased to 12 ohms. But the ratio between resistance and reactance remains the same, as we now have a 16-ohm system, and the damping is unchanged. (Each 8-ohm voice-coil may be thought of as one-half of a 16-ohm voice-coil.) The series connection is perfectly good practice.

3) Another well quoted misconception relates to the fact that the coupling, at bass frequencies, between an infinitely baffled cone and the air into which it radiates decreases as the frequency is lowered, and that this decrease is compensated by progressively increasing speaker cone velocity, as discussed previously.

The belief has somehow gained ground that the loss in acoustical coupling referred to has to do with the low bass regions only, below one or two hundred cps, and that the compensating increase

in cone velocity is related to speaker resonance: that is, that the resonant peak is used to "fill in" the acoustical losses.

Actually the air-load resistance presented to the cone decreases with frequency at an orderly rate (a factor of 4 per octave), below a frequency which is a function of the cone diameter—for a 12-inch speaker about 800 cps. No change in this progressive loss occurs in the extreme low bass. The theoretically ideal compensation for the decrease in air load resistance would be provided by a purely mass-controlled mechanical system, without resonance, which would dictate a doubling of cone velocity for each lower octave. (The electrical analogy is a purely inductive circuit—for the same applied voltage, current through the choke will double with each lower octave, due to the progressively decreasing inductive reactance.) Such a system is a non-existent entity, but if the speaker's resonant peak is properly damped the mechanical system acts as if it were purely mass-controlled at frequencies above resonance, and the proper compensation is provided.

4) As the frequency of the input signal to a loudspeaker is lowered in the direction of resonance, the electrical impedance of the speaker rises far above its nominal value, perhaps by 5 or 6 times. With a high-damping-factor amplifier the voltage across the speaker remains essentially constant, involving a severe drop in the electrical power drawn from the amplifier; with a lower damping factor the drop in electrical bass power is less severe; and with an even lower damping factor electrical power may remain constant, or may increase towards resonance. That value of damping factor which achieves the most uniform *acoustical* output and optimum performance is not tied to a condition of uniform electrical power, but is a function both of the particular speaker used, and of its conditions of mounting. While high damping factors are generally most suitable for horn or resonant-type systems, the same is not necessarily true for direct-radiators. No special virtue can be attached to that value of damping factor which produces constant voltage, constant power, or some intermediate type of relationship betwen amplifier output and frequency, if speaker system performance is unknown.

I would like to express my appreciation to Dr. J. Anton Hofmann for his patient reading of the draft of this article and for his valuable suggestions. Æ

AUDIOCLINIC

(from page 4)

ceptible to hum to varying degrees. Their hum content depends upon the lengths to which manufacturers have gone in an effort to eliminate this condition. To do so means that the cartridge must be well shielded and wound in such a manner as to oppose external fields but still operate normally when internal changes in magnetic fields occur. Certain models of cartridges must be kept well away from stray fields from the motor. The solution to the problem lies in orienting the tone arm in such a manner that the cartridge's path is as far from the motor as possible.

Before mounting the arm permanently, connect the cartridge to the input of the preamplifier and adjust the arm for the lowest amount of hum pickup.

Tweet Filter

Q. What is a tweet filter? Jacob Blackman, Union, N.J.

A. The time constant of the diode load resistor and its shunt capacitor used in conventional AM detector circuits is such that while the r.f. peaks which occur when the diode is conducting are smoothed out, the changes in amplitude produced by modulation by the program source are not smoothed out. Thus we have detected AM signals. Since the capacitor serves to remove the r.f. component from the audio, and since the r.f. is very high, this capacitor is sometimes known as a tweet filter.

LETTERS

(from page 7)

the only property of a speaker or speaker system which can be measured with only an audio oscillator and a voltmeter as equipment. The impedance curve does show the resonant frequency of the unit, but I strongly question the validity of using it to indicate anything else. As a matter of personal interest, I recently ran low-frequency impedance curves on a speaker which I have in my shop. Uncased, it had an impedance peak at about 175 cps, indicating the resonant frequency. Below this, the impedance dropped off steadily. The response, as determined by ear, also dropped sharply below resonance, and was negligible below about 80 cps. The speaker was then installed in a broadband tuned column cabinet and the impedance redetermined. Housing the speaker lowered the resonant point to about 140 cps, but without changing the shape of the curve. However, in this case, audible response was there all the way down to 30 cps (which is as low as my oscillator will go), even at 50 cps and below the impedance had dropped from the nominal 8 ohms to less than 1. *(In general, d.c. resistance of an 8-ohm speaker would be around 5 ohms, so total impedance must be at least that much.* Ed.), and I was not able to measure it with the available equipment. This means, at least to me, that the relationship between the impedance curves seen upon the actual response of the system is so limited as to be of little importance in judging response.

The preceding discussion boils down to

this: The purely electronic sections of an audio system can be made to much closer tolerances than the electro-mechanical or electro-acoustical portions. They can be, and are, made so that the user can vary the characteristics of the electronic system to a considerable degree. However, the final section of the audio system—the speaker in its installation—remains sufficiently variable and enough of an unknown quantity that the use of precision controls in the electronic end becomes slightly ridiculous. A pair of soundly designed, wide-sweeping tone controls—bass and treble—should provide all the variability needed for practically all uses, and high fidelity need not be synonymous with complexity of operation.

R. D. HERLOCKER
7918 Dalmar Ave.,
Hammond, Indiana.

(This letter has been in our hands for some time, but it is just as interesting and provocative now as it was when it was written. ED.) Æ

FIDELITY PERILOUS

(from page 32)

mustn't try to talk too much just yet." She stroked his forehead. "The test was successful. Herbish is proud of you and W.W. sent a personal note of congratulations. I saved it at home for you."

"You're not angry with me, dear . . . for taking the chance I mean?"

"I was almost beside myself when I heard you'd been injured. But then Colonel Herbish told me the whole story and I started doing some real thinking for the first time in my life. I realize now what a fool I've been."

"Don't say that Elissa. It was my fault. I . . ."

"Shh! Not another word. I don't know how to tell you how proud I am of my husband. I'm a lucky woman Joe. I promise I'll never stand in your way again."

Joe felt that his world was complete. A new life with Elissa—this was what he'd been working for.

"I'm wearing a new shade of lipstick, Joe. Like it?"

He stared for a moment. "Why . . . why it's Max Factor *Hi-Fi*."

"Mmm hmm. Now close your eyes and I'll give you a personal demonstration." Æ

NEW PRODUCTS

• Norelco 3-Speed Tape Recorder. Called the "Continental," this new recorder was designed by Philips of the Netherlands. Three speeds—7½, 3¾, and 1⅞ ips assure maximum versatility in both speech and hi-fi music recording. A special Philips magnetic recording head with air gap of only 0.0002 ins. makes possible extended high-frequency response even at the lower speeds. Piano-key pushbuttons control all functions. A dual-track machine, the Continental is equipped with a built-in loudspeaker of the well-known Norelco twin-cone wide-range design. A high-fidelity dynamic microphone is supplied with each unit. Detailed specification sheet on the new Norelco tape recorder may be obtained by writing North American Philips Co., Inc., High Fidelity Products Division, 230 Duffy Ave., Hicksville, N. Y. **K-8**

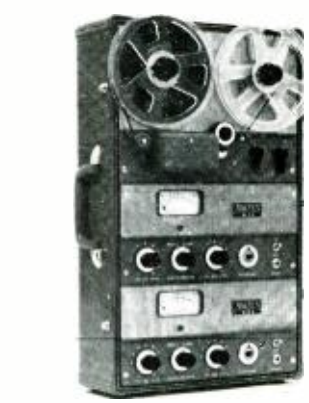
• Molded Cable-Connector Combinations. Great savings of time in the interconnection of high-fidelity components will be afforded by these new phono plugs and extension jacks with shielded handle molded to cable. Manufactured in both straight and right-angle types, as illustrated, the connectors are available in standard cable assemblies of the type used in audio equipment for interconnecting amplifiers, tuners, microphones, test equipment, and the like. Full details may be had by addressing the manufacturer, Switchcraft, Inc., 1328 N. Halsted St., Chicago 22, Ill. **K-9**

• University Wide-Angle P. A. Projector. The new University Model CLH wide-angle reflex trumpet has an air column length of 4½ ft., horn cutoff of 120 cps, and a dispersion pattern of 120° × 60°. It incorporates an exclusive omni-directional swivel mounting arrangement which enables the projector bell to be rotated 360° on its axis. The positive-lock serrated swivel "I" mounting bracket is also specially designed to link two or more projectors into any desired configuration. The CLH can thus project sound in any direction, irrespective of the speaker's physical location. The bell mouth is 21½" × 11½" and depth is 20 ins. less driver. University Loudspeakers, Inc., 80 S. Kensico Ave., White Plains, N. Y. **K-10**

• Techmaster Plug-In TV Remote Control. In addition to providing remote control of a television receiver, the Duo-Master may be used as an FM receiver for TV-sound broadcasts. It will supply a high-quality audio signal to a tape recorder or hi-fi system by means of a receptacle at the rear of the chassis which is fed from a cathode-follower amplifier. In effect, the Duo-Master is a complete TV receiver with sweep and video output circuits, but minus sync, high-voltage supply and picture tube. Installation consists of plugging in a single thin lead into the TV receiver, which permits station selection, fine tuning for both picture and sound, and adjustment of picture intensity up to 50 feet from the receiver. A speaker is incorporated in the Duo-Master chassis for monitoring of tape recordings. Tech-Master Corp., 75 Front St., Brooklyn, N. Y. **K-11**

• Astatic Slim Hi-Fi Microphone. Designed for both hand and around-the-neck use, the new Astatic Model M332 microphone is stated to have a frequency response of 30 to 15,000 cps with an output level of −57 db. Precision made, though low in cost, the M332 is a slim-line design with a pressure-cast housing finished in satin chrome. Manufacturers models are available in satin black or color bodies with chrome trim. Included with each microphone is an 8-ft. shielded cable, necklace-type neck suspension, and stand adaptor. Model M332-S also includes a built-in on-off switch and sells for a slightly higher price. Further information may be obtained by writing for Catalog 33-2, The Astatic Corporation, Conneaut, Ohio. **K-12**

• Ampex Portable Two-Track Stereophonic Recorder. Full professional quality recording is afforded by the new Ampex Model 601-2 in compact portable form. Although the 601-2 is easily transported in its Samsonite carrying case, in performance it is indistinguishable from the Ampex Model 300-2 console recorder. Precision stacked heads are used for both recording and reproducing. Tape speed is 7½ ips. Frequency response is 30 to 15,000 cps, down no more than 1 db at 15,000 cps; 10 to 10,000 cps within ±2 db. Signal-to-noise ratio is greater than 50 db at 3 per cent distortion. Effective inter-track crosstalk rejection is greater than 50 db. Starting time is virtually instantaneous, with tape achieving full recording speed in less than 0.2 second. Playback timing accuracy is ±0.2 per cent (±3.6 seconds for a 30-minute recording). Two phone jacks and a panel-mounted selector switch permit monitoring either from the input or from the tape while recording. Tape tension is controlled to 8 ounces maximum. Each channel is equipped with separate record and playback amplifiers. Two professional VU meters read directly all operating levels on each channel. A specially engineered bias supply common to the two channels insures positive protection from inconsistencies in output levels. Over-all dimensions of the 601-2, including carrying case, are 8" × 13" × 21½". Weight is 42 lbs. For complete information write Ampex Corporation, 934 Charter St., Redwood City, Calif. **K-13**



• Intersearch Tone Arm. Manufactured with laboratory precision in Japan, the new Model 1/S/12 deluxe tone arm incorporates a number of advanced features, including the ability to play 16-in. records. Lateral viscous damping soaks up resonances, aids tracking. Extremely low vertical inertia permits safe use of cartridges with low vertical compliance, also facilitates tracking of warped records. Adjustable horizontal static balancing reduces the effects of floor vibration, minimizes groove jumping. Accommodates all standard

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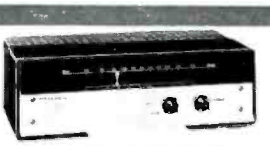

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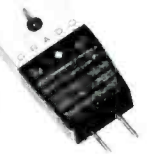

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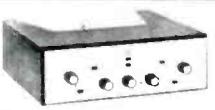

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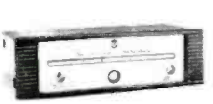

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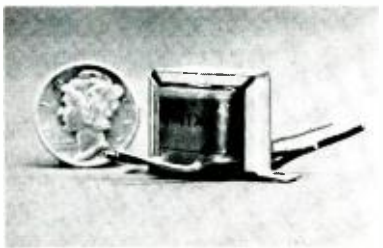
mounting cartridges. Intersearch Corp., 7 Arcadia Place, Cincinnati 8, Ohio. **K-14**

• **Multiple-Speaker Matching Transformer.** Developed for the hi-fi hobbyist who is modifying or enlarging his music system by the addition of auxiliary speakers, equalizers or crossover networks, this transformer permits changes to be made without unbalancing required impedances and power levels. Power handling capacity is 50 watts continuous with 100 watts peak. Frequency response is 15 to 30,000

cps. Power level adjustment is in 3-db steps. Impedance matching range covers 16, 8, and 4 ohms. The unit is supplied with a hook-up chart which shows proper method of connection for many different speaker combinations. Manufactured by Microtran Company, Inc., 145 E. Mineola Ave., Valley Stream, N. Y. **K-15**

• **Triad Transistor Transformers.** A total of 14 new models have been added to the line of Triad transformers designed specifically for use in transistor circuitry. Developed to cover a wide variety of transistor applications, the new units combine



optimum performance with minimum size and weight. Illustrated is a typical model, showing its size compared with that of a dime. A complete listing of all Triad transistor transformers is contained in Catalog TR-57, available by writing Triad Transformer Corporation, 4055 Redwood Ave., Venice, Calif. **K-16**

• **Amperex Type EL84 Power Pentode.** One of the new Amperex series of 'preferred' type tubes for high-quality audio applications, originally developed by Philips of the Netherlands, the EL84/6BQ5 is designed for the output stages of low-distortion amplifiers with relatively low-voltage power supplies. A pair in push-pull will deliver 17 watts at 4 per cent harmonic distortion (without feedback) in class AB

operation with only 300 volts B+ supply. Plate dissipation is 12 watts, which is achieved in a miniature envelope only slightly taller than that of conventional miniatures used exclusively as voltage amplifiers. Detailed data and applications engineering information are available from Special Purpose Tube Division, Amperex Electronic Corp., 230 Duffy Ave., Hicksville, N. Y. **K-17**

TRANSISTOR MICROPHONE AMPLIFIER

(from page 29)

for a 20-kc bandwidth (at 300°K). For a microphone with a sensitivity (RETMA G_M) of −145 db, this lower level occurs at a Sound Pressure Level of 15 db above reference (.0002 dynes/cm²).

For entertainment-type pickup (speech, music, etc.) the maximum SPL encountered is usually 120 db above

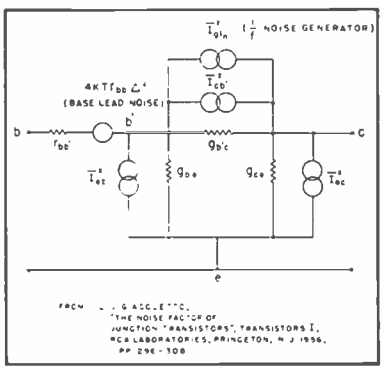


Fig. 7. Common-emitter equivalent circuit with noise generators.

reference. Thus, the dynamic range of the input signal can be as much as 105 db, or the input can be as high as −26 dbm (2.5 microwatts).

If the first stage of the amplifier is designed to have 30 db of power gain, it must therefore be capable of supplying as much as 2.5 milliwatts to its load. If this load should be a second transistor, with 2000 ohms input impedance, this would require a peak output current of 1.6 ma from the first stage. Since, as previously mentioned, the first-stage operating current was set at 0.25 ma, it cannot deliver a peak current greater than this. Therefore, it will overload at a level 16 db below peak input, or at 104 db Sound Pressure Level.

There are several possible solutions to the problem:

(a) Insert a pad on the input. This is quite unsatisfactory because of the adverse effect on the noise figure. (Each db of attenuation raises the noise figure 1 db.)
(b) Raise the load impedance of the first stage. This will be shown unsuitable because of gain-control requirements.
(c) Reduce the first-stage gain by feedback. This is the most satisfactory method, although the limitations of second-stage noise prevent it from being a complete remedy.

Since the second stage is run at a higher operating point, and, if possible, should not have to be selected for noise, its noise figure may easily be 13 db or higher. Should the first-stage gain be reduced from 30 db to 14 db, in order to handle the full range of input, the second-stage noise will be only 1 db below that of the first stage. Because the noise problem in this case was considered most important, the gain of the first stage was arbitrarily set at 24 db, making the dynamic range 95 db. It was assumed that the special case of Sound Pressure Levels above 110 db could be taken care of by a switch or other means.

Gain Controls

Since the first-stage peak output current can be as high as 0.25 ma, it must be followed by a volume control if the

[2] Published by RCA Laboratories, Princeton, N. J.

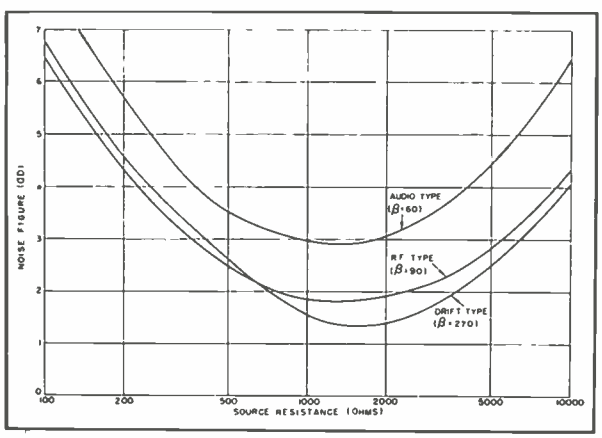


Fig. 8. Noise factor vs. source resistance for a selected transistor of each type.

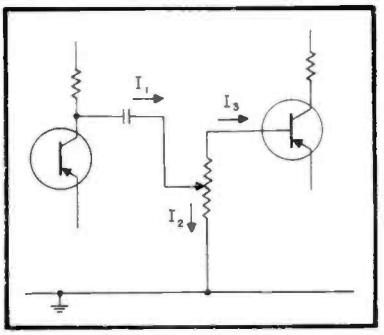


Fig. 9. Gain control shown connected as a current divider.

second stage is not to be overloaded. However, as mentioned, the second stage must be run at a high operating point, in order to handle more signal, and it is also desirable not to have to select this unit. Therefore, second-stage noise can be a problem if the control is turned down. If the stage happens to have a noise figure of 13 db, its noise will be only 11 db below that of the first stage at maximum volume, and will be equal to it if the gain of the first stage is reduced 11 db by the volume control. This strongly indicates the use of a second control, on the output of the second stage.

The use of a dual-ganged gain control is common practice, but some precautions should be observed. First, since transistors have a low input impedance and high output impedance, the control should not be connected as a voltage divider, but rather as a current divider as shown in *Fig.* 9. Also, since the base of the transistor is above ground potential, there is d.c. flowing through the control, which can cause noisy operation if a poor control is used. Finally, since different stages overload at different levels, the controls should be arranged to cut-off later stages first, in order to preserve maximum signal-to-noise ratio. For this purpose, potentiometers with dissimilar attenuation characteristics

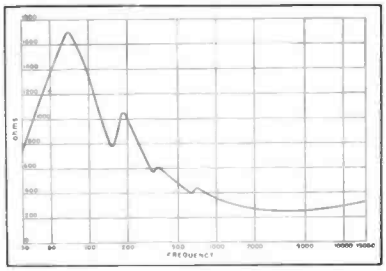


Fig. 10. Impedance of a ribbon microphone with bidirectional pickup (250 ohms nominal).

should be used, such as a linear control first, followed by a log taper, or an anti-log followed by a linear, if linear attenuation is desired. If reasonable care is used, the amplifier can be designed so that at a certain setting of the control all three stages overload at once, giving maximum signal-to-noise ratio.

Feedback

Because of the variability of transistor parameters, and the "in between" nature of many of the characteristics, the application of feedback to transistor audio circuits is almost inevitable. Some of the undesirable characteristics are: common-emitter current gain which rolls off within the audio band (8000–10,000 cps for 2N109 type); input impedance which is low, but cannot be neglected; high output impedance, but not high enough to be considered constant current.

The simplest and most effective feedback for transistors is current feedback. This is achieved simply by inserting an unbypassed emitter resistor, and has the effect of raising both the input and output impedance, making the current gain more linear and more independent of frequency, and reducing the power gain of the stage.

As previously outlined, the power gain of the first stage must be reduced to minimize the amount of overload. If this is done with current feedback, it has the added advantage of raising the input impedance sufficiently to enable the amplifier to be used with velocity microphones. Although work outlined here was done with a pressure microphone whose impedance is relatively constant, it was felt that the amplifier should not be limited to this inspection. As shown in *Fig.* 10, any loading on a bidirectional ribbon microphone will cause a severe loss of low-frequency response, since it yields a flat voltage into an open circuit. With feedback, the input impedance of the amplifier is 6000 ohms which is sufficiently high to ac-

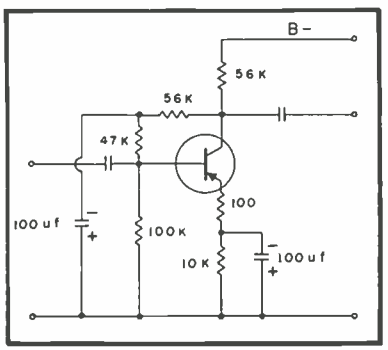


Fig. 11. Temperature-compensated transistor stage.

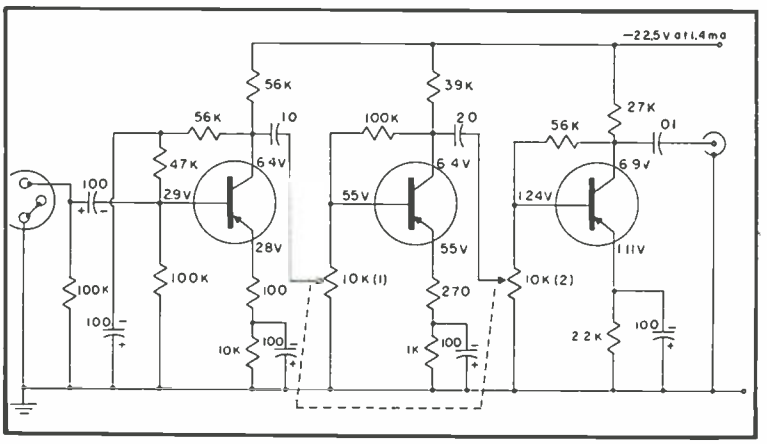


Fig. 12. Experimental microphone amplifier.

commodate the variation of microphone impedance.

Raising the output impedance of any stage is of importance where the load is to be a gain control. The closer the output approaches constant current, the smaller the coupling capacitor can be. Because of the d.c. on the control, the capacitor must be charged each time the control setting is changed. The smaller the capacitor can be made, the less will be the charging current, and the pot will therefore have less tendency to become noisy.

Stabilization

Because transistors change characteristics with temperature, the operating point must be stabilized. This is not a great task, and by using a combination of three forms of stabilization, the operating point can be well fixed to 65° C. The three forms are: constant emitter current, collector-to-base feedback, and base-voltage stabilization. *Figure* 11 shows a stage incorporating these means, and also an unbypassed emitter resistor for a.c. degeneration.

Complete Amplifier

Since the microphone amplifier was built primarily to investigate noise problems, little attention was paid to the proper design of an output stage. All measurements were made with high-impedance instruments, so the output stage was designed merely to give sufficient voltage gain that any extraneous instrument noise would be insignificant. The voltage gain of the three stage amplifier shown in *Fig.* 12 is 70 db, and is 3 db down at 20 cps and 35 kc. This is considerably more gain than is usable for a commercial amplifier, but it simplifies noise measurements. No power supply filtering is shown because a battery was used.

For completeness, a complementary-symmetry output stage and driver is shown in *Fig.* 13. This stage was de-

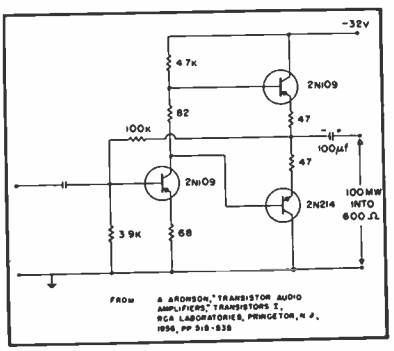


Fig. 13. Complementary-symmetry output stage.

signed by A. Aronson, and is described in *Transistor Audio Amplifiers*[2] in Transistors, I. It is capable of supplying 20 dbm, or 100 mw into 600 ohms. The 32-volt supply is necessitated by the fact that 0.1 watt into 600 ohms requires 22 volts peak-to-peak. Since it is desirable to have under 1 per cent distortion at this output level, a power supply higher than 22.5 volts is necessary.

Figure 14 shows the measuring set-up used to determine the noise figure of the amplifier in *Fig.* 12. Because of the difficulties of obtaining an audio noise diode, the generator method used. By inserting the signal through a small (10-ohm) resistor in series with the source resistance (R_g), the gain, bandwidth, and noise power of the amplifier and filter can be obtained. The filter is used to maintain a constant bandwidth as different transistors are substituted, and as circuit changes affecting frequency response are made. The 3 db point is arbitrarily set at 10,000 cps, and the response is 20 db down at 17,500 cps. The over-all power response (voltage squared) is shown in *Fig.* 15 on a linear frequency scale. The rise before cut-off

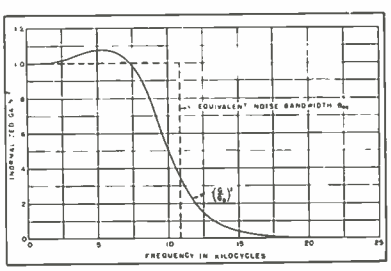


Fig. 15. Equivalent bandwidth of the microphone amplifier plus filter.

is in the filter. The equivalent noise bandwidth is equal to the bandwidth of the rectangle with the same area as the curve, and the same low frequency gain, and in this case is 10,700 cps.

Conclusion

At the present stage of the art, it is possible to build a transistor amplifier closely approaching the perfection of vacuum tubes. Its drawbacks would be: a noise figure one to two db worse than vacuum tubes; and greater tendency toward first-stage overload. Its advantages are: light weight and good portability, resulting from low battery drain; possible elimination of the input transformer; and durability and long life. Since every indication is that the disadvantages will be overcome by improved transistor technology and reasonable compromise in circuit design, it appears that the universal application of transistors to microphone amplifiers is inevitable. Æ

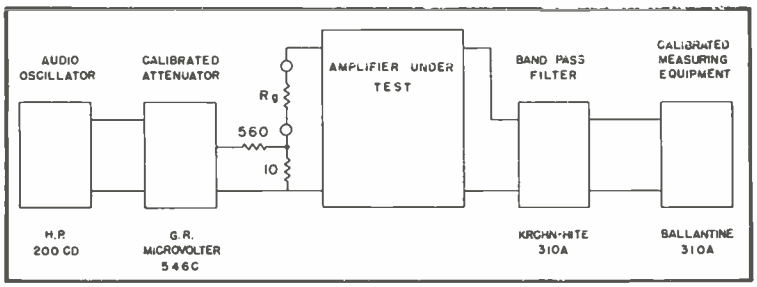


Fig. 14. Noise-figure measurement setup.

AMPLIFIER

(*from page 23*)

R_2 and C_9, and transferring the grid input of V_5 from the secondary of T_3 to the tip of the jack. It will be noticed that the small treble lift capacitor, C_{12}, remains in circuit, when by rights it should be in use only on replay; but it was found to be of assistance when recording from certain sources deficient in top, so the original provision for disconnection has been discarded. Its effect may be countered quite easily by use of the treble tone control. High-level inputs, such as those available from tuners and crystal pickups, are fed into J_2, which is an ordinary single-circuit socket. When this is in use, the whole of V_5 and its associated circuit is completely isolated from the rest of the amplifier, so avoiding the possibilities of noise from this stage breaking through. The tone-controls are effective on RECORD as well as on REPLAY, and the value of this feature, unconventional though it may be, has been demonstrated again and again, the author's experience being that, once an operator has made use of this facility, he will not willingly revert to the standard arrangement of no control on RECORD. The ability to suit the recording to both the acoustic surroundings and the material being transcribed, enables satisfactory tapes to be produced under conditions which would preclude the use of an amplifier with less flexible characteristics. The more conventional user has only to leave the controls on the "zero" positions to satisfy his fastidiousness.

Feed to the head is from V_2 through C_1 and R_{28} and R_{27} to present constant current conditions. A capacitor across the feed resistor as a treble equalizer is quite conventional English practice, but the division of both capacitor and resistor into two is rather unusual. It has been dictated by the necessity of ensuring corrections suitable for all tape speeds, without adding more complication than is essential. Its effectiveness is not to be doubted. At 3¾ i.p.s., C_{19} gives the required lift, C_{20} hardly having any effect at all, while at 7½ and 15 i.p.s., the combined effects of C_{19} and C_{20} together with the head losses at each speed permit a response up to the theoretical maximum. In accordance with accepted standards as dictated by the physics of magnetic recording, nearly all the treble equalization is on RECORD and most of the bass correction on REPLAY: the characteristics of the tone controls give the recommended NARTB bass boost on RECORD, while C_{12} does the same for treble on REPLAY.

Modulation control is by M_1 and its associated circuitry, where, if at all

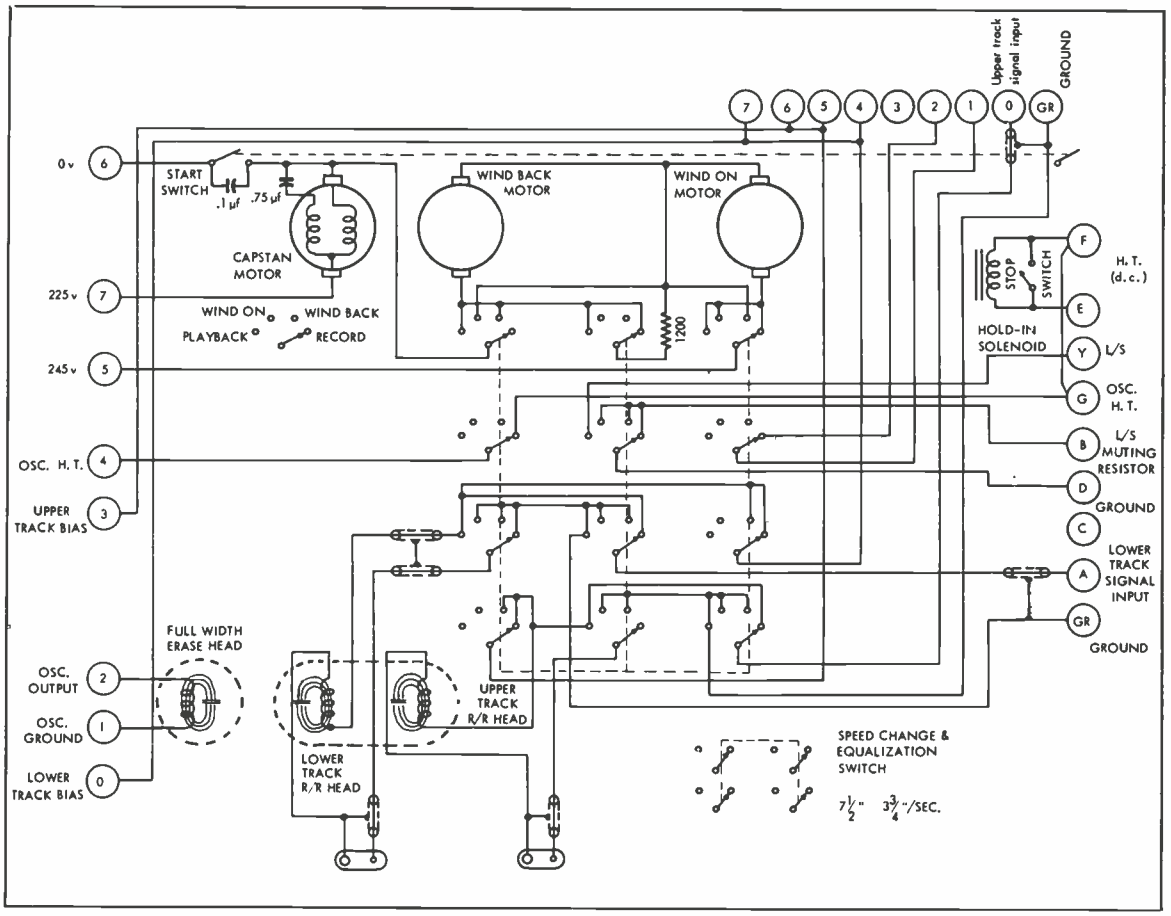


Fig. 3. Semi-pictorial diagram of the underside of a Ferrograph tape deck showing the locations and designations of the terminal or tag strips.

possible, the meter specified should be used, as its ballistics are ideal. The arrangement is conventional for a sustained-peak-reading voltmeter, the delay on peaks being determined by the time constant of C_{53} and R_{82}. The values chosen appear to satisfy most conditions, but there is no reason why the constructor should not make alterations to suit himself. R_{81} and R_{85} bias the meter down to its zero position, and may be replaced by a potentiometer of 500K ohms, while P_9 is for setting the overload point on the scale. Directions for doing this will be given later. The meters are in circuit on both RECORD and REPLAY, and in the latter position are used only to ensure balance between the two channels. Switches S_1 and S_2 short-circuit them when this operation is completed.

Bias Supply

The bias section comprises V_{11} and V_{12}, V_{12} being a slave oscillator controlled by V_{11}. A two-valve oscillator is the simplest way of providing the r.f. requirements, as the demands of the Ferrograph "C" decks in this direction are quite heavy; but other arrangements are quite feasible and two alternative circuits are shown in Appendix 1.

Recording bias to the heads is from the anode of V_{11} via C_{15}, R_{55}, P_{11}, etc., the rheostats being an essential part of the circuit, as each individual head has a bias requirement peculiar to itself. The values will be found on a label under the fly-wheel housing under the deck. Erase voltage is supplied by the separate oscillator V_{12}, and as it is not possible to ensure absolute matching of frequency between the two oscillators, it is controlled by a grid drive from V_{11}, via the secondary of T_3 and P_8, bias loading being provided by the 2.5 mh coil L_1. The oscillators and power pack are built on a chassis separate from the main amplifier.

This completes the description of the FS103, the construction of which should provide a few week-ends of amusement

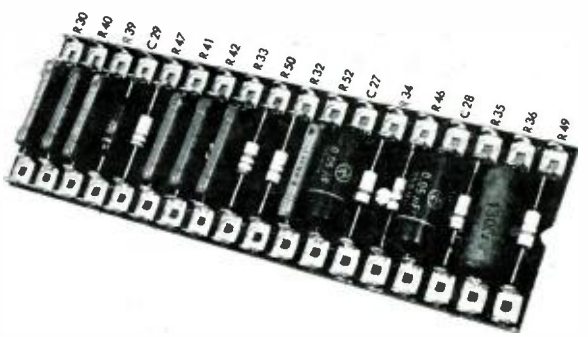


Fig. 4. Arrangement of components on terminal board which makes for simple and direct wiring.

for the competent amateur. It is, in essence, a resonably simple piece of apparatus to make, needing patience, a certain amount of skill, and a fairly well-equipped workshop; but a hint or two as to assembly and what may be expected from the completed amplifier may not be out of place.

Construction

As seen in the parts list, certain resistors are 5 per cent high-stability units. In the commercial equipment, all these, with the exception of R_9 and R_{25}, are 1 per cent, but this is perhaps painting the lily. C_1 must, repeat must, be of very high insulation, as any leakage here will result in noisy recording; and R_{26}, R_{27}, C_{19}, and C_{20} should be chosen to within 5 per cent. C_{19} is to prevent a too rapid decay of oscillation when the RECORD switches are broken, and if switch clicks are objectionable, a 100-ohm resistor may be inserted in series with the B+ line. L_1 may sometimes be replaced by a 1000-ohm resistor. P_3, in view of the high gain—85 db or so[1]—must be absolutely above suspicion, and the author's unvarying choice is either the Morganite type "A" pot, or the Clarostat type "H," both of which are outstanding in the matter of silence. The group board in *Fig.* 4 was made up with Morganite type "S" resistors, and their neat appearance will be noted. They have excellent characteristics, particularly in their long term resistance to change, an important matter in matched amplifiers. *Figures* 5, 6, and 7 show the top and bottom views of the chassis in various stages of construction.

There must be one ground point, and one point only, for the whole amplifier; and this point is where the co-ax inlets from the heads are located. The simplest method is to solder a bus-bar consisting of a piece of #16 s.w.g. wire along the tube sockets, taking all ground returns to it. The sections are screened from each other by a partition that divides the underneath of the chassis completely, while screens isolate each input side—that is T_3, V_3, C_{16}, R_{18}, C_{17}, R_{15}, R_{16}, C_6, R_{20}, R_{21}, C_7, C_8, R_3, and J_2 and the equivalents of Channel 2 from their respective amplifiers. The two co-ax shells are joined by a short length of #16 s.w.g. wire, so making them one from the ground point of view.

Substitutes for the values in the amplifying chains should not be used, as the basic amplifier was actually designed around those specified; and this injunction applies particularly to V_1 V_5 V_6 V_7, the Mullard low-noise pentode type EF86, for which the author has found no really adequate alternative. The oscillators are located on the power pack, which is a separate unit, and no special precautions need be taken here, except

[1] From the grid of V_1 to output.

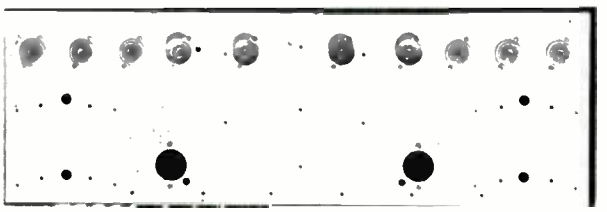


Fig. 5 (left). Top view of the chassis with tube sockets mounted.

to see that the coils are under the chassis, to prevent undue radiation.

Performance

It is difficult to give a figure for permissible residual hum and noise, as it depends on what the individual defines as "permissible"; but some idea of the possibilities will be suggested by the fact that, on the commercial amplifier, given reasonably smooth mains, with the grid of V_3 short-circuited and with the ear held close to the speaker, it is literally impossible to detect a trace of hum even with the bass control at full boost; while with the heads connected and P_3 at full gain, the noise level is still much below the tape differential. At half gain, which is generally the maximum on REPLAY with a properly recorded tape, the background is nearly at vanishing point. There is no doubt that this desirable state of affairs is due in large part to the excellence of the EF86 as a low-noise amplifier.

The setting-up procedure is not difficult, neither need the test gear be particularly involved, at least for the amateur. An audio oscillator capable of a range of 50 cps to 50 kcps, a VTVM, and an oscilloscope are the essentials. After making the usual tests and adjustments on the amplifiers in detail, the speakers can be phased by feeding a 100 cps signal into both channels simultaneously, and changing round the output leads to one of the speakers to the position that makes most noise; but the signal must be kept to a reasonable level, as the ripping of speaker cones off the spiders is not unknown. Next, the grids of V_6 and V_7 are short-circuited, the bass controls tuned to maximum and the volume controls to full gain, with the treble controls at about 12 o'clock. The interaction between the channels should be at least 100 db down, and if it is very much different, the cause should be sought and cured before proceeding further. A possible source of trouble is a high power-factor or low capacitance C_{59}. If the first, a paper capacitor of 1 or 2 μf will sometimes overcome the trouble, while the cure for the second is obvious.

The connections to the deck may now be wired, and the hold-in solenoid tested, after the following alterations to the under-deck connections have been made. The link between F and G is removed, C on the right tag-strip is joined to 4 on the left tag-strip, 5 and 7 on this strip are joined, and the motor mains connected to 6 and 7. If all is in order here, a known good full-width tape should be played, using each channel separately by manipulation of the volume controls. If the results are satisfactory, the meters may be balanced. A 1000 cycle signal is injected into each channel in turn, with the tone controls all at 12 o'clock and P_7 and P_{10} adjusted so that, with 10 volts across the recording networks, the meters stand at

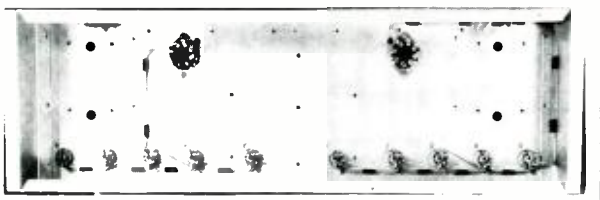


Fig. 6 (right). Under side view of chassis with filament wiring in place.

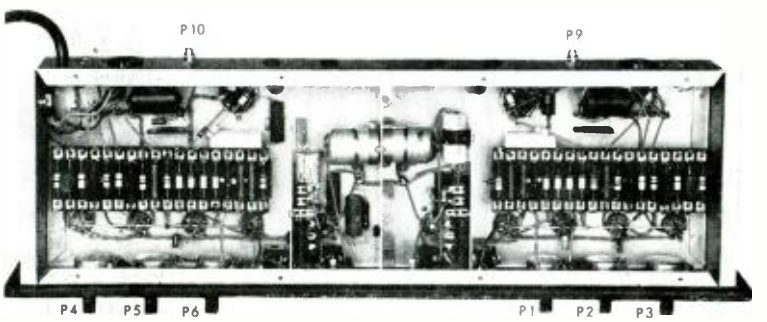


Fig. 7. Bottom view of completed amplifier chassis.

the 7½ mark, which represents peak signal level. Note that this is *not* a reasonable sine-wave recording signal, but the maximum permissible instantaneous peak. Amplifier balance is checked by feeding signals at various frequencies into each channel in turn, and noting the relationships between the positions of the respective controls, for equal indications on the meters. The differences, if any, should be small, and large discrepancies tracked and cured.

The deck should now be switched to RECORD, and the oscillators checked for performance. With the oscilloscope connected between the top of P_3 and ground, the slider of this control is advanced to the maximum consistent with good wave-form, and T_3 is tuned, by means of its adjustable core, to 50 keps. The classical means of calibration is to feed a signal of known frequency direct to the X plates, while the output from the oscillator is taken to the Y plates, the timebase meanwhile being rendered inoperative, and observing the resultant ellipse or Lissajous figure; but with the simpler oscilloscopes, it may prove difficult to attain sufficient stability, and it is far easier to use the oscilloscope in the normal way, filling the screen with, say, four waves from the known source, then disconnecting this and substituting the output from the top of P_3, adjusting T_3 until the same configuration appears. It takes about a minute to do. P_{11} and P_{12} are then set to provide the correct biases to the heads, after which, further adjustment of P_3 may be needed. The oscilloscope input lead is transferred to C_{53}, the slider of P_8 advanced about half-way, and the core of T_8 adjusted until V_{12} locks in. The slider of P_8 is now set as far as it will go without distorting the waveform, and a quick check made at the various positions already covered, as some slight further readjustment may be called for. This completes the preliminary setting up.

The chassis may be of brass, steel or aluminum, depending on the pocket and/or the metal-working skill of the constructor. The one shown in *Figs.* 5 and 6 is of 20-gauge steel, and measures 21 × 10 × 2 in. It is fitted with a bottom cover, thus making a completely enclosed box. Octal sockets are used for the deck connections, and screening of the recording feed wires is unnecessary. Replay leads must be of good quality nonmicrophonic coaxial, and it is suggested that those supplied with the deck be replaced, as they are a little on the short side for custom installation. The ground connection from the deck chassis should be entirely separate from the lead cable returns, and is to be taken to some point on the amplifier chassis remote from the co-ax inputs.

(To be concluded)

EQUIPMENT REVIEW

(*from page 52*)

TAPE-INDX and PERMA-FILE TAPE LOGGING SYSTEM

Every so often one sees an item which calls forth the thought, "Why didn't I think of that?" The Tape-Indx and its associated equipment falls into that category, particularly when one has attempted to develop some means of logging recorded tape so it would be possible to turn to a desired selection quickly and easily, even when using a machine which was not equipped with a footage counter of some sort.

Tape-Indx provides a means of locating any portion of a magnetic recorded tape, and it will locate as selective an area as one word. With its use one may record many short subjects as well as reel-long selections because any number of separate points of indication may be used on a single reel.

Even when using a machine equipped with a tape counter, accuracy of selection is rarely close, and the inconvenience of having to make sure that the counter is set to zero at the beginning of each reel causes the average user to ignore the counter entirely. Furthermore, some counters have a certain amount of slippage, and while they may be accurate when running at playing speed, they tend to lose accuracy when in the rewind or fast forward positions. In any case, it is necessary to log the indications of the counter in order to refer to them, and this is a further inconvenience.

Some users splice in short sections of leader tape between selections—a practice which is thoroughly satisfactory with full-track recording, but impossible with dual-track tapes. At best, it is a time-consuming operation, and requires a splicer of some sort, and in cases where the tape is to be erased and reused for another recording, the recordist is likely to be surprised to find two- or three-second "dropouts" when he replays the tape.

Tape-Indx eliminates all of these objections. The system consists of a number of small tabs printed on sheets of DuPont "Mylar" brand polyester film, each being coated with a strip of pressure-sensitive adhesive of the same type used on splicing tape. With each sheet of six tabs, numbered from 1 to 6, comes an index card which is provided with spaces for listing the titles of the selections at which the tabs are placed. The index cards are striped with an adhesive which permits them to be mounted in the "Perma-File" holder, shown in the upper center of *Fig. 10*, with the bottom edges offset so the number on each card may be seen easily. Each Perma-File will accommodate ten index cards, and additional sheets are available to increase the capacity by twenty cards each. On the bottom of each of the cards are two perforated tabs—one to be placed on the reel itself and one to be placed on the box. A third space is provided to number the card to correspond with the numbers on reel and box, thus making for easy location of any desired reel. The tabs, together with the cards, are put up in a convenient package which will accommodate five reels with six tabs each.

While one might think that the tabs would interfere with tape passing through the heads, and even onto the reels themselves, such is definitely not the case. The tabs are made of the same material as the tape, essentially, and are quite flexible. As the tape is spooled onto the reels, the tabs simply lie down flat against the tape where they are under a spoke, or they pop upright when they are in an open space. As they pass through the heads, they fold over and cause no noticeable change in quality, even when occurring in the middle of a musical passage. The inks used on the tabs are permanent, and will not fade or rub off. Tabs are printed in five colors, permitting the user to assign different colors to different types of recorded material, if desired.

The Perma-File is made of heavy-duty heat-sealed vinyl plastic, and is printed on the inside to indicate the location for each label card. It is apparent that the whole system is well thought out, and its use will simplify the heretofore difficult problem of logging tape selections. After a month's trial, we can find no fault with the complete system, nor can we even think of any ways in which it could be improved. The cost is low enough for any tape user to at least make a trial for himself, and that should be enough to "sell" him on the idea. K-25

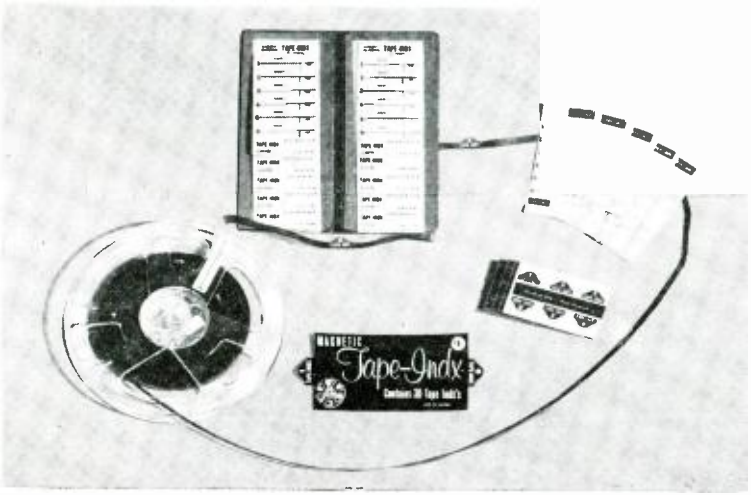


Fig. 10. Tape-Indx, a system for labeling recorded tapes so as to make location of separate selections simple and accurate.

JAZZ AND ALL THAT

(from page 61)

E-Flat horn, arranges and supplies the soaring original *Albatross* and *Henry Hudson*. He adds a touch of satire to *In a Little Spanish Town* and supplies an exotic solo on *Caravan*. Included are *Lazy Mood* and *Rose Room*. Ernie Caceres plays a dulcet baritone sax and shares clarinet chores with Tom Gwaltney, who doubles on vibes. The varied instrumentation gives everything a fresh-minted quality and a fine, full sound. In sum, it is Hackett's best recording in some time.

Leon Sash: This is The Jazz Accordion
Storyville STLP 917

In its devotion to modern sounds, the Leon Sash Quartet is a mid-western answer to Mat Mathews and the New York Jazz Quartet. Slight differences in instrumentation give a more husky voice, and it swings with the brisk breeziness of its native Chicago. Blind since the age of eleven, Sash made his debut as a professional when sixteen. Now thirty-four, he introduced his new group on a recent eastern trip.

His wife, Lee Morgan, plays bass and is his collaborator in four of the six originals. The others are the work of Sash and Ted Robinson, who plays flute, clarinet and tenor sax to blend with the accordion in unison passages. Drummer Max Mariash completes the group. *Lullaby of Birdland* by George Shearing, Sash's friend and evident influence, is heard along with *Deep Purple* and *I Can't Get Started* in a careful recording by Mal Chisholm at Chicago's Universal Recording Studios.

Barbara Lea: Leo In Love
Prestige 7100

In a tender perusal of assorted aspects of love, Barbara Lea shows the fine discrimination in choice of material that heightens all of her collections. The dozen tunes are given thoughtful arrangements by Dick Cary, who accompanies on piano and alto horn. Johnny Windhurst, who is unexcelled in his tasteful background phrasing on trumpet, is again present, along with Garvin Bushell, oboe and bassoon; Ernie Caceres, clarinet and baritone sax; Al Casamenti, guitar; Al Hall, bass; Osie Johnsons, drums. On five numbers, pianist Jimmy Lyon leads his trio of guitarist Jim Raney and bassist Beverly Peer.

The Lea repertoire makes room for such singular items as an *Autumn Leaves* with the French lyrics, *We Could Make Such Beautiful Music Together*, *Am I in Love?* and *The Very Thought of You*. Also Cole Porter's neglected *I've Got My Eyes On You* and *You'd Be So Nice To Come Home To*. A folk-song vein is tapped in the previous unrecorded *Will I Find My Love Today* and *True Love*, which is favored by the addition of harpist Adele Girard. It suggests the revival of a tune associated with her *Little Sir Echo* even at the risk of an echo chamber. It was recorded at Bell Sound Studios.

A Date With Jimmy Smith, Vol. 1
Blue Note 1547

As an expounder of the Hammond organ in jazz, Jimmy Smith has previously seen fit to extend it to lengths not precisely those the designers may have had in mind. That it has roared with such intensity of sound is somewhat of a tribute to its construction. In this album, his first with horns, he essays another role as he tastefully selects registers to underline solos and help build a phrase. Joining him on the date are Donald Byrd, trumpet; Lou Donaldson, alto sax; Hank Mobley, tenor sax; and Eddie McFadden, the new guitarist from his trio. Drummer Art Blakey rises to the occasion in a matching of wits with the pulsing organ.

A dynamic blues, *Funk's Oats*, fills one side and there is an elongated version of the ballad *Falling In Love With Love*. Smith proves there is something new to say on *How High The Moon*, played by the trio with Donald Bailey on drums, in one of the most refreshing treatments afforded this much belabored tune. Like many jazzmen, he has not always handled large volumes of sound successfully. That some never learn is evident in the bands of Lionel Hampton and Stan Kenton. Smith's progress in this direction makes this his best recorded effort.

Sonny Rollins: Way Out West
Contemporary C3530

In this recording made at 3 a.m., during a trip West last March, Sonny Rollins is heard out of his customary context of a Max Roach group. It is his first trio endeavor, and is graced by the presence of bassist Ray Brown, of the Oscar Peterson Trio, and drummer Shelley Manne, who has more chances than usual to build a crackling tension when the tenor plunges into the two originals. Each side is programmed for an orderly exposition of three facets of the Rollins' style, starting with a comfortable lope on the pop tunes *I'm An Old Cowhand* and more than ten minutes of *Wagon Wheels*. The tempo slows to a walk for a tender treatment of *Solitude* and *There Is No Greater Love*. Both end in a well-gaited prance on his originals *Come, Gone* and *Way Out West*. Rollins does some strange and wondrous things on his horn in this fine recording by Ray DuNann. Having left Max Roach in May, he announces on the liner his intention of working for his bachelor's degree in Music.

Ken Moule: Arranges For . . .
London LL1673

Former leader of the Ken Moule Seven, this young British pianist and arranger shows his writing talent on eleven numbers for an octet of his country's top jazzmen. His tendencies to the Gerry Mulligan style, both in sound and sense of humor, are well supported by the work of Ronnie Ross on baritone sax and Donald Rendell, who is hailed by critics as the leading tenorman in Europe. *Cobbly, High Ratio* and *The Tired Badger*, all titles of his originals, express his dry wit. Especially welcome is the trombone solo on *Lullaby of the Leaves* by the veteran George Chisholm, who returns to jazz after a decade of studio work. He can hold his own in any company.

Les Modes: Mood In Scarlet
Dawn DLP1117

The salient combination of Julius Watkins on French horn, Charlie Rouse on tenor sax and Gildo Mahones on piano makes Les Modes one of the most distinctive groups in modern jazz. Their individual musicianship and the evolving patterns of the horns lead to a startling assortment of colors and moods on such standards as *Autumn Leaves, Baubles, Bangles and Beads*, and variations on *My Buddy* in *Let's Try*. In three of the Watkin's originals an oriental atmosphere is conjured up with the aid of soprano Eileen Gilbert on *Mood in Scarlet* and the four parts of *Hon Tai*. The interweaving of her voice with the erupting horns is well recorded by Dave Hancock. *Linda Delia* is a harder swinging extension for the quintet alone. Watkins' thinking is along the lines pioneered by Ellington, as opposed to some other uses of the voice-as-a-horn, and when least pretentious is most moving. **Æ**

AES CONVENTION PROGRAM

(from page 19)

Thurs. Oct. 10 1:00 p.m. session (cont'd)

A CONTINUOUS LOOP MAGNETIC TAPE CARTRIDGE.
Bernard A. Cousino and Ralph E. Cousino, Cousino, Inc., Toledo, Ohio.

MAGNETIC TAPE NOISE.
R. A. von Behren, Minnesota, Mining & Manufacturing Co., St. Paul, Minn.

THE FINER STRUCTURE OF MAGNETIC TAPE: MICROSCOPIC STUDIES.
Dr. Reuben M. Cares, Kings Park State Hospital, Kings Park, N. Y.

"MYLAR" POLYESTER FILM AND ACETATE AS BASE MATERIALS FOR MAGNETIC RECORDING TAPE.
D. L. Ormond, E. I. du Pont de Nemours, Wilmington, Delaware.

7:00 p.m. NINTH ANNUAL BANQUET.

Friday, October 11

9:00 a.m. Annual Business Meeting
Installation of Officers
Committee Reports

9:30 a.m. TECHNICAL SESSION: MICROPHONES AND SPEECH INPUT SYSTEMS.
Philip C. Erharn, Audiafax Associates, Stony Brook, N. Y., Chairman.

VARIABLE "D" CARDIOIDS.
Wayne A. Beaverson, Electro-Voice, Inc., Buchanan, Mich.

APPLICATION OF THE MODEL 667 MICROPHONE.
L. R. Burroughs, Electro-Voice, Inc., Buchanan, Mich.

A SECOND ORDER GRADIENT ULTRA DIRECTIONAL MICROPHONE.
Jere W. O'Neill, RCA Commercial Electronic Products, Camden, N. J.

FM AUDIO RECEPTION.
George Maerkle, Fisher Radio Corp., Long Island City, N. Y., Chairman

STEREOCASTING BY FM MULTIPLEX METHOD.
William S. Halstead, Multiplex Services Corp., New York, N. Y.

A COMPATIBLE SYSTEM OF STEREO TRANSMISSION BY FM MULTIPLEX.
Murray G. Crosby, Crosby Laboratories, Inc., Hicksville, N. Y.

Friday, October 11
1:30 p.m. TECHNICAL SESSION: STEREO PROBLEMS.
H. E. Rays, RCA Victar Record Division, Indianapolis, Ind., Chairman.

ARTIFICIAL STEREOPHONY USING SINGLE INPUT.
Manfred R. Schroeder, Bell Telephone Laboratories, Murray Hill, N. Y.

STEREOPHONIC SOUND WITH TWO TRACKS, THREE CHANNELS BY MEANS OF A PHANTOM CIRCUIT OR 2PH3 STEREO.
Paul W. Klipsch, Klipsch & Associates, Hope, Arkansas.

STEREOPHONIC SOUND REPRODUCTION IN THE HOME.
Harry F. Olson, RCA Laboratories, Princeton, N. J.

THE WESTREX STEREODISK SYSTEM.
C. C. Davis, Westrex Corp., Hollywood, Calif.

THREE CHANNEL STEREO AND ITS SPECIFIC PURPOSE.
W. H. Miltenburg, RCA Victor Division, New York, N. Y.

PANEL:
William S. Bachman, Columbia Records, New York, N. Y.
William H. Miltenburg, RCA Division, New York, N. Y.

Saturday, October 12
9:00 a.m. TECHNICAL SESSION: SPEAKERS AND SPEAKER ENCLOSURES.
John Preston, RCA Laboratories, Princeton, N. J., Chairman.

THE FUNDAMENTALS OF LOUDSPEAKER DESIGN.
Frank H. Slaymaker, Stromberg-Carlson Co., Rochester, N. Y.

SOUND REINFORCING SYSTEMS.
John E. Volkmann, Radio Corp. of America, Camden, N. J.

A WIDE RANGE LOUDSPEAKER SYSTEM.
Maurice E. Swift, Philco Corp., Phila., Penna.

SOME OBSERVATIONS ON REPRODUCED SOUND IN AN AUTOMOBILE.
Bertram A. Schwarz and Donald E. Brinkerhoff, General Motors Corp., Kokomo, Ind.

TURNTABLES AND ARMS.
Ruben E. Carlson, Fairchild Recording Equipment Co., Long Island City, N. Y., Chairman.

SERVO-DRIVEN PHONO ARM.
Jacob Rabinow, Rabinow Engineering Co., Inc., Washington, D. C.

A NEW VISCOUS DAMPED TONE ARM DEVELOPMENT.
Chester A. Snow, Jr., The Gray Manufacturing Co., Hartford, Conn.

A NEW APPROACH TO THE HIGH PERFORMANCE TURNTABLE PROBLEM.
Rein Narma and Erling P. Skov, Fairchild Recording Equipment Co., Long Island City, N. Y.

Saturday, October 12
1:30 p.m. TECHNICAL SESSION: AMPLIFIERS.
Victor Braciner, Radio Wire Television, Inc., New York, Chairman.

SOME DEFECTS IN AMPLIFIER PERFORMANCE NOT COVERED BY STANDARD SPECIFICATIONS.
Norman H. Crowhurst, Audio Design Service, Whitestone, N. Y.

MISMATCH BETWEEN POWER AMPLIFIERS AND LOUDSPEAKER LOADS.
Daniel von Recklinghausen, Hermon Hosmer Scott, Inc., Cambridge, Mass.

NEW DEVELOPMENTS IN OUTPUT TRANSFORMERLESS POWER AMPLIFIERS.
J. Rodrigues de Miranda and Dr. J. J. Zaalberg van Zelst, N. V. Philips' Gloeilampenfabrieken, Eindhoven, Netherlands.

ON THE PERFORMANCE OF LOUDSPEAKERS DRIVEN BY NEGATIVE IMPEDANCE AMPLIFIERS.
R. E. Werner and R. M. Carrell, Radio Corp. of America, Camden, N. J.

HIGH POWER TRANSISTOR AUDIO AMPLIFIERS.
M. B. Herscher, Radio Corp. of America, Camden, N. J.

PHONO PICKUPS.
B. B. Bauer, CBS Laboratories, New York, N. Y., Chairman.

PHONOGRAPH STYLI — THEIR USE AND WEAR.
Barnett A. Edwards, Recoton Corp., Long Island City, N. Y.

THE CASE FOR THE CERAMIC CARTRIDGE.
Jack Bayha, V-M Corp., Benton Harbor, Michigan.

THE HIGH FIDELITY USER LOOKS AT PICKUP DESIGN.
Julian Hirsch, Consultant, New Rochelle, N. Y.

AUDIO ETC

(from page 65)

So also are two additional resonators, one on each side up inside the box in the "throat" area of the horn, again tuned differently to blot out still more potential unevennesses of response. Sort of shaped pouches, with ducts into the two horns at the neck.

All of which sounds dreadfully complex, highly contrived and—maybe impractical. Contrived or no, it works and works exceedingly well, I'd say, and as for practicality—the speaker system is on the market or will be very shortly, at a price that seems to me quite reasonable in view of demonstrated performance and convenience.

I found the Eico speaker system unusually musical, not only in its very pleasing sound quality but, even more important, in its unique sound distribution pattern, from a space that is almost no space at all on any living room floor. This, I'll have you know, is the first loudspeaker that I've ever been willing to listen to that against the middle of my wall. It is the first in my experience that can be placed almost anywhere, along any wall in the room, with equally good results. All other speaker systems, radiating outward horizontally for the main beam, I prefer to place where I can get reflection, where I do not have to face the speaker directly.

This is the first speaker (though I remember a "Fountain Speaker" a few years ago, mounted in some sort of round column facing up) which gives you *really* non-directional sound dispersion, 180 degrees from wall surface to wall, and more than that straight up towards the ceiling and down to the sides. Wherever you put it, the room is filled with sound and the "point-source" unpleasantness is virtually eliminated. For good music listening this seems to me to be extraordinarily important, especially for those who have limited space and few possible locations for a speaker installation. This one will go anywhere that allows a square foot of free floor up against the wall. You can even put it behind a table, since the bass will radiate easily out from underneath and the tweeter element will be raised just above table-top level, about where a conventional table phono or radio would be. Stand it in a corner, next to a fireplace, between two tabourets, next to a door . . . anywhere that a grandfather clock would go if sawed off one-half!

As for the sound itself, I found the Hegeman tweeter very smooth, the sound not unlike the best of the conventional cone-type tweeters but generally brighter because the paper radiating elements are right out in the open at the top of the cabinet.

At first I didn't seem to be hearing much bass (from those slots, at floor level). But I soon found that this speaker system sounds best at a moderate distance, across the room or equivalent. When you stand right beside it the freely radiating highs come straight up at you from waist level, without impediment, whereas the bass is down in your trouser cuffs, or skirts. Result: Too much in the highs. This is actually quite OK; as soon as you move away a few feet the balance becomes entirely natural—and you should always listen at some distance, to any speaker, for musical results.

There is, I should add, a balance control that takes the mid-range—not the higher highs—up and down. I found this quite use

ful in adjusting for the room. We don't well enough realize, I think, that the middle highs do a lot more to adjust room tonal balance than the highest highs. (This control rolls off the woofer's upper response, that which feeds upwards from the front of the cone. Bass goes downwards into the horn.)

Bass quality? Surprisingly clean, for such a small box. This is no boom-box system. It was, in fact, noticeably cleaner on AB comparison than another good small speaker next to it, which shall be nameless. I hadn't noticed anything before (the difference is not great, of course), but the Eico's sharper, lighter bottom made a considerable impression on me in this incidental test.

I didn't worry about how low the Eico could go. As I've said often enough, the extreme bottom range is seldom important in musical listening. But the specs call for flat response down to 30 cps without doubling, with "uniform impedance load," and effective loading continuing to the bottom of the audio scale. Extra damping from another air space, between the tweeter cone and the stationary loading cone . . . this begins to get over my head, but as I say, it does sound as it is claimed to sound.

I have only one reservation, if it can be called that, concerning the Eico's hypothetical ability to stand up to the strains of home life. Alas, it is exactly the right height to accommodate a tall glass of foaming beer, a peripatetic teacup, the over-full ash try (not to mention the flicked cigar ash!) and the teetering coffee pot. *So* convenient and right under your hand, I caught myself, to my horror, about to set a fresh-opened and overflowing beer can on top of it, the other day.

Now if this cabinet were like most, solidly topped in Mahogany or Korina or plastic, ripe for burns and scratches but safe as far as the insides are concerned—all would be well. Go ahead and spill your beer, and mop it up. Flick your cigarettes, and rub the burns down.

But Eico's leading feature is its excellent top radiation of highs. The top, thus, is a plastic grille cover, full of a billion holes, and right underneath are all the essential speaker elements (including the bond-paper flower-vase cornucopias), facing up, ready to catch coffee, beer or live sparks. In fact it all makes a sort of ready-set double catch basin. The woofer, below, will catch whatever beer misses the delicate paper tweeter. . . .

Well, before Eico dies of acute embarrassment let me assure you I'm just using a diabolical imagination; chances are slight that such a disaster would occur in a well-ordered household. After all, diamond pick ups can be ground across concrete floors. TV tubes can be shot at with B-B guns. . . . The last thing I would suggest would be a solid rooftop protector that would cut off the all-important and unique upwards radiation of sound from this speaker! The fact that Eico did not compromise on this vital matter, spilt beer or no, is surely to their credit.

Perhaps the answer will be found in some sort of slightly tilted top panel, discouraging the roving beer can. Or alternatively, there might be some species of raised edging that would keep people's hands a bit further away when dangerously loaded. Anyhow, I had the speaker around for a number of weeks and was able to return it safely, beerless and coffeeless. So could you.

(P.S. Hey, Editor, I have a swell idea. Why not a discreet electric fence around the top? ETC) (*Go ahead, but please be careful—we don't have your next month's column yet.* ED.)

3. PONSONBY

Last spring I got a letter from an audiofan, radio engineer and amateur pianist, in Ponsonby, Aukland, W.1, New Zealand, who collects records, reads AUDIO all the time, and is frustrated because the N.Z. recording firms are much too much interested in Elvis the Pelvis to import the records he's dying to get hold of.

Very specifically, he was after the huge set put out by RCA Victor of the complete Beethoven Piano Sonatas with Artur Schnabel (all of them transferred from pre-war 78 discs), a set which, with the complete musical scores, costs a mere $80. Mr. Wylie's idea, which I pass on to you, was to raise the necessary wherewithal via a barter system. He wonders whether any of our readers are interested in tapes of native Maori songs, or of the New Zealand Champion Brass Bands, to name two suggestions. Any other goods or services of any description you might require 'way down there are offered, to raise that hunk of foreign exchange.

Mr. G. Wylie is at Beacon Radio, Ltd., Brown and Fitsroy Streets, Ponsonby, Aukland, W.1, New Zealand, and I suspect would be happy to hear from you.

4. BOOM AND BUST

A fellow from Maywood, Ill. sends me a clipping from the Chicago Trib, which fairly made me bust. Ad for a set of twin consoles, one TV, the other a Hi-Fi, both for $199. The matching Hi-Fi was described in these delectable terms:

—Magic Mind 4-Speed Changer
—12 Dynamic Speakers
—More WOOF
—More BOOM
—More TWEET.

—which raises a number of hilarious questions, in my skeptical mind at least. *Twelve* speakers?? Well—maybe, if they're all 3-inch jobs. More likely the effervescent copywriter, hardly an audio bug himself, was supposed to say a twelve-*inch* dynamic, but preferred to embroider a bit.

As for the BOOM—chances are that the gentleman was absolutely right. And so we can't really complain, this time, about advertising misstatements. I'll betcha it does go BOOM, on every middle-bass note. (Whether it woofs and tweets is another question.) I'll have to frame that ad, and thanx to Ralph Rabe, who sent it in.

* * * * *

You can imagine how I reacted when, in the very same mail by a freakish chance, Debbie Ishlon of Columbia Records sent in *her* boom contribution:

"EDITORS.—HI-FI FOR FUN.—In the Year of the Boom.
"The keynote of Columbia's Fall 1957 releases will be Hi-Fi for Fun, a succinctly appropriate slogan for the year of the biggest boom in both record and phonograph (sic!) history."

Does she know what she's *saying?* I already had visions of the newest Columbia 360 phonograph, the biggest BOOM box in phonograph history . . . but I'm sure she didn't mean it *that* way. Æ

EMPLOYMENT

Neat, alert young man (29) desires placement with opportunities in audio field. Holds management and Hi-Fi consulting position with large service organization. Strong experience in customer relations and policy adjustments requiring quick, positive decisions. Highly active audiophile dating to pre L.P. era, technical training, veteran. An asset to any firm. Minimum salary, $7,000.00.

CLASSIFIED

Rates: 10¢ per word per insertion for noncommercial advertisements; 25¢ per word for commercial advertisements. Rates are net, and no discounts will be allowed. Copy must be accompanied by remittance in full, and must reach the New York office by the first of the month preceding the date of issue.

THE AUDIO EXCHANGE has the largest selection of new and fully guaranteed used equipment. Catalog of used equipment on request. Audio Exchange, Dept. AE, 159-19 Hillside Ave., Jamaica 32, N.Y. AXtel 7-7577; 367 Mamaroneck Ave., White Plains, N.Y. WH 8-3380; 836 Flatbush Ave., Brooklyn, BUckminster 2-5300.

HIGH FIDELITY SPEAKERS REPAIRED
Amprite Speaker Service
70 Vesey St., New York 7, N.Y. BA 7-2580

LOOKING FOR CLEAN RESPONSE TO 20 CYCYES? Listen to the radically new Racon "Hi C" 15" foam suspension speaker. Racon Electric Co., Inc., 1261 Broadway, New York 1, N.Y.

LONG PLAYING records 20 to 50% discounts; brand new; factory fresh; unplayed; all labels. Send 20¢ for catalog to Record Discount Club, 1108 Winbern, Houston 4, Texas.

FOR SALE: Genuine Klipschorn, Laboratory Model, Style B. Original cost, $593. Sell $475. J. M. Edelman, M.D., 700 Commerce Bldg., Baton Rouge, La.

FOR SALE: AMPEX 300, 350, 350-2, 601, 601-2 Se A-Series, available at Grove Enterprises, Roslyn, Pa., Turner 7-4277.

FOR SALE: Marantz Audio Consolette $125.00. J. M. Edelman, M.D., 700 Commerce Bldg., Baton Rouge, La.

SPEAKER CABINETS
Manufacturers over run—brand name enclosures, genuine mahogany, completely finished, with or without speakers, 50% off audiophile list. Write for details. Custom Craft, P. O. Box 304, Jasper, Indiana.

HEATHKIT AUDIO ANALYZER, including I.M. analyzer, audio voltmeter, and sensitive a.c. VTVM. Carefully constructed. Perfect. $39. A. Turner, Box 22, Oakhurst, Calif.

CUSTOM HIGH FIDELITY systems designed and installed. Equipment expertly serviced and repaired. Free pickup and delivery in New York City area. Eastern Audio Co., 6139 Tyndall Ave., Bronx, N.Y. KI 9-8131.

SELL: New Scott 232B Basic Amplifier; Wharfedale super 8" speaker; Goodman 12" coaxial speaker; Italian 120 Bass Accordion; like new Gretch Drum Outfit. Ely Wisinick, 13-04 146 St., Whitestone, N.Y. FL 3-3141.

WANTED: Hammond reverberation unit. State condition, age, and price. H. White, 2124 W. Broad St., Bethlehem, Pa.

OUTSTANDINGLY CLEAN bass corner horn for 12" driver. $95; J. Lansing 12" D-123, $36; 8" D-216, $18. Can demonstrate all. G. Cain, 15 Manet Circle, Chestnut Hill, Mass. LAsell 7-0826.

FOR SALE: Telefunken U 47 condenser microphone, $225; Telefunken M 221 condenser microphone, $235, both in perfect condition; Presto 6N overhead cutting mechanism (disc) equipped with hot stylus apparatus, $165; suction equipment for 6N lathe, $46; Heath Condenser checker, $16; Heath Signal Tracer, $18; four assorted 16" transcription arms, $6, each. JAC HOLZMAN, 361 Bleecker St., N.Y.C. OR 5-7137.

Write us before you buy any hi-fi, you'll be glad you did. Immediate replies. Key Electronics, 120 Liberty St., N. Y. 6, N. Y. Phone: EVergreen 4-6071.

Industry People...

Henry Klaus, designer of the new KLH speaker system, reports overwhelming acceptance of first production units delivered to the New York area. Mail response to KLH advertising indicates similar enthusiasm on a nationwide scale . . . **Gary Cohn** has been named assistant sales manager of Ronette Sales Corporation, importers of pickup cartridges and microphones—formerly with Mark Simpson Manufacturing Co. . . . **Will A. Connelly,** formerly assistant sales manager, has been upped to sales manager of Metzner Engineering Corporation, manufacturers of the Starlight high-fidelity turntable . . . Concurrent with expansion of advertising and promotional activity, University Loudspeakers, Inc., has appointed **David Glaser** to the position of art director.

Benjamin Kaye, owner of New York's fabulous Liberty Music Shops, has announced the opening on December 1 of a new store in the Socony-Vacuum building at 42nd Street and Lexington Avenue. It will be the fifth store in the chain, and will carry a complete stock of records, packaged hi-fi radio-phonos, and high-fidelity components . . . Appointment of **John P. Taylor** to the newly-created post of manager of marketing plans and services for industrial electronic products, has been announced by **A. R. Hopkins,** manager of RCA industrial electronic marketing department. Other RCA personnel changes include the appoints of **Orrin E. Dunlap, Jr.,** as vice-president in charge of institutional advertising and publications, and **Sidney M. Robards** as director of press relations.

Rein Narma has been appointed manager of the production and engineering divisions of Fairchild Recording Equipment Company. Currently serving as chief engineer, Mr. Narma will continue to carry out these duties in addition to his new assignment . . . **R. M. "Rocky" Gray** has resigned as sales manager of The Rauland-Borg Corporation to open shop as a manufacturers sales representative. His place will be taken by **Elmer Arehart,** who has been director of purchases for the past eight years.

Industry Notes...

Harman-Kardon and Concertone Receive Design Honors. Selected by a committee from the American Society of Industrial Designers, a **Harman-Kardon** Recital II tuner-amplifier and a **Concertone** custom stereo tape recorder have been chosen to represent the United States as outstanding examples of industrial design at the eleventh Milan Triennale, considered by many to be the world's most important international exhibit of industrial design, architecture and home furnishings. The U.S. exhibit, sponsored by the Department of Commerce, is entitled "Communications at Home and at Work." The Triennale will continue until November 2, after which both the Recital II and the Concertone will be made available to the trade fair division of the Department of Commerce for showing in various trade fairs throughout Europe during 1958.

ORRadio Starts New Plant. Ground has been broken for the nation's first plant designed expressly for the production of Videotape and instrumentation tape. When completed, the new plant of **ORRadio Industries, Inc.,** manufacturers of Irish brand magnetic recording tape, will be the only facility of its kind in the world, according to J. Herbert Orr, president. All working areas will be air-conditioned to control dust content as well as temperature and humidity. The plant will increase ORRadio's production capacity 4n0 per cent. Completion date is expected to be sometime this winter.

ADVERTISING INDEX

SPECIFICATIONS GUARANTEED

McIntosh guarantees performance at all listening levels from 0 to 60 watts. Compare these guaranteed specifications:

GUARANTEED

Harmonic distortion of 1/3% 20 to 20,000 cycles. Less than 1/2% intermodulation distortion of any two frequencies provided power does not exceed 120 instantaneous peak watts. Impulse distortion is negligible.

GUARANTEED

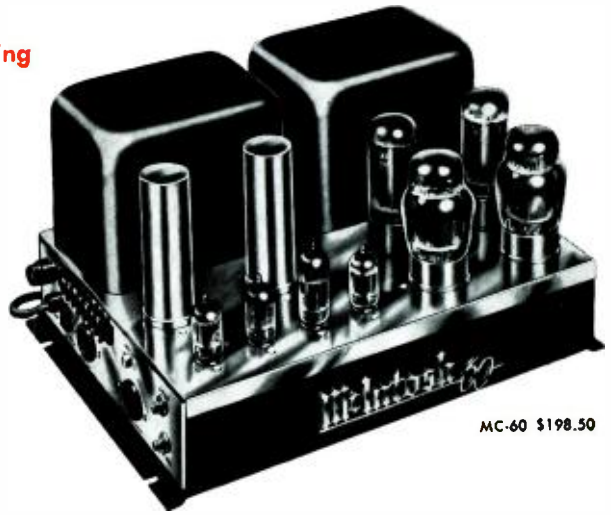
Frequency response is ±.1 db at 60 watts 20 to 30,000 cycles.

GUARANTEED

Total noise and hum is 90 db or more below rated output.

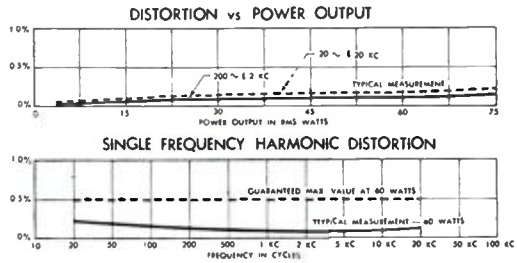
GUARANTEED

Maximum phase shift is less than ±8°, 20 to 20,000 cycles.



MC-60 $198.50

The revolutionary patented McIntosh Bifilar Circuit, results in 99 60/100% perfect (distortion free) power. Only McIntosh, the most trusted name in High Fidelity, brings you such performance.*



C-8 (Less Cabinet) $88.50

The C8 McIntosh Professional Audio Compensator is the finest preamplifier built today. For unmatched brilliant performance and flawless reproduction hear it today. Mc Intosh guarantees the specifications!

GUARANTEED Less than .3% distortion at 4 volts output, 20-20,000 cycles, at any setting of controls.

GUARANTEED Maximum flexibility, the baton at your fingertips for perfect equalization of all phonograph records.

GUARANTEED Total hum and noise is —110 db as referred to input.

In Canada manufactured under license by McCurdy Radio Industries, Ltd.
22 Front Street W., Toronto, Canada

McIntosh
LABORATORY, INC.
4 Chambers St., Binghamton, N. Y.
Export Division: 25 Warren St., New York 7, N. Y.
Cable: SIMONTRICE N. Y.

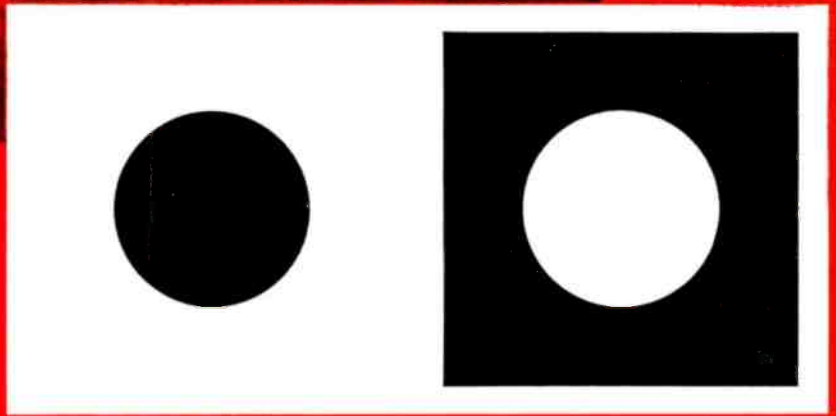
*U.S. patent #2,477,074; 2,545,788; 2,654,058.

AE 9-57

THE NEW TRUSONIC EIGHT-INCH SPEAKER

8 inches big!

8 inches small!



Not an acoustical illusion, this new, full range speaker has big-speaker response designed into a rugged, compact unit. It establishes a new standard for clarity, power-handling capacity, presence and lack of distortion in an eight-inch speaker. Like all TRUSONIC speakers and audio equipment, the new eight-inch 80 FR speaker is produced from the finest materials and engineered for a lifetime of faithful performance. Net Price: $31.50

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