

AUDIO

NOVEMBER / 1965

60¢

...the original magazine about high fidelity!

ACCENT on STEREO

See Page 30



Major advance in FM from Scott!



New "Field-Effect" transistor circuitry lets you hear more stations... more clearly.

Scott announces a significant new engineering achievement in solid state circuit design... the first application of "Field-Effect" transistors to a consumer product! This entirely new Scott circuit, making its initial appearance in the new 388 100-watt AM/FM Receiver, virtually eliminates cross modulation... lets you hear weak or distant stations which are usually masked out when ghost signals from strong local stations appear at unwanted spots on the dial.

According to recent exhaustive tests conducted by Texas Instruments, Inc., "The H. H. Scott FM tuner front end... exhibited IHF sensitivities of 1.6 to 2 microvolts with cross modulation rejection of from 96 to 100 db. Two strong signals, equivalent to more than 50 mv per meter and separated by 800 kc, can be fed into the input without having any measurable intermodulation products generated. This performance

... is more than 20 db better than the best bipolar transistorized front ends."

This radical improvement in FM tuner front end design is but one of the features that make the 388 your best value in a powerful, sensitive, no-compromise receiver. The 388 incorporates direct-coupled output circuitry, utilizing costly silicon transistors, allowing instantaneous power for extreme music dynamics, and affording complete protection against speaker overload. Both output and driver transformers, major sources of distortion and diminished power, are thus eliminated from the design of the 388. Silicons are also used in the IF circuit for superior stability, selectivity, and wide bandwidth.

Other engineering features of the 388 include: heavy military-type heat sinks, scientifically designed for optimum heat dissipation; silver-plated

tuner front end for maximum sensitivity; and extensive protective circuitry to safeguard the receiver and associated equipment from such common problems as accidental shorting of speaker terminals, operating the amplifier section without a load, subjecting the input to a high level transient signal, or operation with capacitive loads, such as electrostatic loudspeakers. In addition, the 388 incorporates famous Scott wide-range AM for your increased listening enjoyment.

See and hear the Scott 388 AM/FM solid state stereo receiver, now at your Scott dealer's.

388 Specifications: Music power rating, 50 watts per channel at four ohms, 40 watts per channel at eight ohms; Frequency response, ± 1 db, 15-30,000 cps; Harmonic distortion, 0.8%; Capture ratio, 4 db; Selectivity, 45 db; Separation, 35 db. Price, East of the Rockies, less than \$500.



H. H. Scott, Inc., 111 Powdermill Road, Maynard, Mass.
Export: Scott International, Maynard, Mass. Cable HIFI

Circle 100 on Reader Service Card

AUDIO

November, 1965 Vol. 49, No. 11

Successor to **RADIO**, Est. 1917

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Harold Lawrence
Edward Tatnall Canby

Harold Weiler
Herman Burstein

Number 27 in a series of discussions
by Electro-Voice engineers



VOICE FROM THE DEPTHS

LEE HAGEY
Senior Engineer

Before the era of SCUBA diving, underwater communications was a relatively simple affair. A telephone system was installed in the diver's "hard hat" with a communications line to the surface. When divers were freed from their cumbersome suits, however, they also lost touch with the surface vessel. Underwater wireless systems were developed and are in use. However, these require the diver to carry additional equipment.

To alleviate this problem, the U.S. Navy assigned Electro-Voice to construct an underwater loud-speaker and associated electronics package that would restore the ability of the diver and the ship to communicate without burdening the diver.

The transducer (it operates as either a speaker or hydrophone) is novel in appearance to those unfamiliar with problems of underwater sound propagation. Essentially it is a double-sided disc, about 16" in diameter, made up of 16 pie-shaped wedges of lead titanate ceramic. The wedges are fitted in a slotted metal ring and sealed with a silicone rubber compound that allows flexing, yet maintains a perfect seal at depths down to 200 feet. While a single slab of ceramic would be preferred, wedges are used since the material is very difficult to fabricate in a single piece of the required diameter.

Ceramic is used rather than a conventional voice coil and piston, since it provides a close mechanical impedance match to the water, thus offering optimum efficiency. Essentially omnidirectional radiation is achieved despite the size of the transducer. This is due to the longer wavelength of sound in water. For example, a 1000 cps tone in air is about 1' long, but is 5' long in water.

Above water, a splashproof dynamic microphone feeds a solid-state amplifier which provides up to 80 watts of audio to the transducer. A range of several hundred yards is achieved with high intelligibility.

When not transmitting to the diver, the transducer is switched to the input of a high gain amplifier and used as a sensitive hydrophone. The gain of the system is so high (120 db) that only under unusual conditions does underwater ambient noise permit full use of the gain available. Of interest, ordinary ceramic disc capacitors could not be used in the low-level input stages, since they proved much too microphonic in this application!

While the diver's mask restricts intelligibility of received underwater speech, he can be easily understood if his mask is in direct contact with the transducer. At greater distances, coded signals (such as tapping on his air tank) can be readily heard to provide two-way communications. While not intended for commercial applications, this system reflects the wide-ranging Electro-Voice involvement in every facet of transducer design and application.

For technical data on any E-V product, write:
ELECTRO-VOICE, INC., Dept. 1153A
602 Cecil St., Buchanan, Michigan 49107



AUDIO (title registered U. S. Pat. Off.) is published monthly by Radio Magazines, Inc., C. G. McProud, President; Henry A. Schober, Secretary. Executive and Editorial Offices, 204 Front St., Mineola, N. Y. Subscription rates—U. S., Possessions, Canada, and Mexico, \$5.00 for one year, \$9.00 for two years; all other countries \$6.00 per year. Single copies 60¢. Printed in U.S.A. at Blanchard Press Inc., Garden City, N.Y. All rights reserved. Entire contents copyrighted 1965 by Radio Magazines, Inc. Second Class postage paid at Mineola, N.Y. and additional mailing offices.



RADIO MAGAZINES, INC., P.O. Box 629, MINEOLA, N.Y., 11502
Postmaster: Send Form 3579 to AUDIO, P.O. Box 629, Mineola, N.Y., 11502

Electro-Voice
SETTING NEW STANDARDS IN SOUND

Circle 105 on Reader Service Card

COMING

SPECIAL TAPE ISSUE

Recording Tapes: newest developments in the available types, coatings, backings, over-all characteristics.

Language - Lab Applications: the story of this newest use of tape recorders throughout school systems.

Tape Duplicating: methods and equipment used in commercial preparation of recorded tapes.

Recorder Buying Guide: a compendium of available tape recorders with their essential features.

PROFILES

Scott 2301 Solid-State Stereo Compact

Altec 844A
Monitor Speaker System

Eico 250-K Wideband A.C. VTVM

In the December Issue
On the newsstands, at
your favorite audio
dealer's, or in your
own mailbox

AUDIO CLINIC

Joseph Giovanelli



Send questions to:

Joseph Giovanelli
2819 Newkirk Ave.
Brooklyn, N. Y.

Include stamped, self-addressed envelope.

Sound Distribution in a Listening Room

Q. This is a question which may involve acoustics and placement of stereo speakers.

In a relatively "hard" acoustical environment, the stereo speakers are placed a few feet from the ceiling and near the corners against the short wall of a room whose dimensions are approximately 15 feet by 25 feet. This problem does not deal with the "hole in the middle." It does concern the "missing sides." Left and right seem to shift toward the center, depending upon the listening position. Figure 1 should make this clear: A and B are right and left speakers. C is the apparent sound source. W, X, Y, and Z are listening positions. L and R are limits of left and right sound areas.

Only at position W is there a natural spread of sound. At position X, it is as if speaker B had shifted to point C. At position Z it is as if speaker A had shifted to

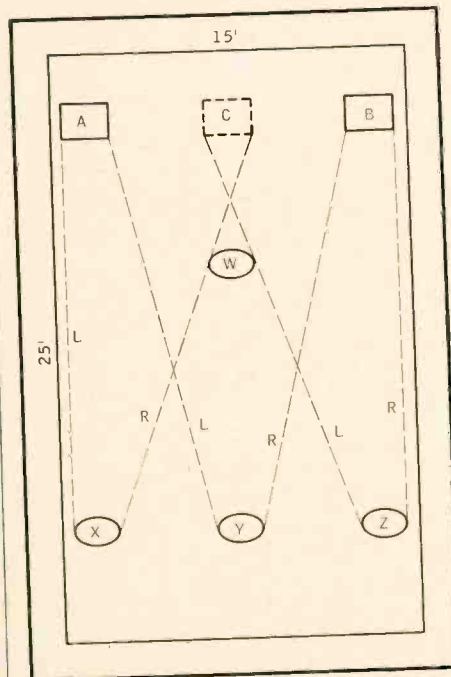


Fig. 1. A and B are left and right speakers. C is apparent sound source. W, X, Y, Z are listening positions. L and R are limits of left and right sound areas.

point C. Most peculiar of all is position Y, where both sides seem, in effect, to have disappeared. Also at point Y, signals that should be coming from A (i.e., violins) sometimes actually seem to be coming from B. In other words, there is general confused spatial orientation. The depth perception at any listening point is excellent. Even monophonic records seem to convey the feeling of depth, but mono sources sound the same from any position. The whole wall (A-B-C) is alive with sound.

Orchestral recordings have a beautiful blend of sound, with instruments generally to the right or left. However, operatic recordings demonstrate the impossibility of pin-pointing a singer. Movement is often noticeable, but the actual location of the singer is impossible to determine.

The speakers cannot easily go elsewhere. Could this problem be merely a matter of insufficient separation? C. J. Spangler, Monterey, Calif.

A. I would, before anything else, do some checking to see if the speakers are in their proper phase relationships and see if the woofer and tweeter in each system are properly phased with respect to one another. Improper phasing could be the cause of much of your entire problem.

Another cause of the difficulty might stem from the fact that your amplifier's tone controls are not set to provide identical sound from the two channels. (Notice that I didn't say that the controls were possibly not set identically, but rather, that they are not adjusted to produce identical sound.) To make this clearer, play a monophonic disc and listen to the sound coming from each channel. Do both channels function? Does one channel have more treble or more bass? Correct these conditions as far as possible by using the tone controls on your pre-amplifier. Do not worry if the tone-control setting for one channel is not the same as for the other channel insofar as their positions on the in room acoustics or it can mean that the front panel are concerned. This can mean that you are compensating for differences potentiometers used in the tone-control circuits are of slightly different tapers.

On stereo, you must expect some loss of separation as you move back away from positions A and B. If you attend a concert of operatic performance, this same loss of separation will be apparent as you sit further and further from the stage. Close your eyes and try to locate an individual singer or instrumentalist. If you are quite far from the stage, locating the performer aurally will be almost impossible, despite the fact that depth perception of the performance as a whole will be excellent.

As tracking forces have become lighter, and stylus assemblies more delicate, so has the danger of damage from manual handling increased. To eliminate this hazard, Garrard has built into the Lab 80 an ingenious tone arm cueing control. This feature protects your records as no other turntable can.

The Lab 80 integral cueing control works for you in three important ways:

1. To play a single record: Press the Manual tab. This starts the motor and activates the tone arm cueing control. The arm stays suspended a safe half inch over the record. Position the tone arm over the first (or any) groove. Now, press the cueing control and the stylus lowers gently into the groove.

2. To cue a record during manual or automatic play: Press the Manual tab. The arm rises and stays a half inch above the record. Move the arm to the band or groove desired, and press the cueing control. The stylus lowers slowly and accurately into the groove. With this feature, there is no necessity to lift the arm by hand causing accidental jarring or scraping of the stylus across the record.

3. To pause during manual or automatic play: When you want to interrupt the music, press the Manual tab. The arm rises directly over the record and stays there. The turntable continues to revolve. When you are ready to resume play, press the cueing control. The stylus lowers accurately and safely,

and the music continues from where it left off.

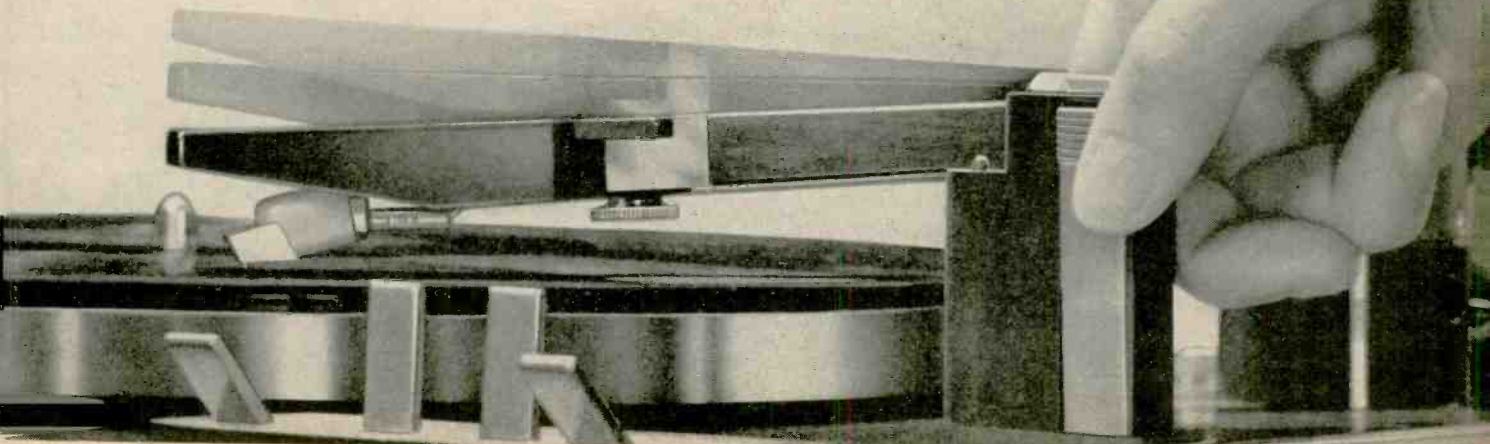
Regarding automatic play: The Lab 80 is a superb transcription turntable for single play. But, in addition, it includes an exceptionally gentle, built-in record changing device, enabling you to play a stack of eight records fully automatically.

**the perfect unit
for taping and
protecting your records**



The
Garrard[®]
LAB 80
Automatic
Transcription Turntable
is the only automatic...

that performs on cue!

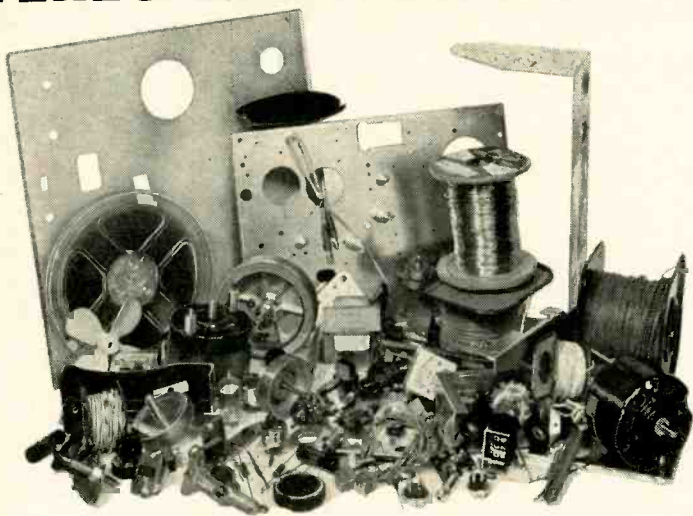


LAB 80, \$99.50, less base and cartridge. For your copy of the 32-page Comparator Guide, write Garrard, Dept. GS-15, Westbury, N.Y. 11591.

CIRCLE NO. 103 ON READER SERVICE CARD

www.americanradiohistory.com

HOW TO BUILD YOUR OWN STEREO TAPE RECORDER...



Start out by engineering a mechanical transport to move tape from one reel to another, tracking accurately within 1/5000 inch over three hyperbolic heads at 3-3/4 and 7-1/2 ips. Tape must run very smooth to hold flutter and wow below 0.2%. Provide high speed-take-up and rewind with a dependable brake system to stop the tape instantly without snapping or stretching. Add tape lifters, counter, automatic stop, pause control, cueing. Connect a fool-proof record interlock to the amplifier section. Design separate amplifiers for recording and playback with a 30-18,000 cps frequency range and facilities to monitor the tape while recording. Provide a bias/erase frequency of 95KC, signal-to-noise ratio of 55DB with total harmonic distortion not to exceed 1%. Include calibrated VU meters, stereo-mono switch, AB monitor switch, high level inputs, mike inputs, amp outputs, monitor outputs and independent record/playback controls for each channel. Package the entire assembly into a compact enclosure no larger than 13 x 13 x 7", provide forced air cooling and cover with a decorator styled stainless steel panel.

IF YOU DON'T FEEL QUITE UP TO MAKING YOUR OWN TAPE RECORDER, ASK YOUR NEAREST VIKING DEALER ABOUT THE...

88 STEREO COMPACT



Hear the magnificent sound, see the smooth action, all set and ready to take home for less than **\$340.00**. Walnut base \$29.95 extra.



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OVERSEAS EXPORT: International Division Viking of Minneapolis, Inc., 9600 Aldrich Av. S. Minneapolis, Minn., U.S.A.

The confused spatial orientation noted at position Y is probably the most unexpected aspect of this discussion. The reversal of some apparent sound sources must be the result of reflections of sound waves within the room, rather than any defects in the equipment. Try to include some stuffed furniture, heavy draperies, and carpeting in your listening room. These items will increase absorption of sound waves, thereby reducing reflections.

After the room has been treated as just described, it is likely that you will again have to adjust the tone controls of your pre-amplifier so that channel A sounds exactly like channel B and vice versa.

Ground Loops

Q. My trouble: Connection to any of the high level inputs on Channel B causes loud hum when I switch to low-level input for playing records. In other words, to play records I have to unplug the tape recorder and tuner to prevent excessive hum. This hum does not occur on channel A amplifier; therefore, it must be in channel B amplifier. Naturally, I have tried all means of grounding, switching plugs, and so on, but to no avail. Hum level is very low, i.e. normal, on low-level inputs after the high-level sources have been disconnected. Reid Curtis, Bragg City, Missouri.

A. First of all, place the equipment as close together as possible, bond the chassis together with heavy wire. If this bonding does not eliminate the hum in channel B when high-level sources are connected to it, you will have to try something else. Connect the high-level sources to channel A as before. Disconnect the grounds from channel B and connect the high-level sources into channel B. There are two ways of handling this. First, you can disconnect the shields at the equipment end of the cable. Serond, you can use skirted plugs which have extra long center pins and push them only part way into the receptacles. You may find that you will have to apply the same treatment to the grounds of channel A or you may find that you will have to disconnect one or more of the bonds. I would rather see you try the cable grounds first, though. This procedure should eliminate the hum.

Selection of High Fidelity Equipment

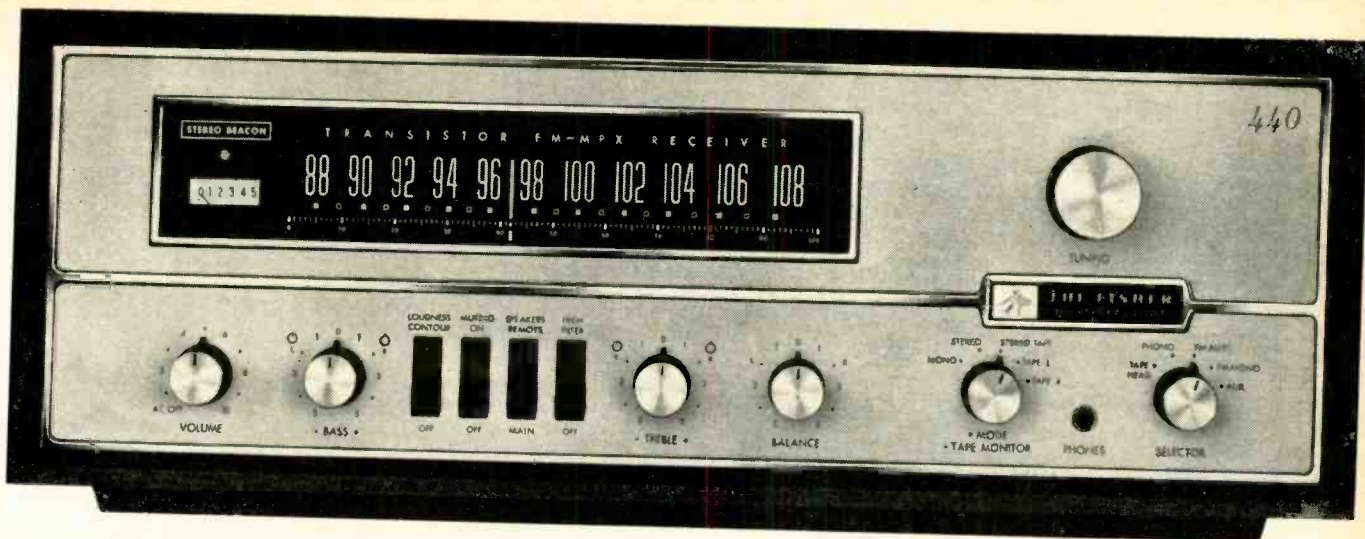
Q. From the enclosed list, could you please tell me what is generally considered to be the finest audio equipment available for inclusion in a home music system? Clifton Wright, San Diego, California.

(Following this, the reader listed a number of brand names under each of amplifiers, preamps, tuners, tonearms, cartridges, turntables, tape recorders, and loudspeaker systems.)

A. I have been asked this question many times, so have decided that I shall print one such inquiry in AUDIOCLINIC at this time.

From experience I have learned that a system which I might select for my own personal use might well not be suited to the needs of other audio buffs. Paul Jones might well select a system which you would not like; you might select a system that Paul Jones might not like, but one

(Continued on page 61)



A Fisher receiver is greater than the sum of its components.

Fisher has always maintained that an all-in-one receiver can equal or surpass the performance of separate components of similar circuitry. And at far lower cost.

The most recent and eloquent proof of this is the new 440-T, the first all-solid-state stereo receiver of Fisher quality under \$330.

On a single chassis occupying only 16¾ inches of shelf space and only 11 inches front to back, the 440-T incorporates a sensitive FM-stereo tuner with automatic mono-stereo switching, an extremely versatile stereo control-preamplifier, and a heavy-duty stereo amplifier. All transistorized, all with Fisher reliability.

By eliminating duplication of parts and circuits, such as extra power supplies and the low-impedance circuitry usually associated with connecting cables, the 440-T actually has a *plus* factor of reliability over separate components. Obviously, fewer parts mean fewer trouble spots. But that isn't all. Hum and noise are more easily reduced to imperceptible levels. And critical preamplifier and power circuits operate at their electrical best. Elimination of other unnecessary parts, such as extra chassis, jacks, knobs, etc., clearly means a considerable cost saving.

In the 440-T, Fisher engineering has also achieved a new degree of reliability in transistorized components. Conservatively rated silicon output transistors permit higher undistorted power and long, trouble-free operation. Damaging heat has been designed out. The receiver can be operated at full power, hour after hour, without harm. You can even short the speaker leads without causing damage. Adjustments and alignments have been practically eliminated, so that the 440-T will operate as perfectly after two years as on the first day.

In spite of its technical sophistication (just look at the specs!), the 440-T is so simple to operate that even your wife will enjoy using it from the very first day. Masses and messes of wire are gone; you simply connect a pair of fine speakers and turn on the music.

It is this total approach to integrated design that makes the 440-T more than just the sum of a tuner, an amplifier and a control center. And that is why it is an unprecedented buy at \$329.50. (Cabinet, \$24.95.)

Features and Specifications

Tuner Section:

4-gang transistor front end; 4 IF stages; 3 limiters; STEREO BEACON*; automatic stereo switching; sensitivity, 2.0 µV (IHF); stereo separation, 35 db; S/N (100% mod.), 68 db; selectivity, 50 db; capture ratio, 2.2 db.

Amplifier Section:

Silicon output transistors; short circuit protection; speaker selector switch (main or aux.); front-panel headphone jack; music power (IHF), 4-ohms, 70 watts; harmonic and 1M distortion, 0.8%; frequency response (overall), 20-22,000 cps ± 1.5 db; hum and noise, 80 db; input sensitivity, phono magnetic (low), 4.5 mv; stereo separation, phono magnetic, 50 db.

Size: 16¾" wide x 5½" high x 12¾" deep (including knobs and heat sink).

Weight: 21 pounds.

*PATENT PENDING

The Fisher 440-T



0311

FREE! \$2.00 VALUE! Mail this coupon for your free copy of *The New Fisher Handbook*. This entirely new, revised and enlarged edition of the famous Fisher high fidelity reference guide is a magnificent 80-page book. Detailed information on all Fisher components is included.

Fisher Radio Corporation
11-40 45th Road,
Long Island City, N. Y. 11101

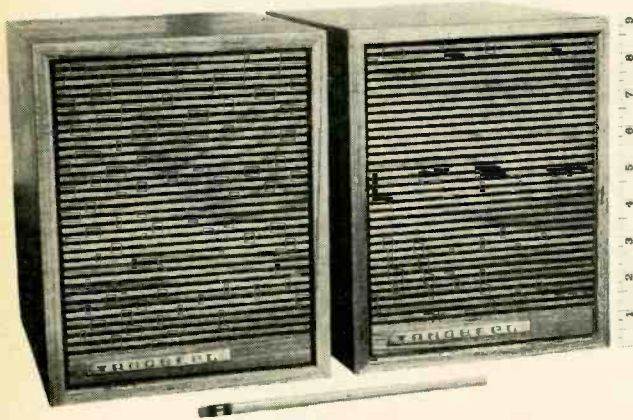
Name

Address

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SPECIAL FREE OFFER

from Tandberg®



Two Stereo Speakers Worth \$99⁰⁰

To introduce the superb Tandberg MINI-SPEAKER Model 113 Stereo Loudspeakers, you will receive a pair *free of charge* when you buy a Tandberg Model 74B Tape Recorder.

A numbered certificate given to you at the time of your purchase, together with your guarantee card, should be forwarded to us. Upon receipt, we'll ship two MINI-SPEAKERS direct free of any additional cost.

The new Tandberg MINI-SPEAKER has been specifically designed to provide a high fidelity response. The MINI-SPEAKER is housed in an attractive teakwood cabinet.

OUTPUT: 8 watts **IMPEDANCE:** 4 ohms
WOOFER: 6.5" **TWEETER:** 2"
FREQUENCY RESPONSE: 60-16,000 cps
MINI-SPEAKER DIMENSIONS: 7" long x 9" high x 9" deep

The Tandberg Model 74B Tape Recorder offers you better, clearer, more natural sound. If you don't know where to get your Tandberg Model 74B, write us for dealer list.

This special free offer begins Oct. 15 and expires Dec. 31, 1965.

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Circle 109 on Reader Service Card

LETTERS

We Please a Musician

Sir:
Many thanks for Harold Lawrence's ABOUT MUSIC in the October issue. Absolutely delicious! It kept me up, just reading and re-reading it. What fun!

ABRAHAM CHASENS,
200 East 78th Street,
New York, N.Y. 10021

And Displease an Engineer

Sir:
There are frequent references in AUDIO¹ (and other magazines) to "rms power." The implication might seem to be that the specification is as opposed to "average power," and that the "rms" value is greater than the "average" value, as is the case for voltage and current. Or possibly it may be an attempt to distinguish "continuous sine-wave power" from "short-time sine-wave power" or "program power."

As your technical editor should know, the product of rms potential difference and rms current is the *average* power, not "rms" power. (After all, the whole reason for rms values is to provide, for a sinusoidal wave, an "effective" value of voltage and current such as to give the same power as for a d.c. circuit having the same value of voltage and current.) "When one speaks of 'the' power supplied to a device in an a.c. circuit, the average power is meant. The 'effective' (rms) power has no significance."²

A little more care on this matter would prevent possible confusion, especially to the lay reader.

JOHN G. MCKNIGHT,
Staff Engineer,
Ampex Corporation
P.O. Box 1166,
Los Gatos, California

¹For a few examples in AUDIO, see: C. V. Campos, KLH 16 and 4-ohm speakers, p. 6, July; Product review, pp. 35 ff, August; Harvard Electronics ad, p. 85, August; Mattes ad, p. 37, August; K. F. Russell, "Protecting loudspeakers against overload," p. 36, Sept., Kenwood ad, p. 47, Sept.
²F. W. Sears and M. W. Zemansky, "University Physics," Addison-Wesley Publishing Co., Inc., Reading, Mass., 1955, 2nd ed. p. 680.

Antenna Articles

Sir:
I am continually amazed over the many years that I have read AUDIO that there has not been more coverage of antennas and feed lines. Now that the antenna has become such a significant part of any good-quality stereo system from the point of view of discrimination between stations, adequate signal strength, and multipath interference, the lack of coverage seems particularly noticeable. Perhaps you could supplement the Product Issue by publishing a list of antennas for FM, cables and feed components, rotators, masts, and related items.

I would appreciate articles on the considerations involved in installation of rotating antennas, propagation effects on FM/stereo reception, and the relative merits of various omni-directional and rotating types.

JAMES O. SPRIGGS,
9903 Thornwood Road,
Kensington, Md. 20795

(We would welcome such articles. As to the listing, most any mail-order catalog covers the subject completely. Ed.)

One on Us—and Everyone Else

Sir:
The "El Cheapo" is almost the only magazine article item I've built that went without having to modify it beyond recognition, and it went first try, and very well at that.

Is I.C. Zero someone's pen name on the Wien Bridge oscillator article in July issue? (Yes. Ed.)

W. Q. COCHRAN,
Church Road,
R.D. #1, Box 35,
Hatfield, Pa. 19440

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AUDIO • NOVEMBER, 1965

NEWEST CONCEPT IN SPEAKER DESIGN

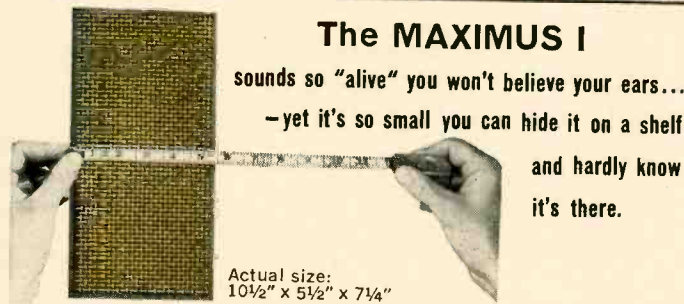


MAXIMUS

With CAPS® (Cushioned Air Pneumatic Suspension)

PACKS MORE SOUND IN SMALLER SPACE THAN ANY OTHER SPEAKER SYSTEM!

ULTRA COMPACT



The MAXIMUS I

sounds so "alive" you won't believe your ears...
—yet it's so small you can hide it on a shelf
and hardly know
it's there.

Actual size:
10½" x 5½" x 7¼"

First of a new generation of Speaker Systems designed for modern living. Delivers depth and brilliance never before possible in a speaker system this size. Designed for the new high powered Solid-State Receivers and Amplifiers as well as present tube components.

Only 10½" x 5½" x 7¼" . . . fits everywhere . . . book shelf . . . end table . . . wall! True bass from the specially designed MAXIMUS woofer. Exceptionally large ¾ lb. magnet structure provides high acoustic efficiency and power capability. Unique L-C crossover network transfers power at 1900 CPS to a newly developed back-loaded mid-range/high frequency unit. Ideal for wide range mono . . . two for stereo. 45-20,000 CPS. Designed for 8 to 16 ohms.

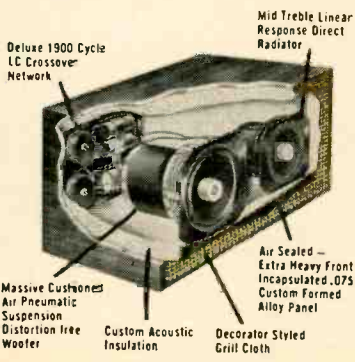
Net Price \$59.50

the MAXIMUS 2 — This middle-size brother to the compact MAXIMUS 1 handles twice the power, extends the bass range down to 35 CPS. It measures only 14½" x 11" x 8". 35-20,000 CPS. 8 to 16 ohms.

Net Price \$109.00

the MAXIMUS 3—Biggest brother . . . but still only 18" x 12¾" x 10" . . . the MAXIMUS III employs 4 MAXIMUS I woofers to give extraordinary precise critical damping for perfect transient response. Has 4 woofers and 2 mid-range and high frequency units. 30-20,000 CPS. 8 to 16 ohms impedance.

Net Price \$169.00

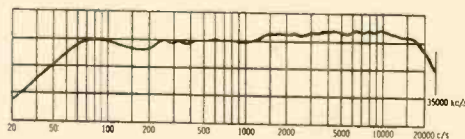


ULTRA LOW DISTORTION SPACE-SAVERS

The MAXIMUS 7 Bookshelf 3-way Speaker System

Less than ¼% distortion from 50 CPS to 35,000 CPS
Less than 3% distortion at 30 CPS

The new UTC cushioned air pneumatic suspension design used in the MAXIMUS 7 speaker system brings the hitherto unattainable ideal right to your unbelieving ears. Extended bass response with swings of 3 to 75 watts at a distortion level that is less than three-quarters of one per cent. This has never been attained up to now, even in speaker systems five times the price of the MAXIMUS 7, and all within a cabinet that is one-third to one-fifth the size of comparable fine speaker systems. The array of laboratory checked components comprising this system includes a heavy 12" pneumatic suspension woofer with a 9½ lb. ceramic magnet structure; two shielded back-loaded bi-polar



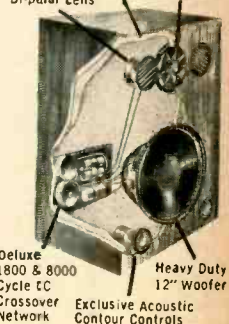
mid-treble wide dispersion lens radiators and a dome lens compression type multicellular ultra high treble horn. To complete this deluxe system, 3-way LC crossovers are provided at 1800 and 8000 cycles coupled to continuously variable mid and treble KOINTOURED ACOUSTIC controls to satisfy individual listening requirements. Uniform response from 25 to 35,000 cycles. Total distortion less than ¼% from 50 to 35,000 cycles. Distortion at 30 cycles less than 3%. Impedance: 8 to 16 ohms. Size: 24" x 14" x 12". Finished on all 6 sides, oiled walnut cabinet with airtight sealed enclosure and custom designed removable decorator style grill.

Net Price \$189.00



Custom Acoustic Insulation

Mid-Treble Unit with Bi-polar Lens



ALL NEW Snap-off and Removable Grill Frame with fully finished Walnut Speaker Panel.

The latest in creative design has been put into the Bookshelf MAXIMUS 4, 5, 6 and 7. A new snap-off removable grill so as to allow you to select the grill panel to blend with your room decor. All Speakers are Oiled Walnut finished on 6 sides. Impedance: 8 to 16 ohms.

MAXIMUS 4



MAXIMUS 5



MAXIMUS 6



the MAXIMUS 5 — 3-Way Speaker System — Exceeds all extant laboratory standards for a low distortion popular priced space-saving speaker system. It has high power capability, superb transient control, and exceptionally clean bass response in the critical region of 30 to 50 cycles. It will handle 50 watts IHFM of audio music, and requires only 3 watts of input drive to fill a large listening area with exciting sound. Features a CAPS woofer with a 5 lb. double duty ceramic magnet structure. The electrical crossover point is at 1800 and 5000 cycles through an LC continuously variable KOINTOURED ACOUSTIC control to 2 shielded back-loaded mid-treble lens speakers. Response virtually flat from 30 to 20,000 cycles. Size: 24" x 14" x 12".

Net Price \$129.00

the MAXIMUS 6 — 3-Way Speaker System — Boasts tremendous, vital, uncanny bass, precise transient control, and virtually flat response from 25 to 22,000 cycles. The CAPS woofer will handle 75 watts of IHFM music power and responds to high power excursions at less than ¾% distortion. Requires only 3 watts of audio driving power to fill a large listening area with superb sound. The MAXIMUS 6 utilizes a pneumatic suspension woofer having a 9½ lb. double duty ceramic magnet structure, two shielded back-loaded wide dispersion bipolar mid-treble lens speakers, and 3-way LC crossovers at 1800 and 8000 cycles with continuously variable mid-treble KOINTOURED ACOUSTIC controls for individual acoustic listening requirements. Size: 24" x 14" x 12".

Net Price \$169.50

the MAXIMUS 4 — 3-Way Speaker System features the newest 8" version in the family of CAPS woofers. The total inter-modulation distortion from 100 to 20,000 cycles is less than ½%. The distortion at 40 cycles is less than 3%. The pneumatic suspension woofer has an ultra efficient ¾ lb. double duty ring magnet structure with a total flux of 17,000 gauss. At 1800 and 5000 cycles the audio drive is transferred to 2 shielded back-loaded mid-range lens speakers. Incorporate a continuously variable KOINTOURED ACOUSTIC control. Frequency response: 35 to 20,000 cycles. 40 watts IHFM. Size: 21¾" x 11¾" x 11¾".

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the new compact reverberation system which gives your station that real big voice. With the Reverbertron you can have that Carnegie Hall effect as close as

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LIGHT LISTENING

Chesler Santon

Carousel (Lincoln Center Original Cast)
RCA Victor ISO 1114

Some fine productions have been mounted at Lincoln Center's State Theatre but this treatment of "Carousel" is one of the best. Since Richard Rodgers is the president and producing director of the State Theatre, his shows are bound to get a more than proper revival. Knowing this, I still wasn't quite prepared for the beautifully finished production of "Carousel" this recording reveals. This particular Rodgers and Hammerstein show has always been a favorite of mine ever since I first saw it on Broadway some nineteen or twenty years ago. The songs defy aging and the presence of John Raitt in the cast of this revival album preserves a great deal of the continuity because he created the leading role of Billy Bigelow in the first production. His performance of twenty years ago was voted the best by an actor in a musical show by the New York Drama Critics Circle and the Donaldson Award Committee. Raitt has kept in touch with the show over the years in summer stock. With a voice that shows no signs of wear or strain, he is still the ideal Billy Bigelow. The supporting cast has been meticulously groomed down to the last syllable of what passes for a Maine dialect on the Broadway stage. There isn't a flaw in the treatment of the major songs with today's microphones (and master tape) getting every word of the lyrics along with conductor Franz Allers' perceptive exploration of orchestral nuance. Until now, I've felt that, over-all, Capitol has had the most rewarding version of Carousel on records in their soundtrack album starring Gordon MacRae. RCA's Lincoln Center release easily matches the performance of the older version while surpassing it by a comfortable margin in the sound department. Perhaps the most heartening note in this new album is the very healthy state of affairs in the American musical theatre as revealed by companies in and out of New York still devoting themselves to Broadway classics.

The Guitars of Los Indios Tabajaras
RCA Victor LSP 3413

Those harboring the notion that they've heard everything that could be done with a guitar were somewhat surprised by the first record featuring these two Indian brothers from the jungles of Brazil. Their talent is a remarkable one and it's a pleasure to note that the latest disc by Los

Indios gives that talent a chance to be heard in improved sound. The appeal of this duo is based on several factors, all of them revealed in fine-grained detail in this recording. The instruments themselves are exceptionally full in voice, even at the low level used by Los Indios in their relaxed stylings of South American and local favorites. Perhaps the most noteworthy accomplishment of these self-taught members of Northern Brazil's Tabajaras tribe is the fresh approach they bring to even the most familiar of American tunes. Their rhythm and heat seems guided by a rock-steady gyroscope unavailable to our own purveyors of pleasant background music. The months they've already spent in American show business haven't dulled a unique gift in music making and complicated arrangements will probably never interest them.

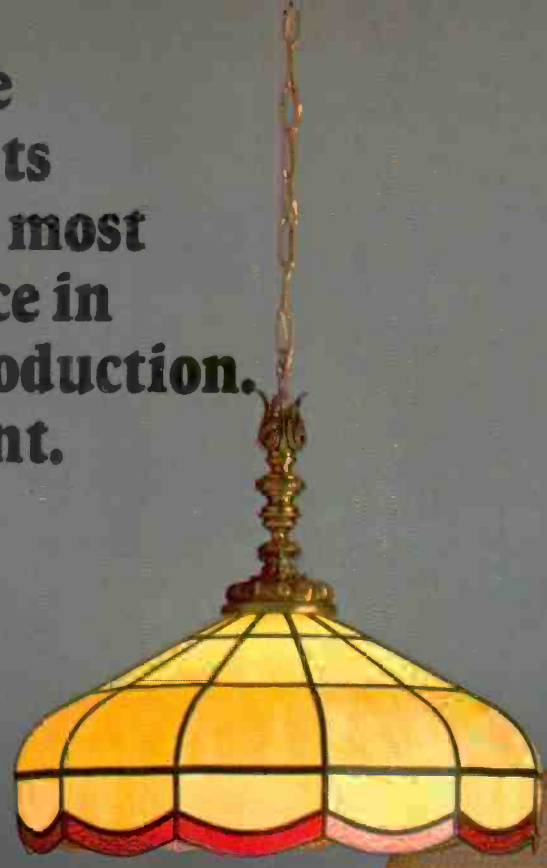
Lena Horne: Feelin' Good
United Artists UAS 6433

This is Lena Horne's first appearance on the UA label. Some of her fans, this reviewer among them, may wonder what is going to happen to Miss Horne's earlier albums in the catalog now that she has switched from one major label to another. It has not escaped the notice of record fans over the years that drastic measures are sometimes taken by a label once a fairly important artist leaves its ranks. The usual retaliation is the unceremonious yanking of the artist's previous releases from the pages of the current catalogs on the part of the "deserted" record company. If the artist happened to work for several outfits of similarly petty attitude prior to his present employment, he can suddenly find himself with only one album listed in the catalog instead of the half dozen he recently had there. It is hard to believe that Lena Horne's outstanding albums made for RCA Victor will be discontinued by that firm solely on the basis of this debut United Artists release. Lena is still in fine voice but many of the songs in this new album just don't have the stature of the tunes in her Victor discs, many of which featured sound that was exceptional for its day. In terms of lasting musical appeal, Side 2 of her latest album outshines the first side by a considerable margin. It would take a lot of doing to convince me that the three songs by Anthony Newley and Leslie Bricusse heard early in this program are anywhere in the same league with "Willow Weep for Me" or "Hello Young Lovers" from The King and I. Lena Horne takes a sensible bit of poetic license in reversing the lyrics of "Girl from Ipanema" in order

(Continued on page 74)

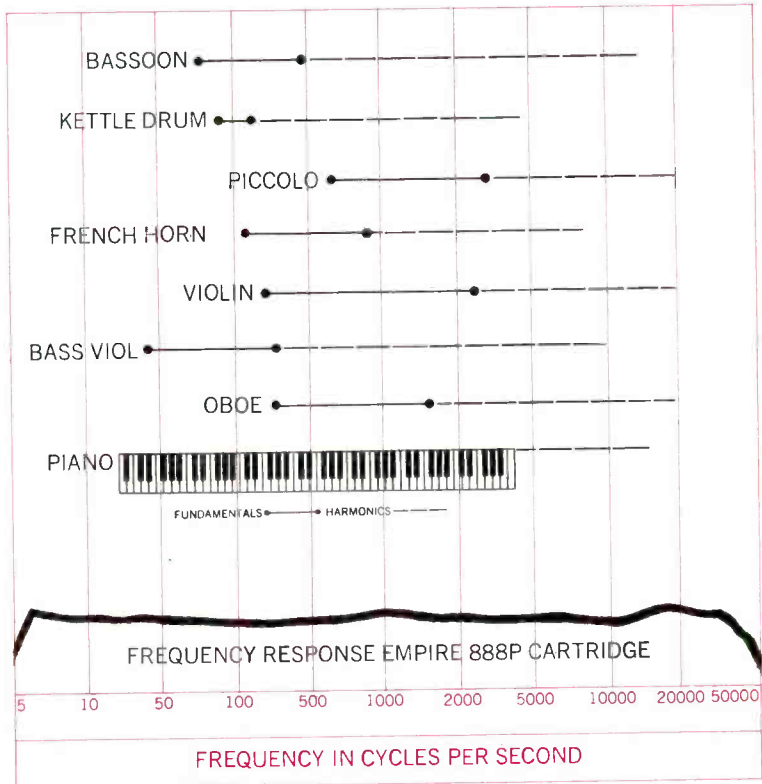
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Feature by feature
Empire components
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Listen for a moment.



THE FOLLOWING

sings! It absorbs! It feels! It captures every sound, caresses every note. The new Empire 888P cartridge is the pulse of our entire music system. Listen to its unbelievable frequency response that spans the complete orchestral spectrum one octave above and below the fundamental range of any musical instrument or of any harmonic content it can possibly generate.

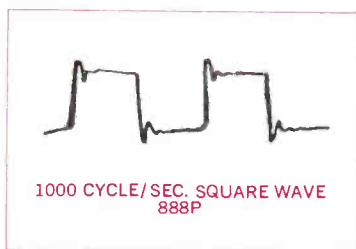


No other cartridge can reproduce the entire musical range as precisely and with such clarity. An important fact to note is that Middle C on the music spectrum producing 261.6 vibrations per second, can be struck softly on a horn or bowed on a violin. The characteristic sound of each is determined by the fundamental vs. harmonic balance. Failure to produce the lowest fundamental or the highest harmonic frequency lose the subtle nuances of the musical note. The new Empire 888 keeps every note "in true character" from the lowest B of the contra bassoon to the highest of the piccolo. The 888 series is a cartridge with instinct. It can pick up sound as low as 8.15 cps—where the sense of feeling occurs before the sense of hearing, or as high as 40,000 cps, well beyond the normal range of hearing. The new Empire 888 series cartridge makes your records come alive.

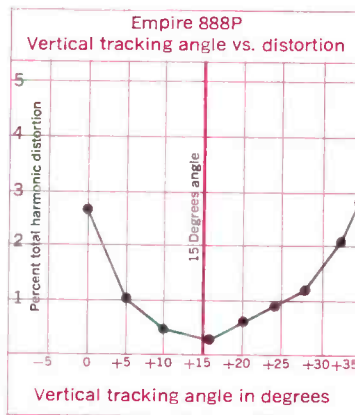
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The 888P gives you razor sharp stereo separation (more than 30 DB) over a frequency spectrum of 10 octaves. Instruments don't waver. The only sound you hear is of exact depth and dimension of your recording.

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sic. Every instrument, every note creates a sense of presence. It is a cartridge designed not only for the appreciation of the music lover, but in appreciation of music. See your Hi Fi dealer today and hear the difference. No other cartridge says it as clearly as the new Empire 888, 888P, or the 888PE. They're all alive!

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Model	888	888P	888PE
Frequency Response	12-24,000 cps	10-28,000 cps	8-30,000 cps
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Stylus Type	.7 mil Diamond	.5 mil Hand Polished Diamond	2X.9 Bi-Radial Elliptical Diamond
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World's most perfect high fidelity components.

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ACTUAL SIZE

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The Famous Empire 398. Outstanding! too perfectly engineered for even a whisper of distortion...to handsomely finished to hide behind cabinet doors.

The new Empire 498 no larger than a record changer—tailor made for console or equipment cabinets.

Both Troubadors set a new standard in playback equipment. In fact, more Empire Playback equipment is used by FM Stereo Stations than any other brand. No wonder equipment reviewers, professionals and audiophiles the world over acclaim the Troubadors as the best money can buy.

(1) Audio Magazine: "Precise performance...an excellent buy for those who want the quality...we tried to induce acoustic feedback by placing the turntable on top of our large speaker system and turning up the gain—we were unsuccessful."

(2) American Record Guide (Larry Zide) "I found speed variations—that is, flutter and wow—to be inaudible...vibration extremely low...Total rumble figures have not been bettered by any turntable I have tested."

(3) Don Hambly, station mgr. KRE AM-FM, Berkeley, Calif. "We have long realized that belt driven tables would be the best to use, but had not been impressed with those on the market. The Empire tables, however, have all the basic requirements of design and simplicity of operation and maintenance that we have sought."

Only Empire makes a completely intergrated 3 speed "silent" record playback system.

Its massive turntable is driven by a heavy duty hysteresis-synchronous motor that provides a constant speed regardless of current fluctuations. Only two moving parts, resilient nylon "seat" supports and cushions the rest of the main bearings. A continuous flexible belt (perfectly ground to a $\pm .0001$ inch thickness) also contributes to its flawless performance.



INCOMPARABLE TROUBADORS TABLE OF CONTENTS:

Highly accurate Fine Speed Control. Push button power control with on-off light. Optimum distribution of turntable mass; 6 lb. heavy machined aluminum, individually balanced to precise concentricity; machined heavy aluminum base plate.

Safety suspension rubber mat. Retractable 45 RPM adapter. Rumble better than 65 db. Wow and flutter less than .05%. Power: 117 volt, 60 cycles AC, 30 watts.

980 dynamically balanced playback arm with Dyna-lift; 888P Living Cartridge with exclusive magnetic cone stylus.

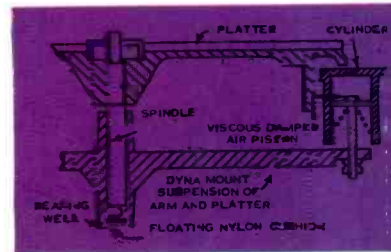
398 complete in handsome walnut base measures 17"W x 15"D x 8 $\frac{3}{4}$ "H. Without base: height above mounting board 4" depth required below turntable base plate 2 $\frac{1}{2}$ ".

498 Troubador, complete in handsome walnut base, measures 16"W x 13 $\frac{3}{4}$ "D x 7 $\frac{1}{2}$ "H.

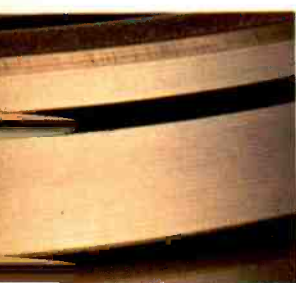
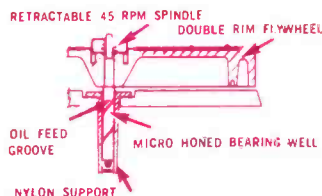
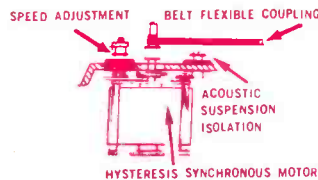
488 Troubador, complete with walnut mounting board, measures 15 $\frac{7}{8}$ "W x 13 $\frac{1}{4}$ "D. Height required above mounting board 2 $\frac{3}{4}$ ", depth required below turntable base plate 3 $\frac{1}{2}$ ".

List Price: 398 Troubador with walnut base \$185.00.

List Price: 498 Troubador with walnut base \$170.00. Less base \$155.00.



Another impressive feature is Empire's sensational "Dyna mount" (vibration absorbing multiple-floating suspension system found only in the 498 and 488) virtually assures stability under any conceivable situation.



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ABOUT MUSIC

Harold Lawrence

Eine Grosse Nachtmusik— Outdoor Sound Reinforcement

THEY BEGAN ARRIVING about noon on a hot August day, carrying picnic baskets, thermos bottles, blankets, beach chairs, and portable radios. By six o'clock, thousands had gathered in front of the acoustical shell, watching the newcomers tiptoe across the bodies in search of a bit of earth. The place: Sheep Meadow in Central Park, unfamiliar even to most native taxi drivers, but soon to become famous to all New Yorkers. By 8:30, some 73,000 people had poured into the area, filling every available plot of grass, and overflowing onto the sidewalks of Central Park West. They had come to hear the first of twelve free concerts by the New York Philharmonic. Nearly half a million eventually turned out for the series, a larger audience than that for which the Philharmonic performs during an entire indoor season. It was easily the biggest musical news of the summer. For Christopher Jaffe, the designer of the mobile shell that housed the orchestra, it was more than that.

When it became clear that the place was going to be overrun, officials of the Philharmonic, who had expected a small turnout, were exultant. Jaffe was worried. He looked out over the sea of reclining bodies and shook his head. "It's staggering! We were prepared for a maximum attendance of 15,000. Now our shell and sound system will have to reinforce a symphony orchestra over an area of a quarter of a mile. This is going to be interesting."

At 8 p.m. Jaffe made a last-minute tour of inspection. His four-unit 36-ton shell (named "Minnie" after Mrs. Charles Guggenheimer, founder of the Lewisohn Stadium Concerts) looked steady enough. It had taken a team of twelve men ten hours

to erect it. Each of the units rests on a trailer 43 feet by 9 feet, and is 13½ feet tall. When the trailers are in position, the frame of the shell is raised hydraulically and leveled by transit measurement to a tolerance of ¼th of an inch. "After the rainfall we had yesterday," Jaffe remarked, "we were afraid our grass pods would sink unevenly into the ground; fortunately they remained stable."

Jaffe approached a group of men hovering over a mixing console to the left of the stage. "The mixer is manufactured by North American Philips and feeds six Bozak Concert Column speakers placed on the top of the shell. We have eight microphones out there, all AKG C-60's set to cardioid patterns: three on the grass and three flying—these pick up the orchestra—and two more to cover the chorus and soloists in the Finale of the Beethoven Ninth. Now here's the rub: the 600 watts of solid-state power we have was designed to reach some 15,000 people, not four or five times that number."

Joined by conductor Maurice Peress, we moved out into the now darkened field. Starting about 500 feet from the stage, we began to walk from left to right across the Sheep Meadow. William Steinberg was conducting Wagner's *Prelude to Die Meistersinger*. Jaffe raised the walkie-talkie to his lips: "How do you read me, Gordon?" "Loud and clear. Can you hear me?" A few music lovers shot annoyed glances in our direction. As we picked our way through the unusually quiet and attentive audience, Jaffe fired off instructions to his crew. "Bring up flying mike number three and soloist mike number eight one point each." "I'm not reading

you, Chris," came the reply, smack in the middle of a soft passage in the score. Outraged looks and much shushing from disturbed listeners. Jaffe abbreviated the message: "Eight and three up one point."

Suddenly the music grew louder. "It's as if we walked into something," said Peress. "Sounds like a 10-dB jump," Jaffe agreed, then turned to his walkie-talkie: "Ask Paul Stone to take his screw driver and go into the amplifier deck and cut back the center amp from full to five . . . That's better." Similar adjustments were made throughout the concert as we stumbled over the figures in the dark. Before the program was over, it was plain that the shell-speaker system was inadequate for the throng. Beyond approximately 400 feet, one had had to strain to hear soft passages. Happily, the audience couldn't care less. Along the outer fringes of the crowd, people tuned in to the local radio station picking up the concert.

What of Jaffe's fiber glass shell and sound amplification system? "Under the circumstances, it was hardly a disaster. But now we knew what to expect. We added four more Bozaks, along with amplifiers to drive them, bringing the total to ten speakers. This made it possible for us to reduce the levels at which we operated the mixer, to cut down on distortion, and to spread out more sound. And speaking of spread, we selected these column speakers because of their excellent front-to-rear level control. The level differential from stage to 400 feet was only 6 dB. In addition, the side-to-side distribution of sound varied only 3 dB on all readings taken in a perimeter arc at 400 feet. With other speakers, the sound up front would have approached the threshold of pain."

Have you considered the use of tape-delay techniques to improve distribution? "We'll probably experiment next year with speakers out in the audience at 400-500 feet and out."

Jaffe was exhausted by his ordeal of one-night stands. Just as he began to adjust to conditions in one place, he had to tear down, fold the huge segments of his shell into their respective trailers, and drive on to the next park. After Sheep Meadow, the Philharmonic played to more than 350,000 more people in Prospect Park, Brooklyn; Crocheron Park, Queens; Botanical Gardens, Bronx; Clove Lakes Park, Staten Island; and back again to some of these locations. Logistics, sound distribution, and the mechanical problems of mounting and demounting the shell were not the only things Jaffe had to contend with. Up, the shell became a structure in the eyes of the Building Department and had to pass inspection; down, it was a caravan of trailer trucks, each of which had to meet the requirements of the Department of Highways.

Jaffe and his team of engineers at Stage Craft Corporation are still reeling from the experience. Recalling his feelings on opening night, Jaffe said: "I kept watching ever-increasing hordes of people arriving at Sheep Meadow. As they poured in, I began to understand how the Union troops felt at Gettysburg when Pickett's men started their charge. Fortunately for the Union and the Philharmonic, neither of us ran." AE

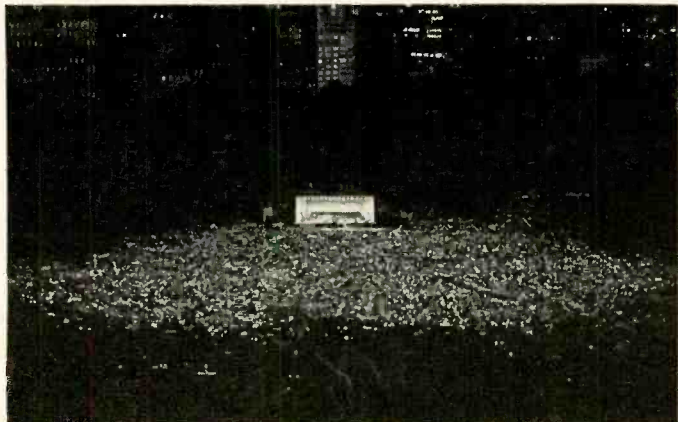


Fig. 1. View of Sheep Meadow in Central Park

AUDIO ETC.

Edward Tatnall Canby



AUDIO ENGLISH

IN THE LONG, dreary stretches of summer vacation, when audio is quiescent, in front of the scenes (though not behind), when the spring announcements are over, and the fall announcements haven't got past the air conditioners yet, when our editorial staff is smitten by enormous reams of new-product data, in anticipation of the annual New Products issue (See *Audio* for August)—I sometimes find myself turning to the oddest aspects of audio, in my boredom with all the inactivity going on around me. Like, say, the pronunciation of the English language as it comes in over my high-rise FM antenna.

Don't tell me that audio (in this particular form) isn't changing our lingo! Some say that the 'teen agers are responsible. Yesterday, *cool* meant formal and distant, like a diplomat. "He got a cool reception." And before that, it merely referred to the weather. Cool. Now, the 'teen-agers have managed to air-condition the word "hot" as we-all once knew it, and so "hot" is now "cool". Remember—how we used to say, "Boy, that's a hot one!" OK—just try reforming yourselves, and repeat, after me, "Like it's cool, man!" Thus, you see, *hot* becomes *cool*, and *boy* becomes *man*. Simple.

It's not so simple in the world of audible audio. It isn't really so much what you say, as how you say it. Which *syl-abbie* you *ac-cent*. And which word, in the sentence—if it is a sentence. I remember some prefatory symptoms of change back in my early FM days when I first learned what it was to write deathless prose for announcers to read out loud on the air.

Next Sunday

We had one program, for instance, that came twice a week, say Wednesdays and Sundays at nine o'clock. It had a standard opening and close, ending with the inevitable "Be sure to listen again next Sunday evening" . . . etc.

The trouble was that on Wednesdays, the announcer was supposed to say "next Sunday," accenting the day, and on Sundays he would have to say, of course, "next Sunday," accenting the "next". Common sense. But not until I wrote out a separate script for each day, with the proper words heavily underlined, could I persuade the announcers to read that little passage right. They were too busy listening to the sweet sounds of their own handsome voices to bother about sense.

Nevertheless, broadcasting people do work hard on pronunciation, and their

spoken product is heard by millions, including 'teen agers. If the young fry originate most of our slang, then the broadcasting fraternity—backed by Heaven knows which "authoritative" dictionaries—have the last word on all of us, ever so definitely—for what *they* say is what *we* hear; and what we hear on the air, in the long pull, is likely to be what we'll be saying ourselves one of these days. Enormous influence.

With this in mind, I began awhile back to make a collection of odd usages I heard on the air. Not formally, like in a card file. Most of my "research" has been jotted down on a batch of convenient Shredded Wheat separators—which, by the way, I recommend as the only pure-white blank cardboard I've ever seen in a commercial product. No ads, no contests, no coupons. Just blanks. (Apparently he hasn't had any lately. Mine now come three in a "poor quality" paper package, and four packages to the box. Maybe he buys the newer brand of Shredded Wheat. Ed.) So, with Shredded Wheat cards before me, I now give you the New Look in audio English, right out of FM stereo and TV, the linguistic horses' mouths.

Temper At You Were

1. Of course everybody knows what the temper-at-you-were is. That's what I said. "The temper-at-you-were is eighty-five degrees." Five separate syllables. So if you are in the habit of saying "Temprachrr" forget it. Learn correct audio English.

2. Then there's that basic institution of advertising life, the fam-ill-lee. Or rather, the hole-fam-ill-ee. Nobody in his right mind, off the air, would ever say anything but famlee, or even famblee. But on the air the entity invariably known as the hole-fam-ill-lee comes complete in four big syllables.

3. Institutional and scientific English has developed a fine new broadcast pronunciation all for itself. Take the wind, for instance. There once was a poetic way of referring to wind, involving the direct approach. You talked right to the wind itself. Remember this one: "Blow, blow, thou winter wind, thou art not so unkind as man's ingratitude."? (Have I got it right?)

Nowadays most of us would speak more prosaically. "Th' wind's from the West" we'd say. And we'd say it correctly, too. The rules tell us we're supposed to pronounce *the* as *thee* only before a vowel. And *a* then becomes *an*. *Thee* apple, *an* orange.

Before all consonants, *the* is correctly

pronounced *thuh*—or was until now. And is similarly *uh*. *Thuh* peach, *uh* pear. Peter Piper picked *uh* peck of pickled peppers.

But broadcast science has now decided otherwise. On the scientific air, now, it is ALWAYS *thee*. And *ay*, to rhyme with may. Says the weather man: *thee*-wind blows straight out of *thee*-South and *ay*-storm is approaching *thee*-coastline. Very precise and professional sounding. Can't you just hear the science announcer on TV asking us, ever so solemnly, "Now *why* did Peter Piper pick *ay* peck of pickled peppers?"

4. That's not the end of scientific talk-style on the air. All the *uh* vowels, all the rest, of any sort, have now been turned into *ee* vowels. I took down dozens of examples on my Shredded Wheat list, right off the air. We have, for instance, something called the *ee*-lectric *ee*-conomy, in my part of the country. And then there's the *ee*-lapsed time in the *ee*-leventh *ee*-vent of some sports affair. Highly unscientific if you ask me. *Ee*-gods! Where will it all end. . . I mean, where will it all *ee*-ventuate?

Ex-peuht

5. Another interesting subversion of the language is the old-fashioned misplaced syllable, in a brand new *ee*-volution. The principle is age-old. Whatever syllable accent is officially correct, you change to another syllable. Thus *cigarettes*—to rhyme with *Rockettes*—long ago changed into *cigrets*, pronounced *cig-r-ts*. Now that the broadcast side of audio has taken up this principle, things are happening all over the place.

I was shocked to hear one announcer speak of a *the-ay-ter*. I thought that was something for the small-town farmer. Next came, instead of *Mus-ee-um*, the altered new form, *Mew-zeeun*. Well, I could let that pass I suppose—but one that kills me is that old-fashioned word *expert*. Evidently the new laws of the air say that when *expert* is an adjective, it is to be pronounced *ex-peuht*. So now you go to your local living insurance agent (what-*life* insurance, Never heard of it.) and from him you *ree-ceive ex-peuht* advice.

Even the British are going haywire on audible syllabification. In one imported BBC news tape I discovered that the old familiar *looker-on*, i.e., the spectator, no longer leans back on his first syllable—*spec-tator*—but now balances himself on the middle one—*spec-tay-tor*. At least that's the way BBC says it in reference to the worthy weekly newspaper of that name, The Spectator.

The nuttiest one yet under this category, though, is an American broadcast item that I picked up one day with utter incredulity. It was the familiar word which means "think about", and looks in print this way: *consider*. The announcer flummoxed me by saying, as calmly as a *cu-cumb-er-CON-sider*.

Yeah, yeah! As the bible has it, *CON-sider* the lilies of the field. *CON-sider* my eye! It'll be a long time before I'll *CON-sider* that one as part of my way of talking.

6. Then there's the Vanishing Y. That's a dizzy one. The special word where this

(Continued on page 62)

4 important ways different...

1. It's efficient... ideal for use with moderate power amplifiers and receivers. W30 doesn't need powerful amplifiers to fill highly absorbent rooms with impressive sound.

2. Sounds good because it is *all there*—rich, musical bass, full-bodied articulate mid-range, bright clear-toned treble. W30 produces this kind of satisfying sound because it doesn't eliminate the mid-range in order to create an aural impression of bass and treble; nor does it bump up the mid-range to provide the illusion of presence.

3. It preserves definition and full-range response at *all* levels.

W30 will not distort at high levels; nor will it fade into an indiscernible sound played at low levels. This is because the system is built entirely of genuine Wharfedale components, renowned for the uncompromising quality designed into them by England's G. A. Briggs.

4. It provides an entirely new technique for complete acoustical correction of *both* the treble and mid ranges, on a frequency discrimination basis.

The W30 Acoustic Compensation Control doesn't resort to a simple resistor or potentiometer which merely attenuates the tweeter for only partial adjustment to room acoustics.

This is how the Acoustic Compensation Circuit operates —

• Switch in "FULL" position:

Crossover network functions as conventional 2-section LC circuit, permitting speaker system to operate unencumbered through entire audio spectrum. "FULL" position is suggested for "normal" living room acoustic environment having upholstered furniture, wall-to-wall carpeting, window drapery. It will also best satisfy listeners who prefer a "lively" sound to their music, projecting instruments and vocalists into the room.

• Switch in "DE-EMPHASIS" position:

Reduces reflections, echoes and reverberation which generally distort the reproduction of music where acoustical conditions may be described as "hard surfaced." This position is also suggested for persons who prefer a mellow, subdued type of sound, but *without* loss of musical timbre, definition or range.

Unlike simple resistors or variable potentiometers, which attenuate all frequencies equally, the W30 acoustic compensation is frequency discriminating, and is applied *both* to mid-range and treble response for preservation of true musical balance. While an alteration in speaker characteristics is apparent in the "DE-EMPHASIS" position, the change is not exaggerated because there is no noticeable loss in frequency range and, therefore, no loss of musical content.

In "DE-EMPHASIS" position, a shunt circuit, introduced into the crossover network...

(1) permits bass frequencies to pass freely to the woofer, but attenuates the mid-range, starting at about 500 cps and becoming more prominent above 1250 cps. (See equivalent circuit.)

(2) attenuates treble energy to the tweeter from 1500 cps to approximately 6000 cps, becoming less effective from that point out to 20,000 cps. (See equivalent circuit.)

The net result is to produce a response envelope in which the range from 500 to 8000 cps is depressed approximately 3-4 db, while attenuating the range from 8000 to 20,000 cps significantly less. This produces a more linear and better balanced response than systems which cut off tweeter response without regard for the relationship between frequency, hearing acuity and room absorption.

For Comparator Guide, write Wharfedale, Division British Industries Corp., Dept. WS-25, Westbury, New York 11591.

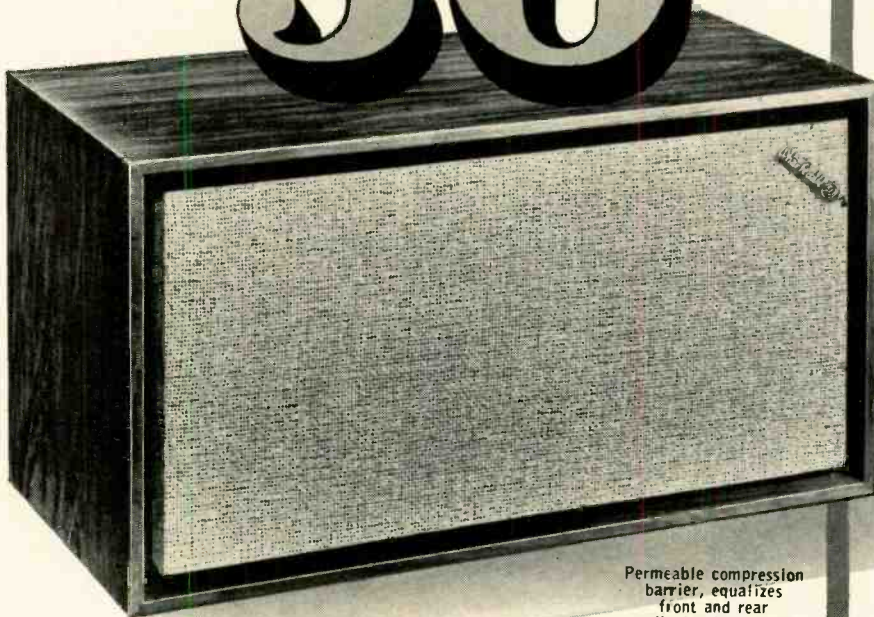


CIRCLE NO. 101 ON READER SERVICE CARD

Wharfedale

presents the

W30



Permeable compression barrier, equalizes front and rear radiation impedance to prevent axial excursion distortion; also improves power handling capacity and speaker damping.

2-section LC network... plus new acoustic compensation control that adjusts both mid and high frequencies; preserves definition and range regardless of listening level.

New Flexiprene surround on 8" woofer for high compliance, low resonance.

High efficiency tweeter, uses heavy Alcomax magnet and low mass aluminum voice coil; produces clear, clean treble to inaudibility.

Cast basket for lifelong adherence of critical relationship between moving voice coil and magnetic gap.

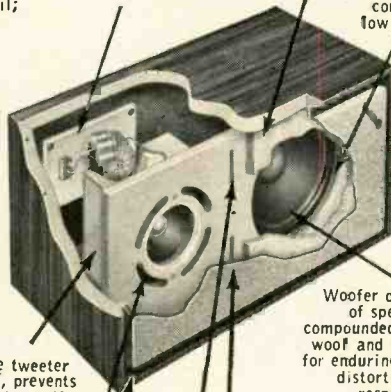
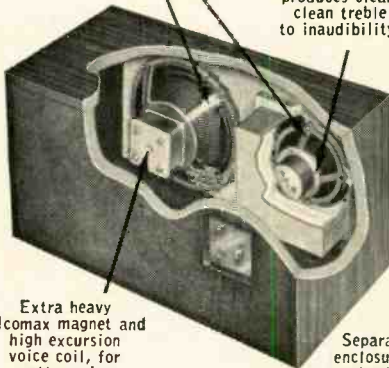
Woofer diaphragm of specially compounded long-fibred wool and virgin pulp for enduring resilience, distortion-free response.

Cabinet tuning slots, complements woofer resonance for greater linearity and range of bass response, eliminates unnatural one-note "thump."

Separate tweeter enclosure, prevents mechanical coupling between woofer and tweeter; extends lower frequency range, reflexes rear wave through slotted exits.

Genuine walnut, fine furniture styling and finish; floating grille to prevent resonance and vibration buzz.

Extra heavy Alcomax magnet and high excursion voice coil, for watts-saving efficiency.



True bookshelf dimensions: Only 19" x 10" x 9 1/4" deep.

Oiled or Polished Walnut, \$69.95. Utility version in Sanded Birch, \$63.95. (Manufacturer's suggested list prices).

EDITOR'S REVIEW

“EIGHT O’CLOCK and the show is closed!” Those were probably the most welcome words heard at the New York High Fidelity Music Show on Sunday evening, October 3rd. All of us in the industry look forward to the opening day for at least two months prior to the event, and then all during the show we look forward to the closing hour. Not that we don’t enjoy the contact with our respective “customers” and with the other exhibitors who we see off and on throughout the year perhaps a half dozen times, and then every day during the show. That is what makes the typical high fidelity show bearable—and to a great extent, enjoyable. But in spite of all that, feet do tire and throats do feel the strain of much talk.

Actually, in a magazine office we are likely to be exposed to everything new as soon as—and often before—it appears on the market, but there is no substitute for actually seeing, hearing, and—in some cases—operating the new units. Thus we are still always curious as to what is new.

We are pleased to be able to say that the over-all sound quality *did* appear to be better this year than last. With most of the exhibitors showing their latest solid-state models, we observed with considerable satisfaction that the quality was uniformly better than it was a year ago. That is, in itself, a distinct “plus” for this year’s show. Long-time readers will remember our comments about the beauty of the decor of the shows in Mexico, and more recently of the Festivals du Son in Paris. This year it appeared that a number of the exhibitors devoted more thought to the artistic appearance of their rooms. At the risk of offending some exhibitors who continued in the old tradition of an unornamented display of their equipment like what

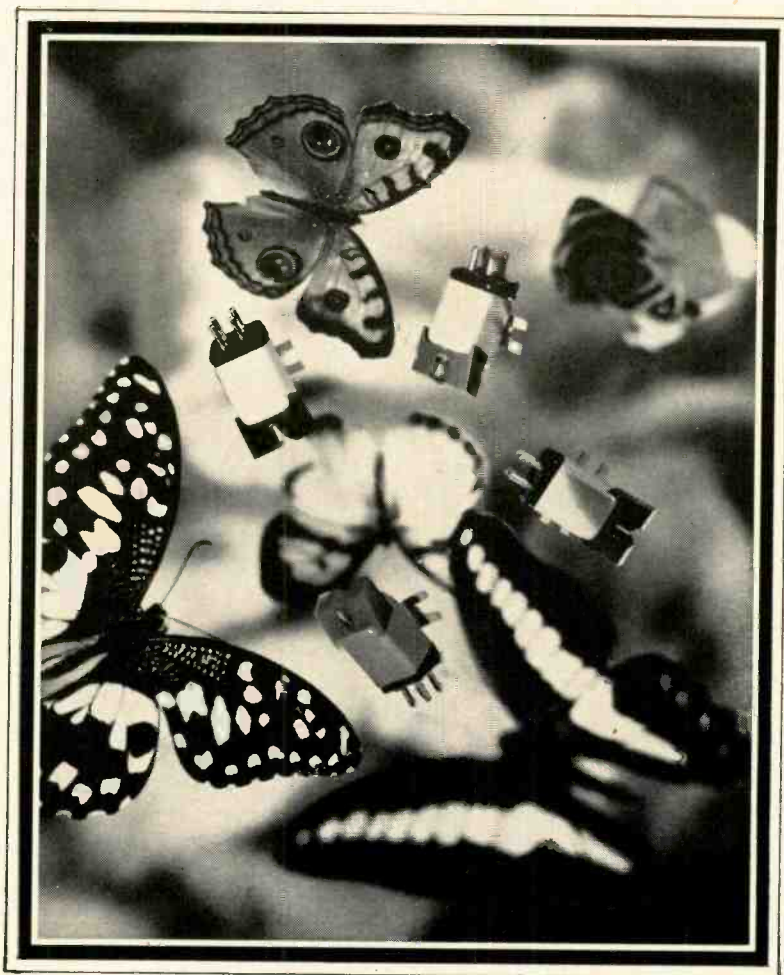
Walter O. Stanton, President of the Institute of High Fidelity, congratulates Mr. Goddard Lieberson, President of Columbia Records, on his “Golden Lyre” award at the industry banquet, September 28.



might be found in a small hi-fi dealers showroom, we must give special mention to the displays of British Industries Corporation, Stanton, Pickering, UTC Sound, Empire, Harman-Kardon (with its discotheque atmosphere), Fisher, and a few others who apparently endeavored to make their rooms decorative as well as informative. Regrettably, most of the exhibits were simply designed to display the products—and we must admit that ours was one of them—with practically no change from their appearance in 1964, or 1963 or 1962. In our opinion; there is no good reason why a display can not be attractively planned, attractively illuminated, and attractively decorated. We must also cite Superscope, McIntosh, and J.B.L. for the over-all appearance of their exhibit rooms.

As was expected, there was a considerable interest in the three home video recorders which were exhibited—Ampex, Norelco, and Sony, to list them in alphabetical order. From the standpoint of price, the Sony is the least expensive, Ampex next, and Norelco the highest. At the show, all appeared to offer about the same quality of picture, but we do not feel that a show is the right place to judge picture quality. But it must be acknowledged that the VTR, or as Ampex calls it HVR (home video recorder), appears to be the next most important component on the agenda of the dyed-in-the-wool enthusiast. More on this subject in future issues, for we realize that the complete home entertainment package must provide for TV with high-fidelity sound (which is readily obtainable) and video recording. We have long wondered why some enterprising company did not provide a tuner with three bands—low TV-band sound, the FM band, and high TV-band sound. It must be acknowledged by now that TV sound is every bit as good in quality (or at least, can be, although we do have one notable exception in the New York area).

There is no doubt in our mind that video tape recorders will be the next big development in home entertainment during the next year. The three already mentioned are available now—two more West German models are announced, and they will certainly be in the U.S. before long. One more Japanese model has already been shown, and is said to be ready for the market by next summer, and we know that several American companies are definitely including VTR's in their futures. While *AUDIO* has rarely acknowledged the existence of television, this is “ostrichian” in concept. Since closing our eyes to it won't make it go away, let us strive to make its sound quality good enough to deserve a place in our home entertainment centers, with the reproduced quality of which it is capable. We sorely need TV sound tuners—let's hope some of them appear on the market, and soon. Then the audio buff will be glad to include TV in his revered system.



Capture natural sound with Pickering.

From the softest flutter of the woodwinds to the floor-shaking boom of the bass drum, natural sound begins with Pickering. Right where the stylus meets the groove.

Any of the new Pickering V-15 stereo cartridges will reproduce the groove, the whole groove and nothing but the groove. That's why a Pickering can't help sounding natural if the record and the rest of the equipment are of equally high quality.

To assure compatibility with your stereo equipment, there are four different Pickering V-15 pickups, each designed for a specific application. The new V-15AC-2 is for conventional record changers where high output and heavier tracking forces are required. The new V-15AT-2 is for lighter tracking in high-quality automatic turntables. The even more compliant V-15AM-1 is ideal for professional-type manual turntables. And the V-15AME-1 with elliptical stylus is the choice of the technical sophisticate who demands the last word in tracking ability.

No other pickup design is quite like the Pickering V-15. The cartridge weighs next to nothing (5 grams) in order to take full advantage of low-mass tone arm systems. Pickering's exclusive Floating Stylus and patented replaceable V-Guard stylus assembly protect both the record and the diamond. But the final payoff is in the sound. You will hear the difference.

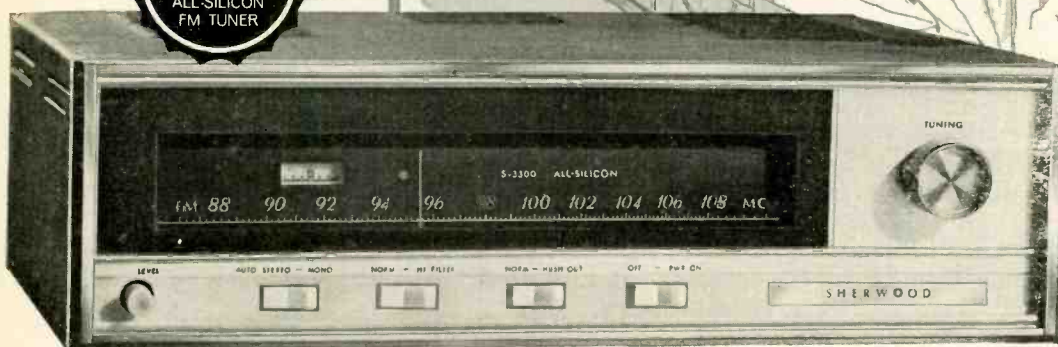
PICKERING—for those who can **hear** the difference.

Pickering & Co., Plainview, L.I., N.Y.

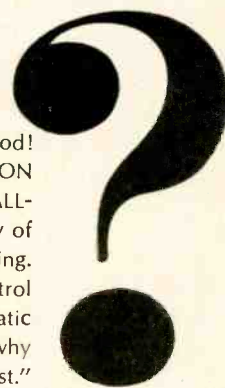
Circle 112 on Reader Service Card

Compare these Sherwood specs! S-3300 IHF sensitivity $1.5 \mu\text{v}$ (30 db quieting), Stereo frequency response 20-15 kc $\pm 1/2$ db., Capture ratio 2.4 db., Drift $\pm .015\%$, Hum and noise -70 db, 16 silicon transistors plus 15 silicon diodes, \$167.50. Companion ALL-SILICON Solid-State amplifiers S-9900 90 watts \$229.50, S-9500 50 watts \$179.50, S-9000a 160 watts \$309.50.

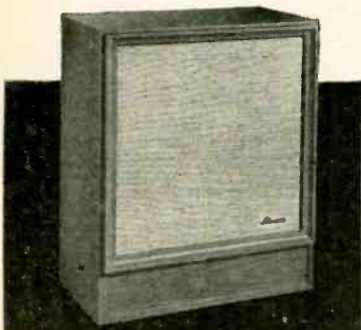
S-3300
first
ALL-SILICON
FM TUNER



WHY DID SHERWOOD SAY "NO" TO GERMANIUM



No germanium transistors or nuvistor-tube hybrid designs for Sherwood! Instead, Sherwood insisted on the acknowledged reliability of ALL-SILICON Solid-State circuitry to make the new Model S-3300 the industry's **FIRST** ALL-SILICON Solid-State tuner. The S-3300 achieves the pacesetter sensitivity of $1.5\mu\text{v}$ (IHF) with newly developed circuits that are immune to overloading. Sherwood's engineers even included an amplified dual automatic-gain-control system to maintain proper selectivity under the strongest signals, automatic stereo/mono switching, and silent-action interchannel hush. All reasons why we dare to say, "Sherwood ALL-SILICON Solid-State High Fidelity is the best."



Another first from Sherwood: The Tanglewood II 4-way speaker system features Sherwood's revolutionary omnipolar® high-frequency radiator with 160° dispersion to 22 kc. A pair of 10-inch woofers extends response to 24 cps @ -6db. In oiled walnut: \$219.50.

Sherwood

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AUDIO • NOVEMBER, 1965

Application of Dual-Track Techniques to Lecture Recording

C. B. HAGEN*

When the recordist is confronted with the problem of making a usable tape during a lecture which is followed—or interrupted—by a question-and-answer period, the procedure outlined can provide quite usable results.

STEREO RECORDINGS or, in a more general way, multiple-track recordings, are generally associated with the recording of music and the subsequent re-creation of what is popularly known as "stereo-realism," a "wall of sound," and so on. It is not generally realized, however, that these techniques can be extremely successful when applied to a different type of recording. One of such is the recording of lectures or classes with active participation of audience, such as when a lecture is followed by a question-and-answer period.

Leaving aside the musically oriented concept of left and right, we have here two different sources of sound that require totally different approaches, especially from the point of view of microphones.

The lecturer is generally stationary and in such a case microphone placement offers no problem. The questions from the audience, on the other hand, can offer quite a challenge to the recording engineer and an almost impossible one if the simple conventional monophonic method is applied. If the standard cardioid microphone is used for the lecturer, any question from the audience will be almost totally lost. Sometimes to remedy this the lecturer or moderator agrees to repeat the question, but this seldom works. A repetition is cumbersome per se, much of the original spontaneity is lost, and often, especially in heated exchanges, the repetition of the question is simply forgotten. Other times a bi-directional or omni-directional microphone is used.

*UCLA Map Library, University of California, Los Angeles, Calif. 90024

¹H. S. Mawby, "New Microphone Has Unique Directivity", *AUDIO*, April, 1960, pp. 26 & ff.

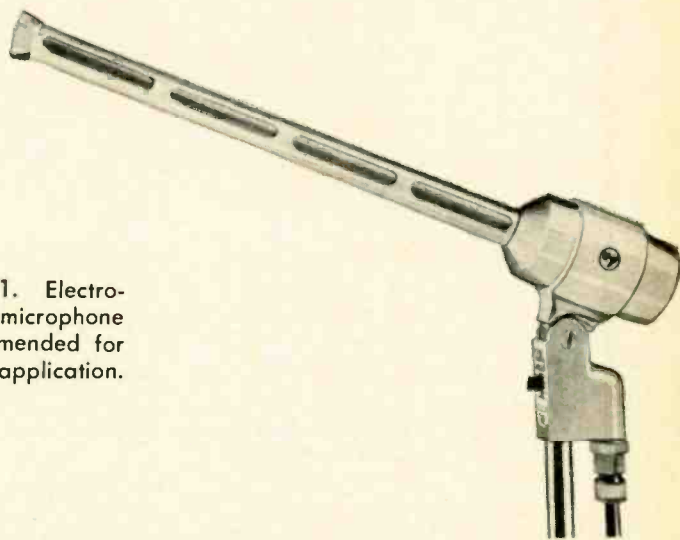


Fig. 1. Electro-Voice microphone recommended for this application.

The first microphone is well suited for a dialogue and the second one for a round table debate, but, for the purpose in discussion, they are not the answer. One reason is that during the entire lecture such microphones would be picking up considerable ambient noise from the auditorium (such as rustle of feet, coughs, and all other sorts of undesirable noises). Another reason is that the difference in levels is considerable, between the lecturer's voice and the very faint (from the microphone's point of view) one from the audience participant.

Use of a Second Microphone

Another technique, fortunately not too frequent, is to provide a second microphone on the floor for the use of the participants. In most cases the fact of having to go to a microphone to ask the question in front of the audience inhibits the person to the point where most of the spontaneity is lost.

Finally, a more advanced technique is to provide a second microphone, a directional one, with a mixer, the micro-

phone being aimed at the participant in the audience. This, the best so far of the conventional monophonic techniques, has its inconveniences. The main one is that the signals of both microphones, once mixed, cannot be separated and, therefore, any subsequent correction or filtering is extremely difficult, not to say impossible, to perform.

All these problems can be easily solved through the use of a stereo recorder and two microphones, one of them directional. Thus, one track is for the lecturer (upper, that is, the usual left channel) and the other one for the audience (lower, that is, the usual right channel).

The setting we have found most favorable is as follows: a cardioid microphone is used for the lecturer, mounted on a tripod so as to isolate it from all noises and vibrations from the lecturer's platform; then, a highly directional microphone, ideally manned by a second operator, is used for the audience. The most favorable and inconspicuous position for this audience microphone is generally at floor level, at one side of the

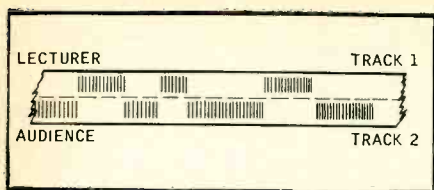


Fig. 2. Alternate recordings from lecturer and audience appear on a stereo tape in this fashion. Same usage would appear on a 4-track machine, allowing for the different track spacings.

front row. All connections should be low impedance, of course, to permit the use of long microphone cables.

Now, in the absence of any highly directional microphone while operating in a small auditorium, a good cardioid microphone can be used for the audience with quite good results. During the lecture this microphone's gain is kept at 0. During the question period the engineer can aim the microphone approximately towards the source of sound and ride the gain up and down according to the distance and voice level of the questioner. An additional advantage is to have a microphone provided with an on-off switch. In this case, however, an assistant to operate the microphone and switch is almost mandatory. Another good feature for a cardioid microphone used under the circumstances described is a built-in cut-off filter for lower frequencies. This in some microphones is indicated as the "V" (voice) position of the proper switch. But if there is no such filter, one has to remember that this audience track can always be filtered and corrected during the dubbing process.

Highly Directional Microphones

Some significant breakthrough in the field of directional microphones have been achieved by Electro-Voice. Their three models in this line are the Nos. 643, 642, and 644. The 643 is an ultra-directional "gun" microphone and is the type used, for example, in Presidential press conferences to get the questions from newsmen in the audience. The cost of these specialized microphones, however, is so high (around \$1,000.00) that their use is restricted mostly to networks and remains quite out of reach for small radio stations, recording studios or similar concerns. Perhaps the best compromise is the 642 (priced at about \$250.00), a highly directional microphone now used extensively by motion picture studios and major radio stations. The 644 or "Sound-Spot" microphone¹ shown in Fig. 1 is a welcome addition to this line of directional microphones and its price (\$65.00) puts it at the reach of almost any concern or individual.

Another interesting possibility that

might be explored is the use for these purposes of a microphone attached to a parabolic reflector, a set-up as the one used by naturalists to record bird and animal calls and other forest noises. The biggest difficulty in this regard, however, is the use of such a conspicuous and obstructive apparatus in an auditorium. If we remember that the use of simple recording equipment is frequently frowned upon by lecturers and stage managers who regard it as an obtrusive element, we could foresee that the use of a parabolic reflector would most certainly find considerable resistance for the purposes described.

The Wandering Lecturer

An entirely different advantage of the second microphone has to do with the unreliability of some lecturers. In not too infrequent occasions the engineer carefully sets the microphone for the lecturer, adjusts volume levels, and so on, only to find out that—due generally to personal inhibitions or the individual's character—the lecturer stays away from the microphone and begins to wander around the stage. This is especially true in cases where the lecturer has material for exhibition such as slides, figures, and such, or the lecture has the format of a class with use of the blackboard. In these cases a recording with only one microphone would be ruined. Having a second microphone, however, it can be aimed towards the peripatetic lecturer. We have faced a number of these situations and in every case the final recording comes out, thanks to the audience microphone, almost as good as if done under normal circumstances.

For the actual recording process, the microphone for the lecturer is fed to the left or upper channel and the microphone for the audience is fed to the right or lower channel. During the lecture the level for the audience microphone is generally set at 0. However, this is not always the case, especially when a record of audience participation—such as in a comic talk or even sounds of disapproval in case of political material—is felt to be desirable. An assistant for the audience microphone is quite

necessary to aim the microphone towards a certain spot and to operate the on-off switch. However, since the microphone for the lecturer and its level are generally fixed elements, a skilled recording engineer can successfully operate the right channel too, using one hand to operate the microphone boom and the other to adjust the volume level.

Thus, when somebody in the audience participates, the second microphone is aimed towards that spot and at the same time its volume level is adjusted according to the distance and voice level of the participant. One person could, thus, do all the operations at once, but generally a better result is achieved if there is an assistant to handle the audience microphone and if this instrument is provided with a remote on-off switch.

For monitoring, a couple of pairs of stereo headphones for the engineer and assistant will prove convenient. A portable stereo amplifier may be needed for boosting the monitor signal from the recorder. Such signal is generally too weak, even for high-efficiency headphones.

At the end of the recording session we obtain a tape with two totally independent channels containing separately the lecturer's address and the questions or reactions from the audience. Making the two tracks visible, a condensed piece of two-track tape would appear as in Fig. 2. (Two tracks of a four-track machine would serve equally well, of course.)

This master tape could be used for actual broadcast, playing it back on a full-track machine. However, a master tape is seldom used for broadcast for both safety and editing reasons. Also, a much better finished product can be obtained through a skillful handling of the second channel during dubbing. For this purpose, and especially for the question-and-answer period, a useful device is a cue sheet giving starting times for the questions. Such a sheet can be prepared conveniently during the actual recording.

Dubbing the Final Tape

During the dubbing, both channels
(Continued on page 67)

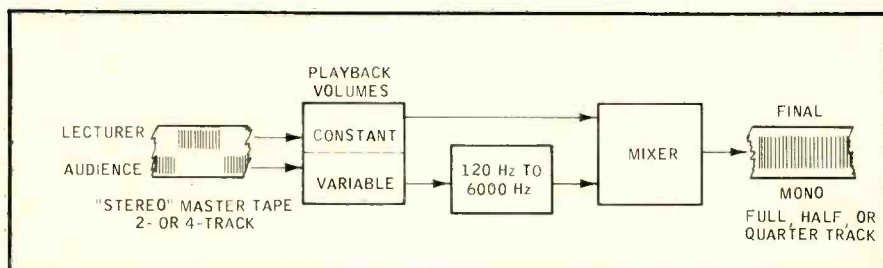


Fig. 3. Block schematic of the suggested dubbing set-up for making the final tape from the original two-channel recording made in the auditorium.

Evaluating the Performance of Stereo Cartridges

J. H. KOGEN*

If we are to be able to discuss the performance of phonograph cartridges in terms which will be understandable to everyone, we must make sure that we are talking about the same things, and our measurements—as opposed to listening tests—must be standardized. Not only must cartridges *measure* good—they must also *sound* good.

ONE OF THE MOST perplexing problems confronting both the purchaser and manufacturer of hi-fi cartridges is that of properly defining quality. Certainly the major factor is how the device sounds. This is a subjective quality and relates to the opinions of the listener. To evaluate a phonograph cartridge properly, we should have some means of measurement which can be related to this subjective listening quality. This paper will discuss some of the means now in current use for making such measurements.

How Do We Define Phonograph Cartridge Quality

If we are to provide a measurement of quality, we must first define what we mean by "quality." What is it that makes a phonograph cartridge sound good? This is a difficult question to answer because it requires that we relate measured characteristics to the hearing capability and the psychological reaction of a human being. We are, therefore, confronted not only with matters of instrumentation, but factors of human experience, education, and taste. We are also concerned with the characteristics of the human ear and the brain.

We will define the reproducing quality of a phonograph cartridge as the characteristic of accurately translating the information cut in a record groove into an electrical signal. This definition implies that the response of the cartridge will be such as to reproduce the modulation in the record as accurately as possible. The adequacy of such a definition might be questioned by those who feel that a cartridge should impart some coloration to the reproduction. This type of requirement is often imposed on microphones and loudspeakers when the response is designed to be most effective with a particular type of reproduction. Some microphones are designed, for example, to work most effectively in reproducing voice as op-

posed to orchestra or other types of applications. Similarly, some loudspeakers sound better with one type of program content than with another.

We would argue against the concept that the phonograph stylus should impart coloration to the information it reproduces in electrical form. Our argument against coloration is based partially on the method of making a phonograph record. During the mastering the record is evaluated by being played back through a high-quality cartridge. Adjustments are made to perfect the sound quality. The resulting record is strongly affected by the taste and desires of the people in charge of making the record. What these people hear is directly related to the cartridge used. If we assume that the record has been properly made, the purchaser of the record should then use a cartridge similar in characteristic to the one used during the mastering. Thus, the requirement of the phonograph cartridge is not that it *alter* the information which appears on the disc, but that it *accurately reproduce* this information in the same manner as the cartridge used by the recording company.

It must be noted that we are implying in our definition of reproducing quality that an accurate reproduction of the modulation on the record will produce a good sound. If we accept this definition, we must then determine how to assure ourselves that the cartridge is capable of making an accurate reproduction. This is the basis of the problem of which measurements to make and how to make them.

Factors Which Must be Considered in Making Measurements

Before stating which measurements can be used to evaluate a phono cartridge, we must draw guide lines of practicality. Important factors which must be considered are as follows:

1. The measurement must be reasonably easy to accomplish.
2. The measuring equipment must be reasonably inexpensive

3. The measurements must be reproducible.
4. The measurement must be meaningful in relation to the reproducing quality of the cartridge.
5. Measurements must be made under standardized conditions.
6. Measurements should simulate, insofar as possible, record speeds, recording velocities, and other variables similar to those in common use.

With respect to 4, we must explain what we mean by the word "meaningful." To be meaningful in terms of reproducing quality, the characteristic measured should be directly related to the functional capability of the cartridge, or how the cartridge sounds. This is as distinguished from a parameter relating to the design of the cartridge. A characteristic related directly to how the cartridge sounds, for example, is the frequency response. We feel that this is a meaningful measurement because it tells us directly which frequencies the cartridge is capable of reproducing. A characteristic which would be considered a parameter of design is *compliance*. This characteristic is important in terms of the overall design, but does not tell us specifically that the cartridge is good or bad. It is conceivable that a cartridge with low compliance could be better than one with high compliance. As an analogy we might cite the case of a cigarette which is claimed to have the least nicotine and the least tars, but which at the same time might also be a very poor tasting cigarette. We should not confuse individual design parameters with over-all reproducing quality.

There are many variables which come into play in measuring phonograph cartridge performance. Such items as tracking force, tracking angle, temperature, the tone arm, the turntable, the record speed, distance between the center of the record and the stylus tip, cartridge alignment, tip radius, record material, and so on, all come into play. Any measurement will

*Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois.

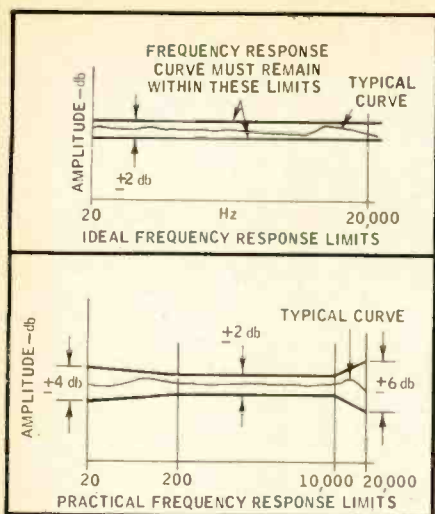


Fig. 1. Frequency-response limits—(A), Ideal; (B) Practical.

lose meaning unless conditions are standardized. It is important, therefore, that all of these variables be properly defined and maintained.

Of particular importance is the test record, where many sources of error can be introduced. The master itself will contain some degree of distortion, crosstalk, and noise, which may affect the measurement. Variations have been noted in different pressings from the same master. Comparing two of the best test records available today, measurements clearly indicate a difference in orientation of the groove which seriously affects separation. These are but a few of many observations which emphasize the need for high-quality, reproducible test records.

Tests Commonly Used in Evaluating Performance

A. Frequency Response. Frequency response is measured by determining the voltage out of the cartridge as the frequency is varied over the range of interest. Frequencies covered extend from the lowest end of the audio range, around 20 Hz, to somewhere above the top of the audio range in the order of 20,000 Hz. The frequency-response plot, therefore, provides an indication of the ability of the cartridge to reproduce frequencies in the audio range.

Theoretically, we might say that for perfect reproduction the frequency response of the cartridge should be flat over the entire range of interest. To be realistic, however, we must define what we mean by the word "flat." It is difficult for even the best listeners to detect variations in frequency response of ± 2 dB. A cartridge with a response flat within ± 2 dB as shown at (A) in Fig. 1 would, therefore, provide the practical ultimate in frequency response.

The frequency content of normal pro-

gram material, however, does not require such a narrow tolerance on response. The energy content in most program material decreases rapidly in both low- and high-frequency ranges. As a result it is possible to broaden the allowable tolerance in response in these ranges. We believe that (B) of Fig. 1 presents a more realistic approach wherein the response tolerance is wider below 200 and above 10,000 Hz. Listening tests on a large variety of program material indicates that a cartridge falling within the limits shown in (B) would sound similar to other cartridges falling within the same limits (other things such as distortion being equal, which they frequently are not).

Future improvements in recording and playback techniques will most probably require a tightening of the specification of (B) between 10,000 and 20,000 Hz. It should be noted that good frequency response is a necessary, but not a sufficient criterion, for reproducing quality.

Since there are many factors which can affect the frequency-response measurement, it is of utmost importance that we carefully define the details of measurement. The following are some

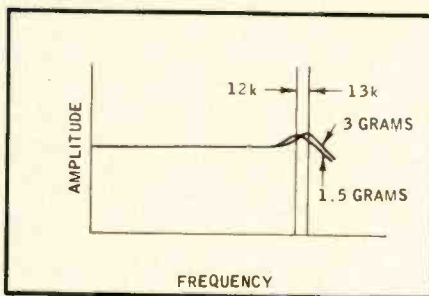


Fig. 2. Frequency response of Shure M33-7 cartridge using test records of different speeds — all other conditions identical.

important factors which can affect the response:

1. **Record Speed.** Many cartridges exhibit a resonance in the frequency response in the range between 10,000 and 20,000 Hz. In some cases, it is found that the frequency and amplitude of this resonant peak is affected by record speed. For example, a 78-rpm test record will usually provide a response with a resonant peak at a higher frequency than will a 33 1/3 test record (Fig. 2). The speed of the record may also affect the amplitude of this resonance peak. It is important, therefore, to define the rotational record speed and the radius from the center of the record to the stylus.

2. **Tracking Force.** The frequency at which the resonance peak occurs

generally increases with tracking force (Fig. 3). Although the effect is small, this variable must be specified.

3. **Recorded Velocity of Test Record.** Theoretically, if the reproduction were entirely free of distortion, frequency response at one recorded velocity would be the same as that of another. Since some distortion or some nonlinearity does exist in a phonograph reproduction system, it can be expected that the frequency response will depend to some extent on the cutting velocity. This parameter, therefore, should be defined, and should be a value similar to the cutting velocity used normally on standard records. A peak velocity in the order of 5 cm/sec up to 10,000 Hz and 2 cm/sec between 10,000 and 20,000 Hz is reasonable.

4. **Distortion.** In any case, when measuring frequency response it is assumed that distortion is held to a minimum. One might achieve a flat frequency response by simply driving the device to saturation at all frequencies. Obviously, such a measurement would be meaningless. Likewise, if in measuring frequency response at a reasonable cutting velocity, say 5 cm/sec, considerable distortion was noted, the frequency-response plot would have little meaning. It is imperative therefore, that the wave form be monitored, or that distortion be measured at the same time frequency response is measured. It is meaningless to claim a good frequency response for a phonograph cartridge, if the output being measured is highly distorted.

5. **Load.** The input resistance of the amplifier and the capacity of the cable can affect the response appreciably and must be specified.

B. Separation. Separation is an indication of the capability of the cartridge to reproduce the stereo effect. The measurement of separation is made by determining the output of one channel, while the stylus is tracing a groove containing modulation only in the other

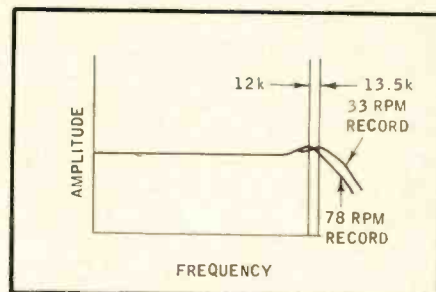


Fig. 3. Frequency response of Shure M3-N22 cartridge at two different stylus forces.

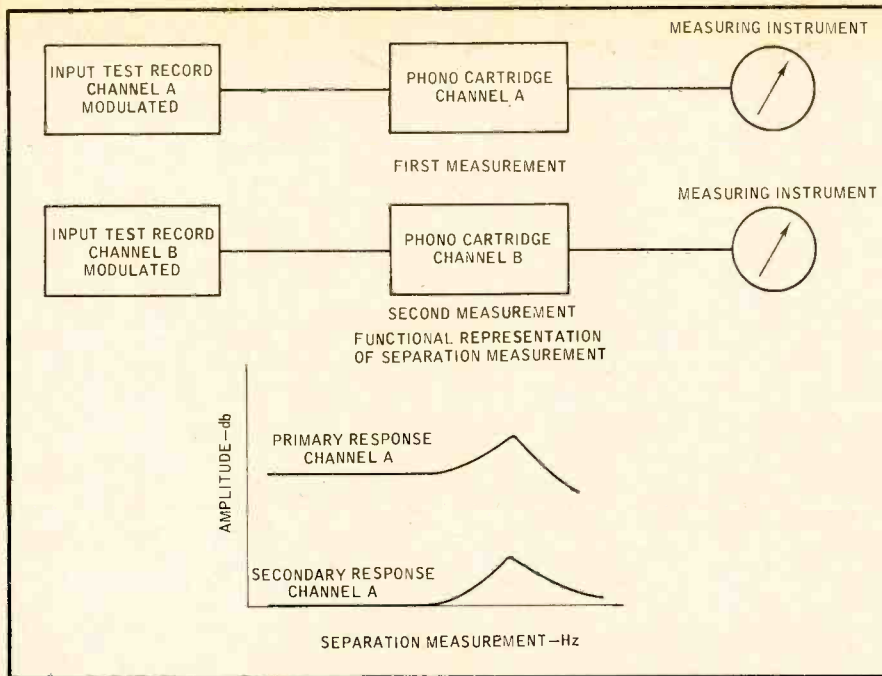


Fig. 4 Separation measurement: upper, functional representation; lower, measurements obtained by this method.

channel. This is shown functionally at (A) in Fig. 4. Two grooves are used, one with modulation in channel A, and no modulation in channel B, and the other the reverse. First, a measurement of channel A is recorded, and is indicated as primary response at (B) in Fig. 4. The second groove is then traced and the output of channel A is measured, and shown as secondary response at (B). The difference in response in decibels between the two curves is defined as separation.

Separation is usually designated at specific frequencies such as 1000 Hz and 10,000 Hz. Separation in the range from roughly 200 to 6000 Hz is most important and should be a minimum of 20 dB with 25 to 30 dB being preferred. Separation at 10,000 Hz and above need not be as great because this range includes primarily harmonic frequencies which occur at relatively low energy levels. The major separation effect is accounted for by the lower frequencies. A separation value of 10 to 15 dB in the higher range is generally considered adequate.

In measuring separation, we must take into account the same factors which were considered in measuring frequency response. An additional factor which can strongly influence separation is the orientation of the cartridge and the record. This can alter separation measurements in at least two ways:

1. Looking at the cartridge from the front, the bottom of the cartridge should nominally be parallel to the record. Figure 5 shows how a slight rotation of the cartridge about its longitudinal axis can change the separation. It has also been found that the peak separation on several test

records does not occur at exactly 0 deg. Two of the more popular records differ by 6 deg.

2. Vertical tracking angle error can effect separation⁷. The effective cutting angle of the record used must therefore be specified. Lateral-tracking-angle error can also influence separation to a small extent and, as with all other tests, should be minimized.

C. Distortion. Distortion is a general term which refers to the difference in shape of the output signal as opposed to the input signal. Distortion products can often be a very disturbing influence in reproduction quality. This factor must be carefully considered and defined in evaluating the reproducing capability of the phonograph cartridge. The major sources of distortion in phonograph playback are:

- Poor Trackability⁸
- Tracing Distortion¹⁻⁶
- Lateral Tracking Error⁴
- Vertical Tracking Error⁴⁻⁵

Measurement of Distortion

For an over-all measurement, one would normally not be interested in isolating the various causes of distortion. Knowledge of these causes of distortion do however give us some indication of the factors which must be considered in performing the measurement. Thus:

1. We must guarantee good trackability. By "trackability" we mean the ability of the pickup to maintain proper contact with the modulation in the groove. The pickup must be able to track reasonable modulation at all frequencies through the audible spectrum. Records having a variety of modulation velocities at several frequencies should be used to determine the velocity which the

pickup can track as a function of frequency. Since distortion increases catastrophically when the pickup ceases to track, all subsequent tests must be made at a modulation velocity less than the "trackability" limit.

2. To standardize the effect of tracing distortion we must specify the record speed, the radius of the record at which the measurement is made, the recorded velocity, tip radius, and the frequencies employed.
3. To standardize the effect of lateral tracking error, we should define the tone arm plus the tone arm turntable geometry. If possible, an arrangement using an adjustable tone arm similar to the configuration in Fig. 7 should be used to provide a virtual elimination of distortion due to lateral-tracking-angle error.
4. Vertical-tracking-angle error will be affected by the effective cutting angle of the record used for testing. It is recommended that a record which is cut at 15 deg. be employed. It would be preferred that measurements be made on both channels in a 45-deg. stereo recording to provide a situation similar to that used in the actual cutting of program material.

An indication of the distortion products which can be expected from the last source can be obtained from Fig. 6 which shows a curve of harmonic distortion versus vertical-tracking-angle error. Such a curve can be obtained by any means which allows the phonograph cartridge angular position to be changed with respect to the surface of the record. One such arrangement is shown in Fig. 7. A turntable is mounted on a pair of pivots, the centerline of which runs through the center of the turntable. A straight tone arm is used, and positioned so as to be tangent to the record groove being played. The needle tip is placed directly on the rotational axis of the turntable. Distortion can then be measured for different angular positions of the turntable. Vertical tracking angle can then be related

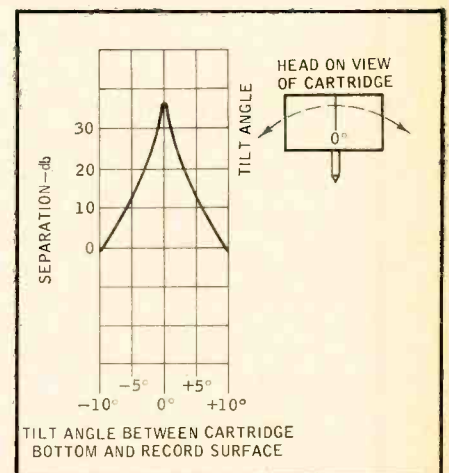


Fig. 5 Separation vs. cartridge tilt for Shure M44-7 cartridge at 1000 Hz.

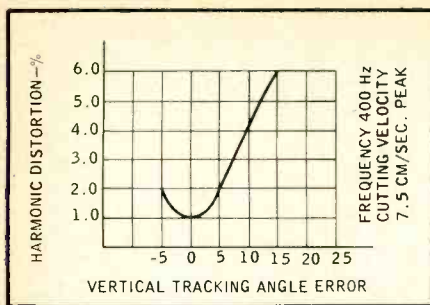


Fig. 6 Harmonic distortion vs. vertical-tracking-angle error on vertically modulated groove—400 Hz at 7.5 cm/sec cutting velocity.

to the angle which produces minimum distortion.

It should be noted that in this arrangement, distortion cannot become zero since the residual effects of tracing distortion still exist. Also, we have made the assumption that distortion caused by vertical-tracking-angle error is minimum when this error becomes zero. This is an assumption based on theory and might possibly be modified by factors not considered in the theory. Because of these factors, one would not expect the accuracy of a measurement of this type to be much better than ± 2 or 3 deg.

Once having measured vertical-tracking-angle error, we turn to the means of eliminating distortion from this source. The obvious way to do this is to design phonograph cartridges with a vertical-tracking-angle to match the angle at which records are cut. Unfortunately, no standard has existed in the past for the cutting of records. Both the RIAA and EIA are now proposing a standard of 15-deg. effective cutting angle. Most of the major record companies in the United States (including RCA and Columbia) are using this proposed standard.

A phonograph cartridge designed to match the proposed 15-deg. standard provides for virtual elimination of distortion from this source. Table I shows several measurements of IM and harmonic distortion with the Shure M44 cartridge which was designed to eliminate distortion due to vertical-tracking-angle error. The most important figures in the table are those for distortion in the stereo mode since this is a duplication of the way in which stereo records are played. The measurements for distortion in the lateral mode are, as expected, very low. The values for distortion in the vertical mode are also rather low, considering the fact that vertical modulation has always been considered the most difficult to follow. To standardize the measurement with regard to inertial distortion we should follow the same rules as given for tracing distortion. Several methods are

used for measuring distortion. These include:

1. *Harmonic Distortion.* To measure harmonic distortion, we use a single modulation frequency and make a measurement of the harmonic content of the output signal. Harmonic distortion is the ratio of the total of all harmonics compared to the fundamental. This type of measurement loses significance to some extent at the higher frequencies of 8000 Hz and above where the harmonics are above the audible range. The measurement does, however, have a distinct advantage in that it is quite simple to perform and to control.
2. *Intermodulation Distortion.* This type of measurement is made using two frequencies, often 400 and 4000 Hz. The upper frequency is lower in amplitude, usually $\frac{1}{4}$ of the lower frequency. When two such signals are fed into a device which produces no distortion, the output will be only

easily with an IM distortion meter and a proper test record. This type of measurement is a sensitive one and is easy to reproduce. One disadvantage is that if only two frequencies are used, no information is obtained about the effect in other frequency ranges. For example, if we use 400 and 4000 Hz. we do not learn about the distortion occurring at 10,000 Hz. Another problem arises from the fact that this type of measurement depends upon one frequency modulating another frequency. In phonograph reproduction, it is found that frequency or phase modulation exists as well as amplitude modulation⁴. This may complicate the issue and make the measurement questionable.

3. *Difference Frequency Method.* This method requires the use of two frequencies separated by a constant difference. The two frequencies are varied across the frequency range of interest. Distortion is defined as the total of the sum and difference frequencies divided by the sum of the two fundamentals. The advantage of this method is that it is useful up to the very top of the frequency range of interest and provides a measurement which is function of frequency. The disadvantage is that the measurement is much more complicated than for either harmonic or IM distortion, in that it requires a readjustment of the measuring equipment at each new frequency. Since this method depends on modulation, the same comments as made for IM distortion apply here as well.

While one might propose any number of additional means of measuring distortion, we must keep certain factors in mind. First, it is important that we follow the rules discussed earlier.

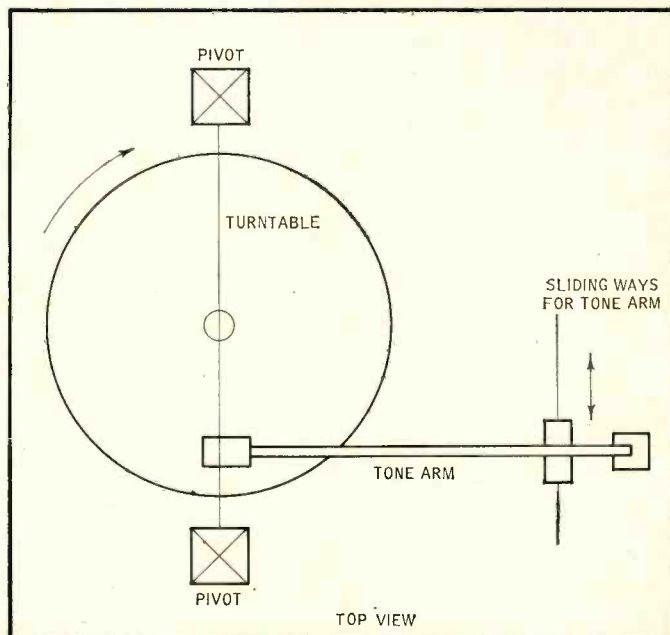
TABLE I
Distortion measurements on Shure M44-5 cartridge

Second Harmonic, 1000 Hz, 5 cm/sec	
Lateral	0.80%
Vertical	1.10%
IM—400 Hz at 11.2 cm/sec 4000 Hz at 3.54 cm/sec	
Lateral	2.2%
Vertical	7.0%
Stereo	3.3%

Record vertical cutting angle specified by manufacturer as 15 deg.

400 and 4000 Hz. If the device being tested does produce distortion, the output will include sum and difference frequencies, such as 3600, 4400, 3200, 4800 Hz and so on. IM distortion can be measured fairly

Fig. 7. Diagram of tiltable turntable for measuring vertical tracking error.



standard record speeds. If possible, the measurement of distortion should be related in some way to the psychoacoustic effect on the human being. This means that we must consider the energy content at different frequencies in normal program material, as well as the ability of the ear to hear the distortion products. Unfortunately, sufficient data has not been collected as yet to define properly the psychoacoustic relationships to distortion. Although a number of papers have been written on the subject, we still do not have adequate data to say precisely that a particular percentage of distortion is disturbing, tolerable, or even noticeable. These effects are related to many factors, including masking, transient phenomena, and volume. Although we cannot say that a given percentage of distortion is acceptable and another percentage is not, we can strive to minimize the distortion and to make repeatable measurements of what we have accomplished.

D. Output Level. The output level is the voltage obtained for a given modulation on a record. This factor is of practical importance as it relates to signal to noise ratios. Any phonograph system contains some residual noise. One major source is the hum pickup in the phonograph tone arm and its wiring. A larger signal level from the cartridge tends to minimize the effect of this hum. Signal levels in the order of 1 millivolt output per centimeter per second velocity modulation on the record have been found to be a reasonable minimum for practical installations.

The measurement is made by accurately measuring voltage at the output of the cartridge while playing a record with a carefully calibrated cutting velocity. The speed of the turntable must, of course, be carefully controlled

while making the measurement.

E. Extraneous Pickup. Another characteristic of a phonograph cartridge relating to signal-to-noise ratio is its ability to shield the internal parts from effects of electromagnetic and electrostatic fields. The measurement of magnetic pickup is made by placing the cartridge within a loop of wire through which current is circulated at some defined frequency and current level calculated to provide a specified magnetic field. Voltage measured across the output terminals of the cartridge under these conditions is a measurement of the hum pickup. It is usually found that a magnetic cartridge with low electromagnetic pickup will also have low electrostatic pickup.

Other Factors

In addition to the tests which have been described we must, of course, consider many of the practical aspects related to a phonograph cartridge. It is of utmost importance that the unit be reliable and rugged. Often it is necessary to give up something in the way of response in order to achieve the desired ruggedness. The importance of this factor should not be overlooked since the phonograph cartridge is designed for practical use in the home or studio rather than the laboratory.

One must consider the life of the cartridge. A cartridge which plays well when it is new, but deteriorates rapidly, is far less valuable than one which may not be quite so good when it leaves the factory, but retains its quality over a long period.

Another factor which might be considered is the record wear caused by the stylus. While no standard tests exist for this variable, some rough indications can be obtained by repetitive playing of records. Indications of wear on test

records can be found by examining frequency response, separation, distortion, and noise before and after a series of repetitive playings.

One should also consider the physical characteristics of the cartridge such as its weight, its susceptibility to damage, and its versatility. Susceptibility to damage can be affected appreciably by the design of the parts surrounding the stylus and the protection which is afforded for the stylus. Since many users follow the practice of changing styli for different records, as for example new stereo records vs. old monophonic, the facility for making this change should be considered.

Listening Test

Finally, we come to what is unquestionably the most important factor in evaluating a phonograph cartridge—how the cartridge sounds. All of the other factors are meaningless if the cartridge does not produce the desired sound. Thus, our final evaluation is a listening test. Such a test, because of its importance, must be considered very carefully, and the conditions under which it is held must be well defined and practical. To evaluate a cartridge properly, it is of utmost importance that the equipment used and the room in which the test is made be of the best possible quality.

1. The choice of a tone arm is extremely critical. Frictional and resonance effects in the tone arm can deteriorate the performance of the cartridge. The tone arm chosen should be of highest practical quality to eliminate this possible source of error.
2. The electronic amplifier should have response characteristics, distortion, and power capability such as to have no practical effect on the measurement. One point of caution must be noted here with regard to noise and hum level. Such factors can be a very disturbing influence and must not be introduced by the amplifier.
3. The choice of a loudspeaker is a difficult one, since this is often a matter of personal preference. The loudspeaker should have a maximum bandwidth and must be devoid of any sharp resonance peaks or valleys in its response. The speaker must also be capable of producing adequate output with low distortion. It is often well to test the phonograph cartridge with several types of speakers in order to eliminate the possibility that a particular speaker is masking or over-emphasizing a defect.
4. A wide variety of program material should be used in testing the cartridge. It is often found that a cartridge which may sound excellent for one type of program material will not sound as well with another. For

(Continued on page 74)

TABLE II
PHONO CARTRIDGE LISTENING TEST—EVALUATION

Characteristics	Descriptive terminology			
Bass (below 200 Hz)	Muffled	Boomy	Moderately clear	Clear and well defined
Midrange (200-3000 Hz)	Lacking	Smooth	Over-emphasized	
Treble (above 3000 Hz)	Lacking	Smooth	Noticeable peak	Over-emphasized throughout
Over-all	Poor balance	Good balance		
Presence	Lacking	Moderate	Excessive	
Realism (voice)	Poor	Good	Excellent	
Realism (percussion)	Poor	Good	Excellent	
Realism (applause)	Poor	Good	Excellent	
Distortion on highly modulated passages	Considerable	Barely detectable	None	
General comment:				

Microphone Amplifier and Coupling Unit for the Stereo-Modified Uher 4000-S

C. G. McPROUD

For lecture use, it is desirable for the person speaking to appear to be in the center, directly between the two stereo loudspeakers. A simple configuration makes this possible and is combined with the output coupling unit for the modified Uher 4000 Report-S tape recorder.

WHENEVER A LECTURER uses a microphone for reinforcement and is reproduced over a stereo system, his voice *should* appear to originate half way between the two speakers. Unless he wants to be troubled by the need for switching from stereo to mono each time he speaks, it is more than likely that he will be reproduced by only one channel. The writer recognized this problem several years ago on the occasion of hi fi talks before a few audio groups, and the circuit employed seemed to be a simple and effective solution.

On the assumption that some sort of microphone amplifier must be used—for few preamps have mike inputs, and even if they do—it requires a certain amount of switching to change the equalization, or at least to switch from the sound source being used for demonstration material to the microphone input. This is usually inconvenient, to say the least, so the ideal sort of device would appear to be a simple microphone amplifier arranged to feed its output equally into the two stereo channels.

In the writer's lecture appearances, a tape recorder is normally used as the source of program material. Using the

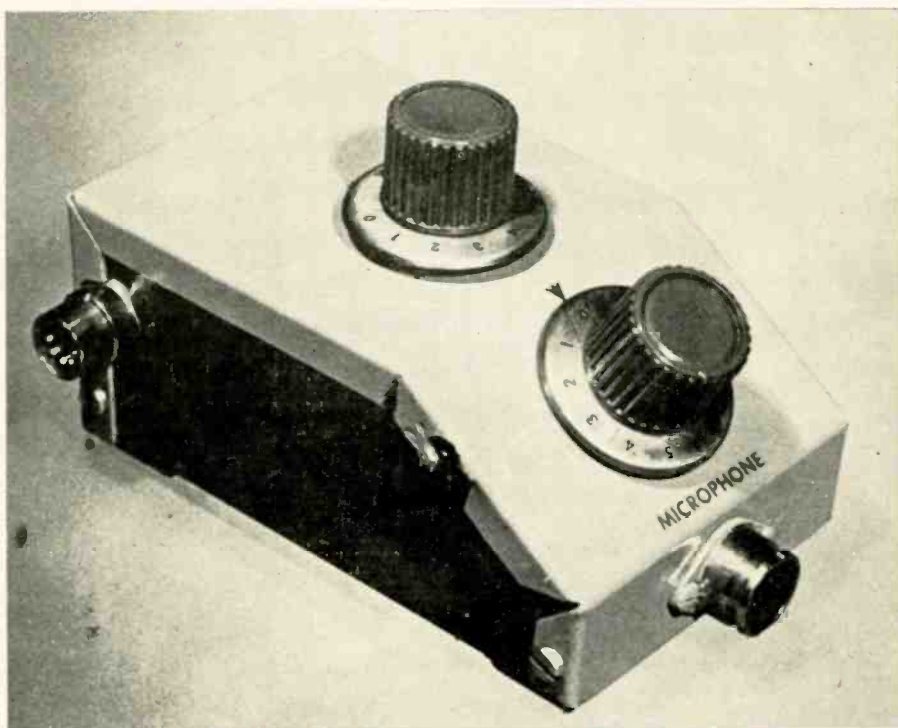


Fig. 2. External appearance of the coupling unit-microphone amplifier.

recorder as a "lectern," the control of program volume is readily achieved without the need for another operator.

Referring to Fig. 1, a block schematic of the arrangement, it is seen that the two outputs from the tape recorder are fed through equal series resistors to the top ends of a dual potentiometer, and thence to the power amplifier and speakers. The arms of the dual pot are connected together and fed from the output of the transistorized microphone amplifier. At the counter-clockwise end of the dual pot, a switch turns off the battery supply to the amplifier.

Altogether, this serves two functions—when the pot is at the counterclockwise position, the output of the microphone amplifier is connected to the grounded end of the pots, and no signal is fed to the output. Turning the knob

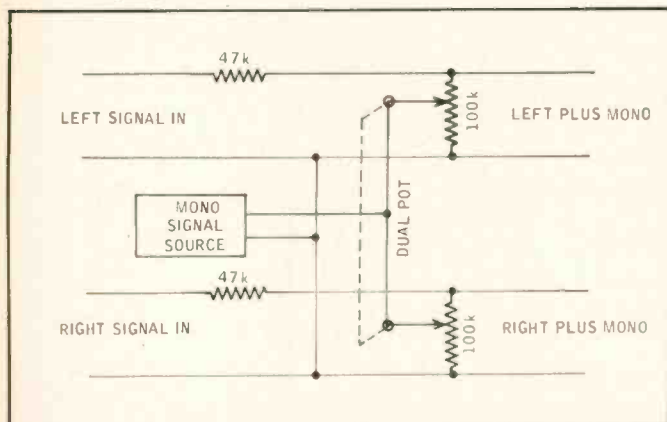


Fig. 1. Block schematic of the method of feeding a mono signal equally into both channels of a stereo system.

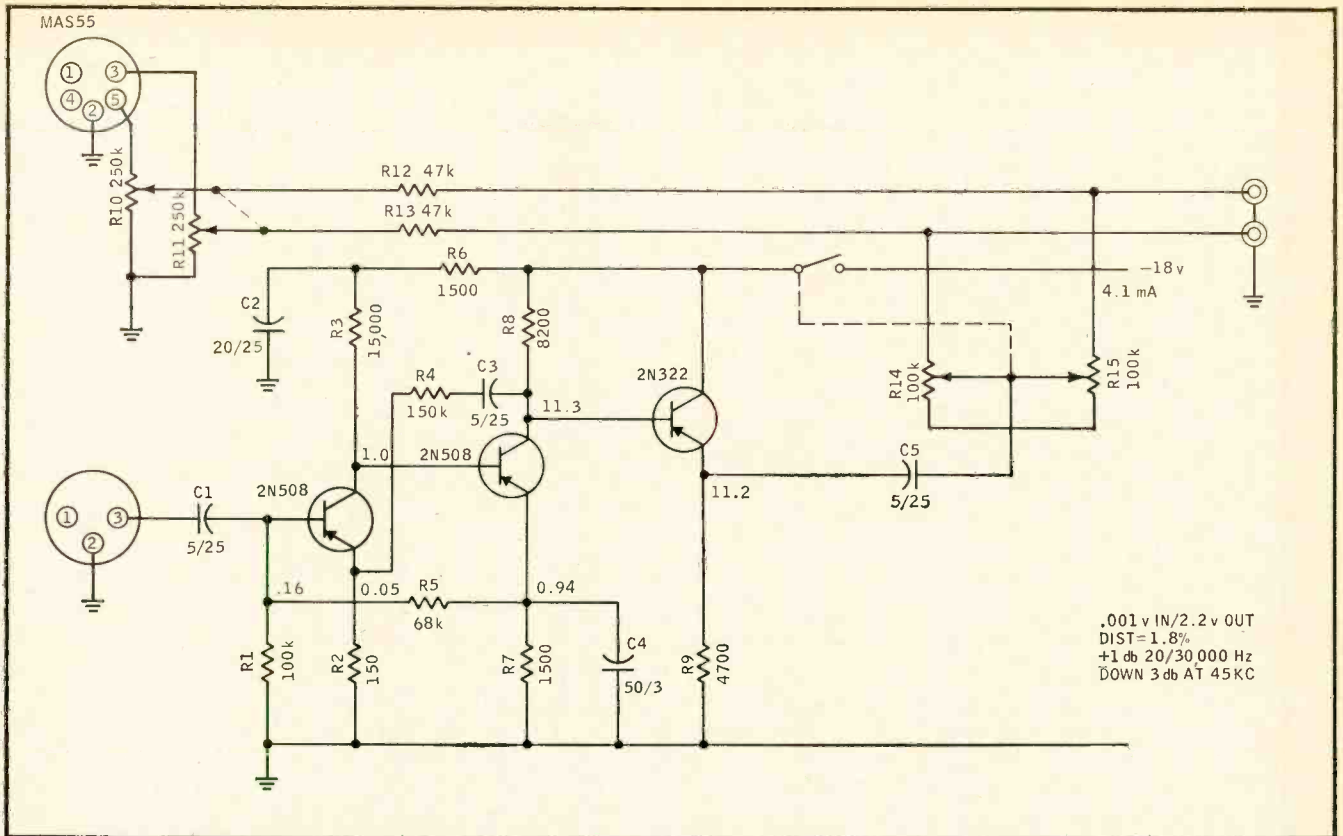


Fig. 3. Schematic of the entire unit, showing wiring to plugs and jacks.

slightly turns on the battery supply, and since no signal is yet being fed to the output, there is no click in the speakers as the battery is turned on. As the pot is turned further, more and more signal is fed to the output circuit, and at the maximum travel of the pot, the low impedance of the mike amplifier output effectively "swamps out" the signal from the tape recorder because of the series resistors. It sounds simple, but it works perfectly. It is only necessary to adjust the gain of the amplifier so that when the pot is at maximum the speech level is just under feedback. Then the output level of the recorder is adjusted for suitable reproducing volume, with the mike amplifier at minimum. The lecturer can thus adjust the relative levels of speech and program to any desired degree, yet when he wishes to drown out the program he can do so with only one control.

The Output Coupling Unit

For the use the writer had for the stereo-converted Uher 4000-S, some form of volume control had to be provided, since the 4000 has none in its high-impedance output circuit. Also necessary was the microphone amplifier and control just described. And also necessary was some means for turning on and off the new right-channel amplifier. The unit shown in Fig. 2 was the chosen solution. It incorporates a 5-pin plug which fits into the socket in the recorder (changed from the original 3-

terminal socket), it provides a level control for the recorder output, and it houses the microphone amplifier, battery, and microphone level control and switch.

It need not be assumed that the circuit suggested should of necessity be used only with the converted Uher, or in the over-all form shown here. It is

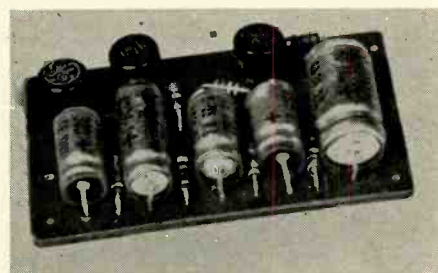


Fig. 4. The complete amplifier on its printed circuit board.

suggested, however, that the idea can be applied to any monophonic source which is to be fed equally into two stereo channels.

In the same vein, it should not be assumed that the conversion suggested for the Uher is limited only to that particular recorder. It is likely that if we had had available a Yiffniff Model 10 monophonic recorder and were faced with the same problem, we would undoubtedly have designed a second-channel amplifier which would have served

equally. While we have here presented a particular embodiment—as they say in patentese—of the proposed circuit, it is not expected that the reader will follow slavishly the plans of this particular arrangement. It is suggested, however, that this circuit and its connection into a stereo system is one effective solution to the problem.

The Amplifier

Figure 3 shows the schematic of the amplifier itself, utilizing three transistors in a circuit proposed in one of the earlier General Electric Transistor Man-

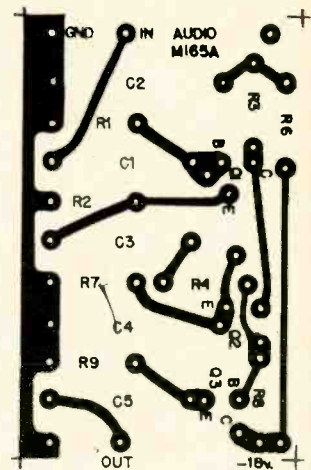


Fig. 5. Layout of the printed circuit board, full size. This may be used to produce a negative for photo-etching the laminate.

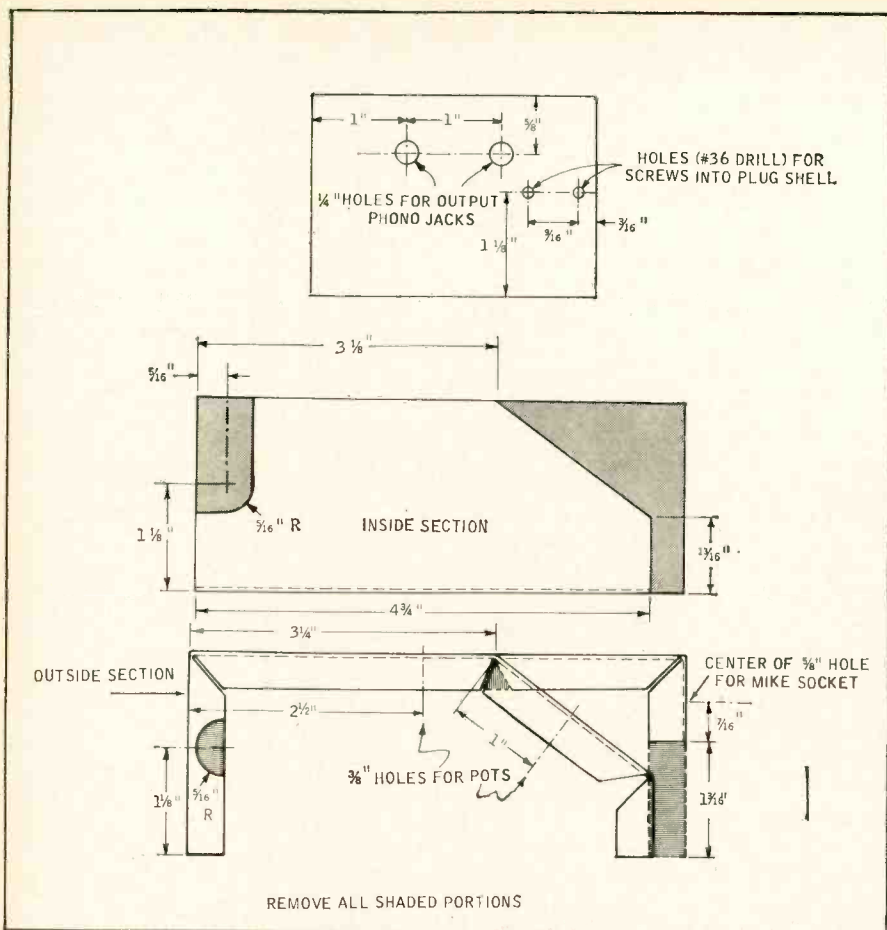


Fig. 6. Modifications to standard Minibox to make the small sloping-panel housing for the amplifier, batteries and coupling unit.

uals, but, of course, with a few of the writer's modifications. In the original GE circuit, R_2 had a value of 47 ohms. Since the circuit was offered as a phono preamp, C_3 was of a value which provided the correct turnover at 500 Hz, and a small capacitor was placed across R_1 to provide the rolloff. Since our application demanded a "flat" amplifier for microphone use, C_3 was increased considerably, and the shunting capacitor across R_1 was eliminated.

When the value of R_2 was 47 ohms, an input signal of 2mV provided an

output of 0.87V, with a distortion of 3.2 per cent. The output of the tape recorder was nearer 0.3 volts, and no more was required of the mike amplifier. It was found that distortion was lower when the value of R_2 was increased. At 150 ohms, the distortion was 0.8 per

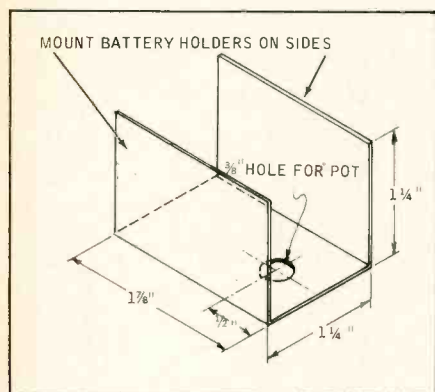


Fig. 7. Battery holder bracket, which mounts under recorder gain-control potentiometer.

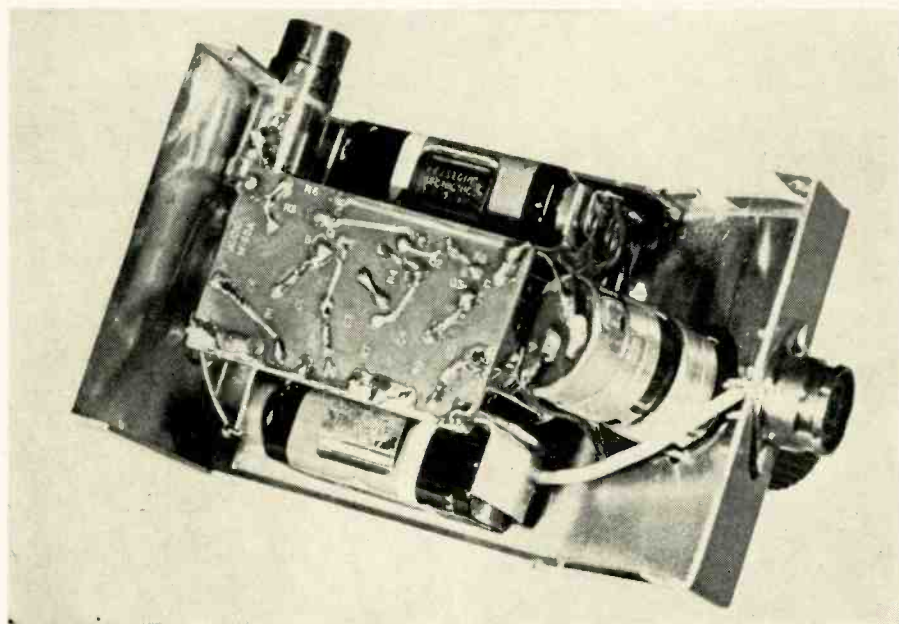


Fig. 8. Underside view of the complete unit.

cent while still maintaining an output of 0.5 volts for a 2-mV input signal. The first two transistors are GE 2N508's and the output stage is a 2N322. Supply voltage is furnished by two 9-V transistor batteries (RCA VS-323) in series, at a current drain of 4mA. The resistors in series from the recorder output are used to provide a relatively high-impedance source which could be swamped out by the lower impedance of the microphone amplifier output. The amplifier is shown in Fig. 4, with the printed circuit plan in Fig. 5. Instructions for making the printed circuit boards were given in Part 1 of this article.

Frequency response of the amplifier was flat within ± 2 dB from 30 to 20,000 Hz.

Construction

The little sloping-panel housing shown in Fig. 1 was made from a 5 1/4 x 3 x 2 1/2-in. Bud Minibox, modified as shown in Fig. 6, which shows the new cuts and bends. One additional piece of sheet aluminum is required for the battery-holder bracket, as shown in Fig. 7. The connection to the new 5-hole socket on the recorder is made by a Hirschmann MAS-5S plug, which is attached to the rear wall of the housing at the proper height by two 3-48 screws which fit into two matching tapped holes in the plug shell. The battery-mounting bracket, with the two battery holders on it, is held to the panel by the dual pot, R_{10} - R_{11} .

The left-channel lead is brought out from pin 3 of the plug, the right channel from pin 5, and ground from pin 2. Pins 2 and 4 are connected together in the plug to close the battery circuit when

(Continued on page 67)

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Shure Brothers, Inc., 222 Hartrey Ave., Evanston, Illinois

Circle 114 on Reader Service Card



Present living-room installation showing two folded-horn four-way speaker systems.

THIS MONTH'S COVER

Accent on Stereo

WILLIAM G. DILLEY*

The cover photo is a view of the combination end table/coffee table that houses the TV remote control. It could, just as easily, house an entire receiver in this day of compact components. This unit is part of the author's three separate stereo systems which are described in some detail.

Photographs by Dick Jones, San Bernardino, California

FOR ANYONE WHO is actively engaged in audio endeavor, the need for a high-quality reproducing system is quite obvious. It is difficult to impart the advantages or disadvantages of the various aspects of audio reproduction equipment by words alone, and some demonstration is usually mandatory for the uninitiated.

*4168 North 425 West Ogden, Utah 84404

In order to fulfill this requirement, the author embarked upon a spare-time home-installation venture that did not culminate until some nine months and three stereo systems later, and actually is really *never* completed.

The initial objective was to install a high-quality system of moderate price range, but this objective slowly became obscured by mounting enthusiasm to improve each portion of the system as

the work progressed. Needless to say, the completed stereo system does not have even a nodding acquaintance with that first established objective of moderate price range! The quality portion of the objective, however, is met quite satisfactorily.

Beginning with the ultimate form of the four-way loudspeakers, the left one has crossover points at 230, 600, and 3500 Hz. Level controls balance all speakers to the mid-bass (230-600) range. The low end is a folded horn driven by an 18-in. Electro-Voice, and the rest of the system is basically an E-V Patrician with the exception that the high end employs four E-VT-350 tweeters mounted for wide coverage. The right system is essentially the same except for physical layout and a lower design with a slightly higher cutoff frequency. These changes were dictated by the architectural requirements of the living room in which the speakers were to be installed.

"Low-cost" unit with E-V SP-12B speakers in end compartments with reflector doors.



YOU DON'T HAVE TO TREAT YOUR AR TURNTABLE GENTLY.

We published this picture in our first ad for the AR turntable, to illustrate its mechanical stability. Equipment reviewers, in addition to reporting the lowest wow, flutter, rumble, and speed error of any turntable they had tested, raved about its insensitivity to mechanical shock and to acoustic feedback.*



But a few complaints of sensitivity to jarring trickled in. Investigation showed that under special conditions the complaints were justified; when a floor was exceptionally springy or when the AR turntable was placed on a shaky surface (factors introducing a horizontal shock component), the much-vaunted resistance to jarring disappeared. We advised the users who had this problem to place their turntables on sturdier pieces of furniture, and went back to the lab.

For more than a year now we have been using an improved suspension design. As before, when the turntable is placed on a solid surface you can pound directly on its base or stamp violently on the floor without making the needle jump grooves. The difference is that the newer model, designated by serial number prefix XA or TA,** will take considerable mechanical abuse when the mounting conditions are less favorable.

Literature on the AR turntable, plus a survey of the hi-fi equipment recommendations of four magazines (the AR turntable was the top choice of all four), is available on request.

*Reprints on request.

**The new suspension would not make any difference at all in most cases. However, if you are interested in converting your old AR turntable to the new XA model (cost \$15 plus freight), please write us for details.



\$7800 complete with arm, oiled walnut base,
and dust cover, 33 $\frac{1}{3}$ and 45 rpm

5% higher in the West and Deep South

ACOUSTIC RESEARCH, INC., 24 Thorndike Street, Cambridge, Massachusetts 02141

Circle 115 on Reader Service Card



Lowery spinet organ and the main recording rack which provides complete flexibility.



Close-up view of the equipment in the "low-cost" system to show arrangement of turntable and tape deck.

Since the available signal sources numbered four—phono, tape, TV, and organ (FM reception is not satisfactory), two Fisher 80C preamps were selected for the central control, along with two Fisher 30-watt amplifiers to drive the speaker systems. A Rek-O-Kut B-12H turntable with a Fairchild arm and a choice of cartridges provided for record playback, while a Viking 85 deck provided for tape playback.

The TV set was mounted in a cabinet designed to serve as a room divider, planter, and corner extension for the folded horn of the left speaker system. A cathode-follower stage was then designed to allow the organ to be played through the entire system.

Progress, thus far, allowed the playing of records, tape, TV, and organ, but no recording capability had been planned.

Since insufficient space existed in the console for this function. It was then decided to incorporate an improved playback amplifier, a third channel, and some live recording facilities. As in most self-imposed goals, the actual project turned out to be much more ambitious than originally programmed, and like the speaker systems, kept growing during development.

The result, in its present form, is a six-foot rack-mounted unit that houses, from top to bottom, a Concertone tape

deck, a two-channel-record/three-channel-playback amplifier, a six-position mixer, two separate d.c. heater supplies, and a regulated high-voltage power supply.

To provide a maximum flexibility with a minimum of unsightly patch cords, a switch-jack arrangement is employed for all electronic switching functions. The record/playback amplifier, for example, operates through the main system when all switches are in the UP position. Thus for the normal operation of recording from the main console, no patch cords are required and the unit presents a clean appearance. If, however, any switch is placed in the DOWN position, it divorces that section from the unit, and the jack position becomes "hot." External recording is accomplished by patching from the mixer to the record amplifiers. This patching flexibility makes possible the following operations:

- Two-track recording from any source available at the main console;
- Tape copying from an external recorder;
- Tape copying from an external deck, using the internal preamps for playback;
- Sound on sound;
- Echo;
- Live recording from up to six inputs;
- Practically any desired type of dubbing.

To ensure freedom from hum, noise,

and microphonics, hand-picked 12AY7 tubes were employed, and were shock-mounted. All critical stages contain premium low-noise resistors, and two separate power supplies provide heavily-filtered adjustable d.c. voltages to the record/playback and mixer units. No a.c. exists in either of these mixer chassis—even the meter lights are on d.c.

The bias oscillator operates at approximately 95 kHz, and has provisions for noise balance, bias level, and head balance. The last adjustment allows identical bias currents to be established in spite of small differences in the inductance between halves of the record head and/or circuit capacitances. Mica capacitors were used throughout the bias circuit, and all critical capacitors and resistors were bridge-matched.

The third-channel preamp is the result of electronically combining the two main channels to eliminate any interaction between them.

Third-Channel Speaker System

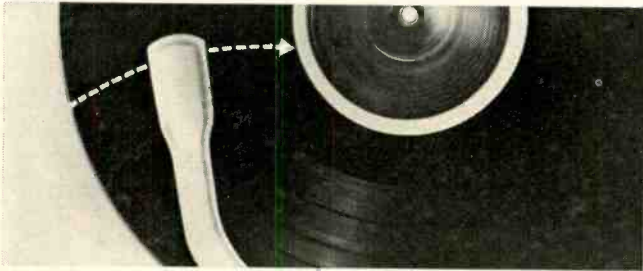
Completion of this rack-mounted rig indicated that a three-channel playback system must be installed to utilize the output of the tape system. At this point, it was decided to retain one of the original amplifiers for the third channel and to provide two higher powered units for the main channels. Two iden-

marantz

believes you should know the facts!

THE PROBLEM:

Achieving the total signal of a stereo recording.



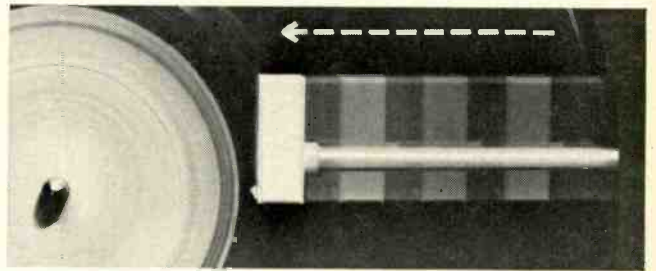
When the master disc is cut, the cutting head travels across the disc in a straight line. The grooves are cut proportionately to the volume of the sound; as the sound ebbs, the grooves narrow — as the sound swells, they broaden. Each side of the groove carries a separate track — one for each stereo channel. These grooves carry the total sound originally recorded.

To reproduce the original sound faithfully, the stylus must pick up the full track created by the cutting head on each side of the groove. In order to achieve this result the tone arm must travel the same straight line created by the recording cutting head.

During conventional tracking the tone arm moves in an arc across the surface of the record — completely opposed to the straight path created by the cutting head. Dynamically the stylus is drawn against the inner side of the groove and away from the outer. The result is a clear signal on the inner channel, distortion and loss of signal on the neglected outer channel. Consequently, conventional tracking can never faithfully reproduce the sound as it was originally recorded.

THE SOLUTION:

Straight Line Tracking by Marantz.



The Marantz SLT-12 tone arm tracks across the disc in a straight line following the path originally created by the cutting head. Thus the stylus, always tangent to the grooves, receives the full signal *incised on each side of the groove*. It is the only system available which *faithfully reproduces the sound that was originally recorded*.

The critical elements of the Marantz SLT-12 Turntable provide maximum precision and stability in support of the tone arm assembly. The free-floating stylus is always fully positioned in the groove by counter-balancing the tone arm assembly. A 12 lb. cast and dynamically balanced turntable rest upon a massive, precision-ground tungsten carbide thrust bearing to produce low friction, dimensional stability. Power is derived from a hysteresis-synchronous motor. The precision-ground uscothane drive belt is noted for its uniquely stable elasticity. Push-button controls have been installed for convenience, while the cueing device eliminates the necessity of ever touching the tone arm. *SLT-12 Turntable \$295 complete.*

THE SOUND OF MARANTZ IS THE SOUND OF MUSIC AT ITS VERY BEST!



marantz

MARANTZ, INC. SUBSIDIARY OF SUPERSCOPE® INC.
25-14 BROADWAY, LONG ISLAND CITY, NEW YORK

Circle 116 on Reader Service Card



The "transient" system—an intermediate-priced unit of good quality between that of the main system and the "low-cost" model.

tical 60-watt amplifiers were constructed by the author to satisfy this requirement, and a third speaker system was to be installed in the main console. Since the bass provided by the two main-channel speaker systems was more than adequate, and since no vibration could be tolerated in the equipment cabinet, it was obvious that the best approach for the bass in the third channel was to *omit* it. Also to preclude internal vibration, the use of fully enclosed integral horns (rather than open cone-type speakers) appeared advantageous. This type of speaker limits the vibration to the mounting board. Two horns, an E-V T250 and an E-V T350, were then mounted in one partition of the sliding drawer, with the mounting board separated from the drawer and damped by a half-inch foam-rubber gasket. The T250 operates from 800 to 3500 Hz. and the T350 above 3500.

The completed system certainly illustrates what *can* be done, and the results are quite impressive, but the enthusiasm of the majority of people does not warrant such expenditure. Therefore, design commenced immediately on a second system of not only moderate price range, but rather a minimum cost commensurate with high fidelity standards.

The "Low-Cost" System

This system was located in the study, and provided a ready comparison of quality between these two arbitrary limits of the cost spectrum. The integral stereo unit performs with a clarity not usually associated with inexpensive systems, and under separate listening conditions impresses the novice quite favorably. Direct A-B comparison (of the same source material) from one system to the other leaves one quite dissatisfied with the performance of the inexpensive system, and usually he imagines the middle ground between the two as an ideal compromise between quality and expenditure.

It follows, of course, that just such an intermediate unit should grace the premises if the spare time, interest, and energy were still present for this ever expanding project.

This unit materialized along the same exterior design as the low-cost rig, but with much improved internal components and speaker enclosures. The finished unit was placed in the family room in what I now refer to as the "transient" position, for although three separate stereo units are always present, only two of them remain permanently. The third unit occupies the transient position only until a new and

different model is ready to take its place, and then the retiring unit is sold to some friend who has long since expressed a desire to acquire that particular unit. The present "transient model" is already scheduled for departure, and is an expanded version of the original.

Needless to say, all new source material undergoes a listening test on all three units, and such listening helps prevent the stagnancy of continued exposure to any one system. It is interesting to note that almost *any* system of some quality can be made to sound excellent with the proper choice of source material. The converse—listening tests of many and varied sources—is, of course, the only true test of quality.

While two of these units were designed primarily for demonstration purposes, they have provided many hours of listening pleasure and have provided an interesting by-product. Most people, when listening in the home, listen primarily to the program content, and only rarely do they consciously evaluate the reproduction quality of the system, but when exposed to more than one system they make an individual effort to note the differences between the systems—and in so doing have taken the first and most important step toward complete enjoyment of music—that of *listening*.

Æ

Circle 117 on Reader Service Card >

AUDIO • NOVEMBER, 1965

Of the 3 automatic turntables priced at 99⁵⁰ only one offers all these features.

Look into it.



a. Hysteresis Motor. The 40H is the only automatic so equipped. Maintains accurate speed even with extreme voltage variations. Uses famous Papst motor, found in professional turntables and tape transports.

b. Dynamically Balanced Tone Arm. Tracks any cartridge at its recommended stylus force setting, as low as ½ gram. Calibrated rotating dial provides direct adjustment of stylus force. Cartridge head has interchangeable insert; permits interchanging cartridges without rewiring.

c. Dynamically Balanced Turntable.

One-piece, 12", non-magnetic casting is machined to precise concentricity, then individually tested for dynamic balance. Weights are affixed to one or more points for equal mass distribution. Rides in Teflon-enclosed, dust-free, ballbearing races.

d. Feathertouch Push Buttons. A Miracord exclusive—only the slightest touch is needed for automatic play or reject. Arm responds gently without jumping, slapping or skating.

e. Time-Tested Mechanism. The same basic internal mechanism which gave the Miracord 10 and 10H their repu-

tation for trouble-free reliability. Assures smooth, quiet operation even with extended bass response.

The Miracord 40H operates at 4 speeds: 78, 45, 33 and 16 rpm, and handles 7, 10 or 12" records. It plays single records manually or automatically, and stacks of up to 10 in automatic sequence. It is a modern instrument for modern stereo systems.

See it at your hi-fi dealer, or write. Benjamin Electronic Sound Corp., 40 Smith St., Farmingdale, N.Y. 11736

The Miracord 40H

Development of Pulse Modulated Audio Amplification

NORMAN H. CROWHURST*

IN FOUR PARTS—PART THREE

Further considerations on the development of this potentially excellent amplifier system. In this installment, the author actually introduces some of the "hardware" which brings the unit closer to completion.

WHEN ONE GETS AS FAR AS we have into a development like this, one is "hooked." There has been enough success so far that obviously there *must* be a way to make the whole thing work the way we want it to, even though at times it may seem as if the gremlins in it are determined to prevent us from finding that way! Actually, as we get more familiar with the whole technique, it turns out that there are several ways of making the same principle work. What we are working on is an altogether new mode of operating audio amplifiers. Like the superhet in radio, a few decades earlier, we are working on a new technique that brings with it a whole bag of new technology.

So back to work. Adding the negative feedback was no great obstacle. The bias of the mixer stage is changed slightly so that without feedback (the series transistor non-conducting, or removed from its socket), the pulse width is definite and no slight changes of voltage will extinguish it; and also so that shorting the resistor across the series transistor (emitter to collector) definitely does extinguish the pulse. This sets the range over which the feedback will work.

Now put in the npn transistor and adjust the base resistor, from the positive-going-pulse point (common-collector connection of drive stage) so the height of the quiescent pulse is just half its maximum height. This may be done at the drive stage, with its emitters grounded, and checked again when the output stage is coupled on, changing the value of this base resistor if necessary.

Getting the Required Drive Signal

At this point it is good to check the audio stages ahead and feed signal into the phase inverter from an audio gen-

*Gold Beach, Oregon.

erator. Check the quiescent pulses with the signal off, then gradually increase the signal to check what happens to the pulses. Synchronism of the 'scope to the pulse frequency can be achieved simply by connecting the output side of one of the diodes to the external sync terminal of the 'scope (Fig. 3-1).

At the common collector of the drive stage, you can observe both sets of pulses simultaneously (interleaved), while at the collectors of the individual mixer stages you can observe the individual pulses, one for each "side" of the audio waveform. An advantage of taking sync from one side (which it should not load appreciably) is that the trace locks tightly on that pulse, and the pulses on the screen can be identified from their horizontal position along the trace.

To see what kind of following the modulator gives to the audio waveform, we can use the "Lissajou" form of trace—if you can call it that when it gets that complicated! To do this, connect the horizontal input of the 'scope to the audio generator, before it is attenuated. (Fig. 3-2). There will inevitably be some phase shift, so the "up" and "down" traces do not retrace. But a phase-shift capacitor (shown as .005 μ f which will compensate correctly somewhere between 400 and 1000 Hz) inserted in the attenuation for the input will correct this, removing the ambiguity due to the double trace, by adjusting audio frequency till the two coincide.

Figure 3-3 shows some traces obtained with these two time-base connections, at the points and conditions stated.

Using traces of this type was how the discontinuity that occurred without the negative feedback for amplitude control (a defect we mentioned earlier) was tracked down. Having satisfied yourself that this whole drive section is working fairly well, and giving the

kind of drive you need for the output stage, you can connect up to the output stage (Fig. 3-4) which uses a push-pull auto-transformer, with capacitors across the output side.

Leakage inductance in conjunction with these capacitors will serve as filtering to remove most of the ultrasonic residue, before the signal reaches the load. However, as we are using a method with higher inherent circuit efficiency than the original Class-D arrangement, and with lower residual ultrasonic energy generated, the efficiency of the filter does not materially affect operational efficiency. And any residual that does get into the load is inaudible.

Putting It Together—Instability Appears

Now you may find almost anything can happen. One thing we had happen was a violent motorboating as the voltage was turned on to the whole assembly. This cannot be reasoned out in terms of a low-frequency instability of normal variety, but must be considered in terms of time sequence or analysis. As soon as the output transistors start taking current, it is many times the magnitude of the current we've been "playing with." So the voltage starts to drop.

What does the dropping voltage affect most? What produces the biggest effect is the change of voltage between the phase inverter and the modulating stages. The coupling capacitors here have a d.c. charge, which does not change as rapidly as the change in supply voltage that causes it, so the differential is applied to the mixer-stage bases as "signal"—not antiphase as would true audio input, but both working together. The phase is such that this stage conducts more, lowering (making more positive) the collectors and thus reducing current contributed from this stage to the mixer; so the pulse duration becomes longer, making the output transistors draw more current, and load-

SOME SOLID-STATE RECEIVERS USE GERMANIUM TRANSISTORS.

(Better Than Vacuum Tubes.)

OTHERS USE BOTH GERMANIUM AND SILICON.

(Better Still!)

ONLY THE NEW 100-WATT ALTEC 711 USES ALL SILICON TRANSISTORS!

(Ultimate Performance!)

**NEW
PLAYBACK
SERIES**



Only silicon transistors have the inherent ruggedness, the ability to "take it" that ensures years of trouble-free listening enjoyment. And by "take it" we mean that silicon can handle at least 200% more heat than germaniums (the type of transistor you had to settle for in receivers until we introduced the 711).

Other stereo receivers may use *some* silicon transistors, but only Altec's new 711 is *all* silicon! No ambiguities like, "Silicon *output* transistors for long operating life and better high-frequency performance." The 711 uses silicon in *every* stage! Many receivers advertised as "solid-state" or "transistorized" use the so-called "nuvisitors" in their RF stage—these are nothing more nor less than miniature metal vacuum tubes!

The rugged reliability of silicon transis-

tors is why military specifications for critical electronic equipment demand silicon instead of germanium. This is the reliability you get in the new Altec 711 receiver—and what a receiver it is!

SOME AMPLIFIER!

It gives you clean, undistorted power. The kind you can *use*, not just talk about! Turned up to a roof-lifting 70 watts, the amplifier has a total harmonic distortion of a mere 0.25%! Even at the full 100 watts, distortion is still only 0.5%!

And if you want to improve on the 711's frequency response of 20-20,000 cps ± 1 db at 100 watts, you can always lower the power and get a fantastic 10-100,000 cps ± 1 db! Rocker switches plus a complete control panel give you instant mastery of every audio and electronic function. You never even have to change fuses, thanks to

the 711's automatically resetting circuit-breakers. Of course, there are no transformers to cause distortion.

SOME TUNER!

The 711's masterful combination of sensitivity and selectivity picks up even the weakest stations—then hangs onto them like a bulldog. Drift is a problem of the past!

The 711 tuner is extremely sensitive, with a volume sensitivity of 0.9 μ v and usable sensitivity of 2.2 μ v IHF. Other specs that back up the superior performance of this years-ahead tuner include capture ratio of 2.5 db, stereo separation at 1000 cps of 40 db, and a power bandwidth of 20-20,000 cps ± 1 db.

A unique 4-gang tuning condenser makes the 711's special sensitivity-selectivity combination possible. The fully neutralized IF uses the newest high-gain silicon transistors for optimum integration with the tuning gang.

**REALLY CONVINCE YOURSELF—
COME SEE THE FANTASTIC
ALTEC 711!**

It's all silicon—it's all excitement! The 711 comes completely enclosed in a beautiful metal case (walnut case optional), thanks to its no-heat operation! Your Altec dealer is waiting to show you the new 711. Or, for complete information, write Dept. A11

COMPARE FOR YOURSELF THE 711's POWER-PER-DOLLAR VALUE!

Make	Model	Price	Watts	Dollar-per-watt	All-Silicon Transistors
Altec	711	\$378.00	100	\$3.78	Yes
Bogen	RT 6000	359.95	60	6.00	No
Fisher	500 C	349.50	75	4.66	Tube
Fisher	600 T	459.50	110	4.17	No
Fisher	440 T	329.50	80	4.12	No
Harman-Kardon	SR 300	264.00	36	7.33	No
Harman-Kardon	SR 600	354.00	50	7.08	No
Harman-Kardon	SR 900	434.00	75	5.79	No
Scott	344	429.95	50	8.60	No
Scott	340 B	399.95	70	5.70	Tube
Scott	348	499.95	100	5.00	No
Sherwood	S-8000 IV	312.50	80	3.92	Tube
Kenwood	TK 80	339.95	80	4.22	No
Kenwood	KT 10	269.95	40	6.74	No
Kenwood	KW 55	219.95	40	5.49	Tube

Chart is a cross-section of comparably priced receivers available at the time this advertisement was prepared. Prices and wattage figures are based on information contained in advertisements of the respective manufacturers.

Circle 118 on Reader Service Card



ALTEC LANSING
A Division of
ESFV
Ling Altec, Inc.
ANAHEIM, CALIFORNIA

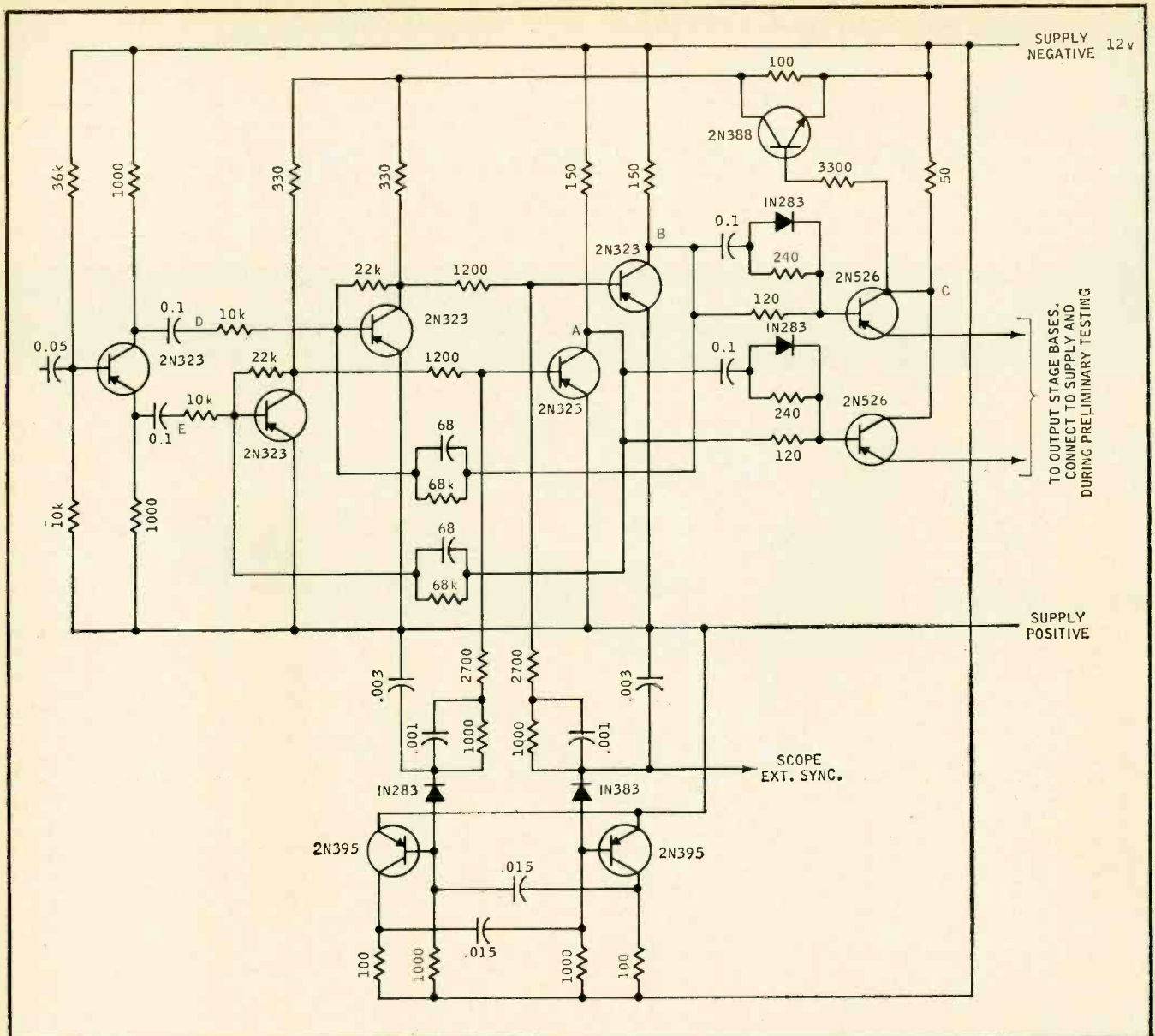


Fig. 3-1. Complete circuit, as checked out, with audio drive, prior to connecting on output stage. Note connection for external 'scope sync.

ing down the voltage in cumulative action.

As the voltage drops to the point where current drops due to low voltage, the voltage can start to build up again. This cuts off pulses altogether, until the rate of climb starts to level off. Then pulses start again, and the cycle repeats.

In this circuit, decoupling of the phase-inverter stage proved to be enough to regain stability at this point (Fig. 3-5). So work proceeded. Although the circuit was now quite stable, the output-stage current was producing a residual drop in the supply voltage, which did affect the pulse magnitude and required a lower value of resistance in the base circuit of the negative-feedback transistor, to hold the quiescent amplitude to its half-value magnitude.

Over-all Feedback

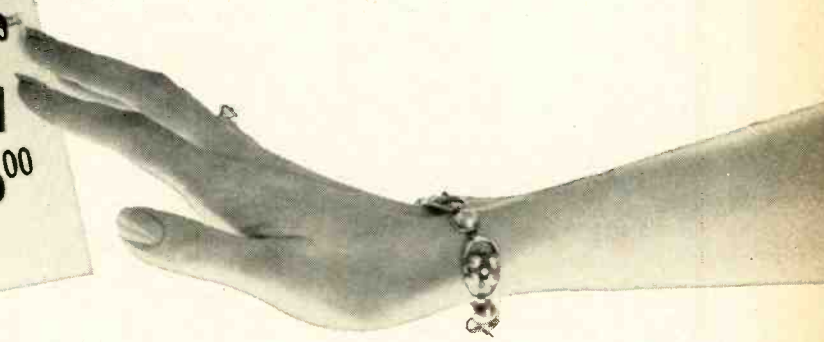
Next, simple audio stages were built to precede the phase inverter and provide a means of introducing over-all negative feedback. There are two choices (Fig. 3-6): from one side of the output to the base of the phase inverter, using the preceding stage as controlled impedance so any external impedance will not affect operation; or from the other side of the output to the base of the preceding stage, using the first stage (not shown in Fig. 3-6) as the controlled impedance (although here it is hardly necessary, because the base-input resistance of the stage shown is low).

To find the correct side to connect the feedback, you can reason out polarities through the amplifier stages. We used arrows pointing upward and down-

ward, starting with an upward arrow at the base of the first stage shown. Feedback must go from the output point to an input point where the arrow points the opposite way, if it is to be negative.

Checking negative feedback stability at this juncture follows methods similar to those for traditional amplifiers: check amplitude and phase characteristics with loop open and closed, and adjust time constants, or roll-offs to get a satisfactory stability margin with adequate feedback. We suffered some instability here at high frequencies, but this proved to be our own fault!

We've written more articles than we care to remember including advice about proper grounding. So what had we done? We'd forgotten our own advice, natch! We'd grounded everything



The last reason in the world to buy an ADC 18 speaker is that its price has been cut by \$65.00.

(But you must admit it's tempting.)

This is the same ADC 18, newly styled, about which *High Fidelity* said, "The response of the ADC-18 was extremely clean and smooth throughout its range, which is estimated to extend from below 30 cps to beyond audibility... It is a very smooth, natural-sounding speaker

system that strikes us as one of the finest presently available..."

Electronics World reported, "The tone-burst measurements pointed up the excellent transient response and freedom from breakup and ringing of both drivers..."

Audio stated, "The ADC 18... has one of the fullest 'bottom ends' we have experienced... This fine speaker belongs in the top rank of available speakers..."

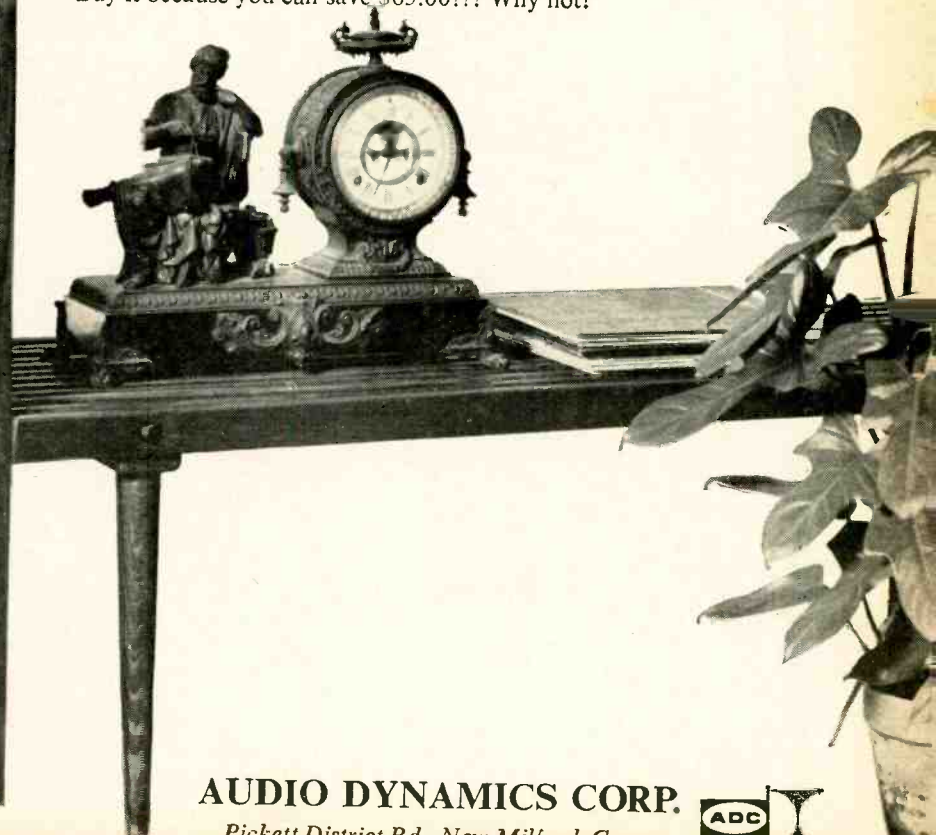
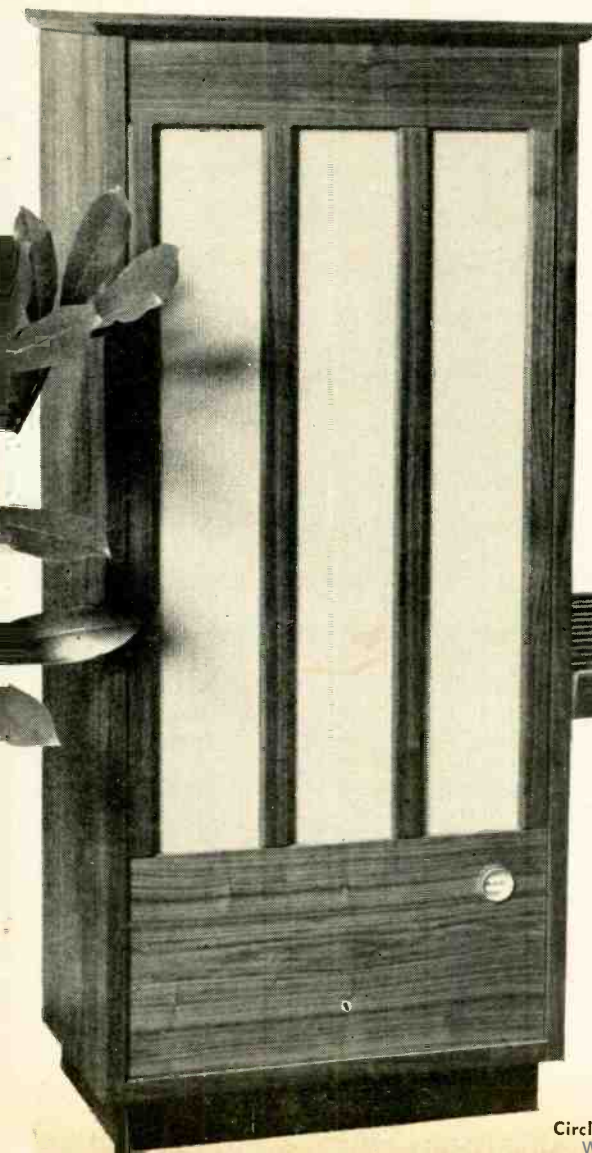
This is the same ADC 18 that features the first rectangular woofer. You get twice the radiating surface of conventional woofers.

This is the same ADC 18 that is a fine piece of furniture as well as a fine speaker.

Buy it because you can save \$65.00??? Why not!



The ADC 18 is also available in contemporary styling at a slightly higher price.



AUDIO DYNAMICS CORP.
Pickett District Rd., New Milford, Conn.



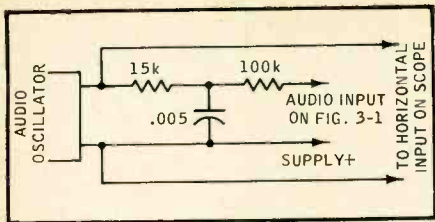


Fig. 3-2. Input connections to provide attenuation and phase compensation for "Lissajou" presentation with audio horizontal.

at the output end, and the input ground was getting a bit of everything injected in series with it, and the whole amplifier shrieked its head off. Fortunately it made the load hot instead of popping the output transistors, so presumably that part was working satisfactorily.

Eventually we deduced what was happening and changed our grounding (Fig. 2-7). Supply positive must go to the output end of the line. Connection from the oscillator and to the 'scope ground, must go to the input end of the ground line, which is also the best place to ground the wiring to chassis. Then there will be no ground loops. After we had changed this, everything was stable and quiet, as in any good amplifier.

We went ahead and adjusted feed-

back and were able to use about 14 db with this model, which we had restricted in frequency range for commercial use. We had an ultrasonic frequency of 18 kHz with an audio roll-off at 5000 Hz, which doesn't leave much margin for playing around. But later models have been built with higher switching frequency, which allows more latitude.

More Trouble

Our next step was to have someone else check the thing over. Tests with mikes and a speaker were quite impressive, and we were getting over 40 watts of audio power, working from a 12-volt car battery, without bothering the output transistors, which were not those high-cost silicons, but relatively inexpensive germaniums (in the \$5 to \$10 bracket). But we were careful to do everything right: would it stand average handling?

We had tested, then listened. Our friend reversed the procedure, as many audio fans would: listen first, then test to make sure their ears are working right! He was quite impressed with the sound, working it from a car battery, which was the intent of this version, but to test it, he used a battery eliminator or charger with a rather poor regulation (which is not a "poor" feature for its own purpose, of course).

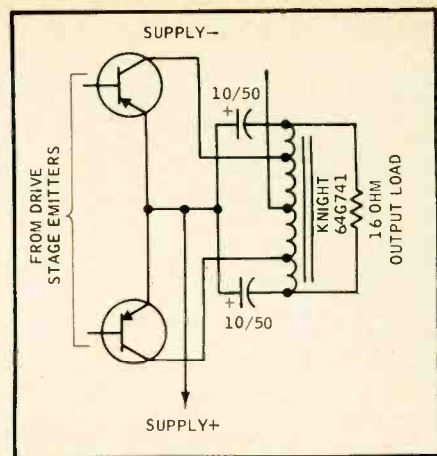


Fig. 3-4. Output stage connected for final completion.

In consequence, after turning up the voltage to supply full current with maximum signal, he turned down the signal, and the voltage flew up as current dropped before he realized what was happening. Apparently they flew a bit too high for one of the output transistors and it popped. After getting a replacement and putting it in, he was more careful. But something else had gone haywire: the replacement transistor, in the socket of the one that had

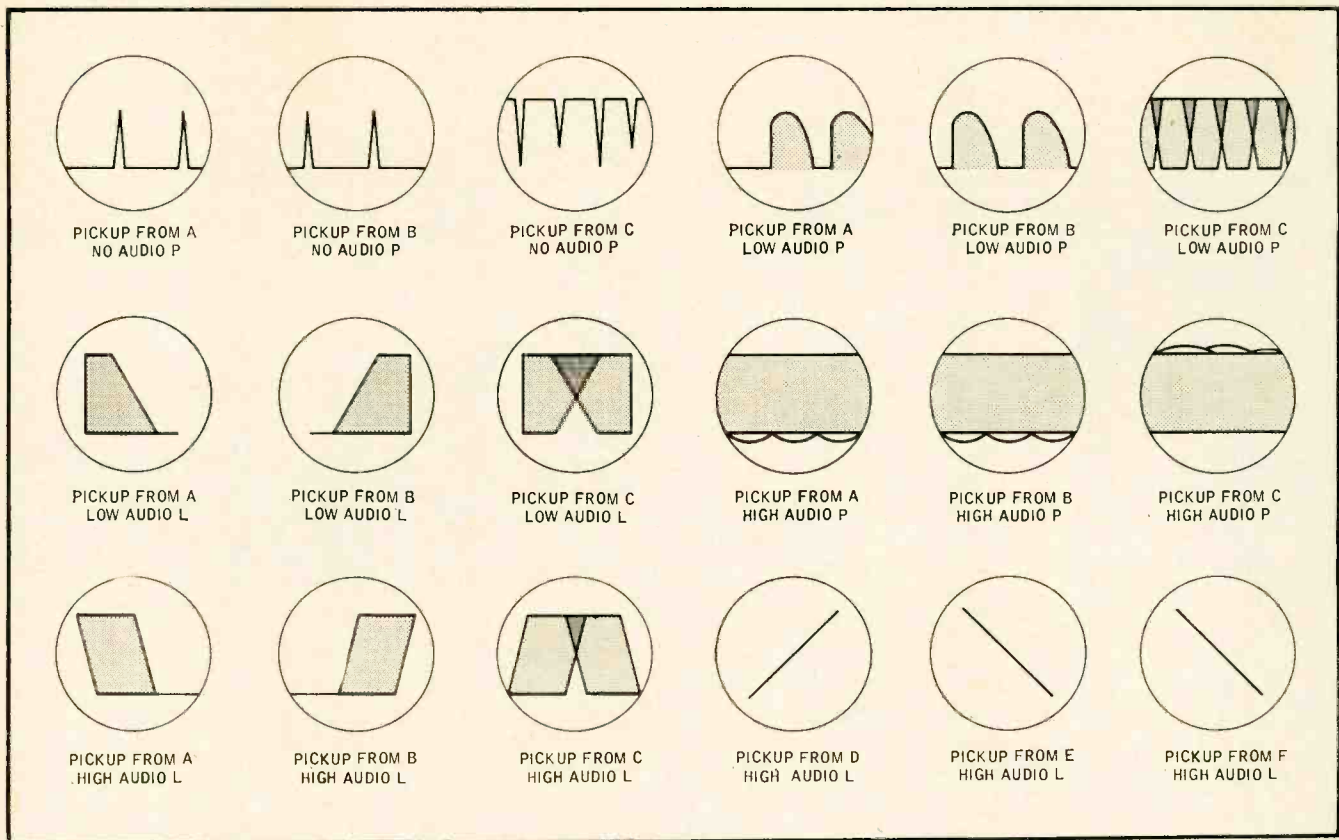


Fig. 3-3. Traces obtained at points identified on Fig. 3-1. Letter P signifies use of internal time base of half the ultrasonic frequency, locked by external sync using the connection shown in Fig. 3-1. Letter L signifies use of audio input to horizontal input of 'scope, to get "Lissajou" display. Note that in P displays, positioning identifies which pulses belong to which side.

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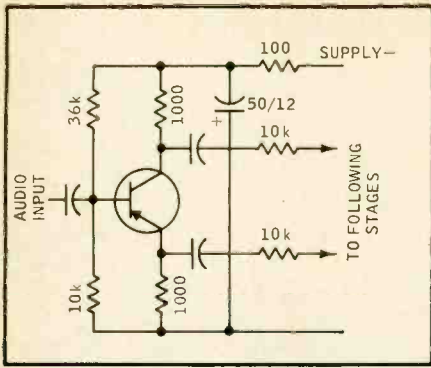


Fig. 3-5. Decoupling of phase-inverter stage to achieve stability.

popped, started to overheat quickly. So, reluctant to pop more transistors without knowing what he was doing, he hurried my baby back to me!

Apparently the over-voltage strain had been a little too much for one of the modulator-stage transistors. It had not popped, but its characteristic had

changed. Prior to letting my friend have the amplifier, I had tried a dozen transistors of each type in the various sockets that used them, and found results consistent enough to believe the amplifier would work satisfactorily provided transistors of the right types were used in all the right sockets. But this one had changed its characteristics further than the maximum deviation I had found between new transistors, although it had not blown.

Back to the Drawing Board

Anyway, I felt that a circuit in which the safety of output transistors appeared to depend rather vitally on a certain pair of transistors (in this case the modulating stage) staying "put" rather closely, was not the best we could do. I had already thought of another way to do this part, so I set to work, ripped this section out and started again.

Briefly, the new way to do the job

consists of removing the modulating stage (before the mixer stage) as an *amplifying* stage, and using resistors to achieve the bias for the mixer stage, with the negative pulse feedback applied to the top end of these resistors (Fig. 3-8). Then audio is introduced through an a.c. coupling of suitable form, with series resistors to convert a basic *voltage* signal (from the phase-inverter stage) to the required *current* signal.

At this point the change seemed obvious and much more sensible. But when we tried it, new instabilities appeared. The positive feedback, to sharpen the pulses, had to be taken from the common collector of the drive stage to the mixer bases, instead of the preceding stage, which has now been eliminated. But won't this mean we'll have to use separate collector resistors for the drive stage?

Actually, separate collector resistors
(Continued on page 70)

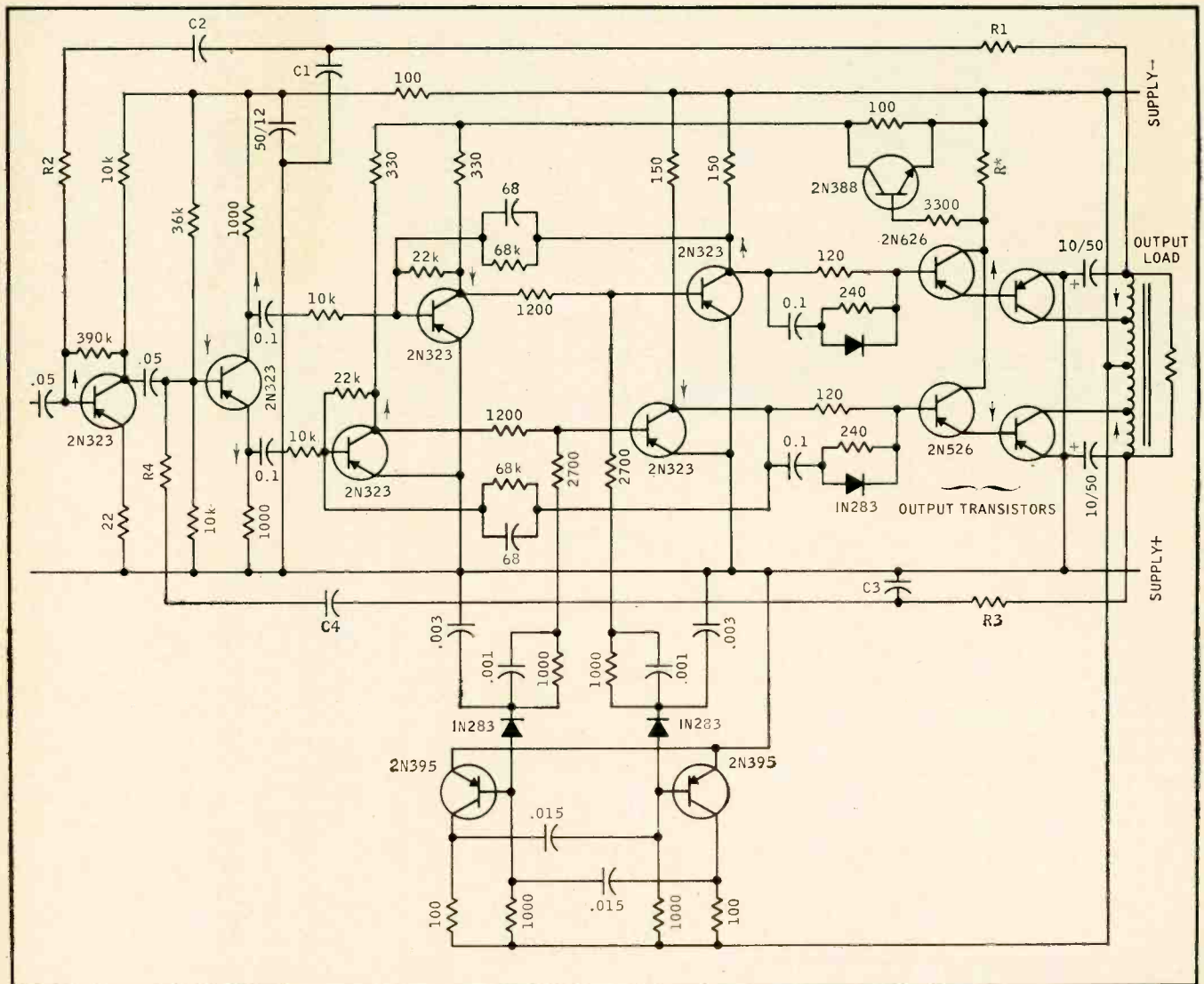
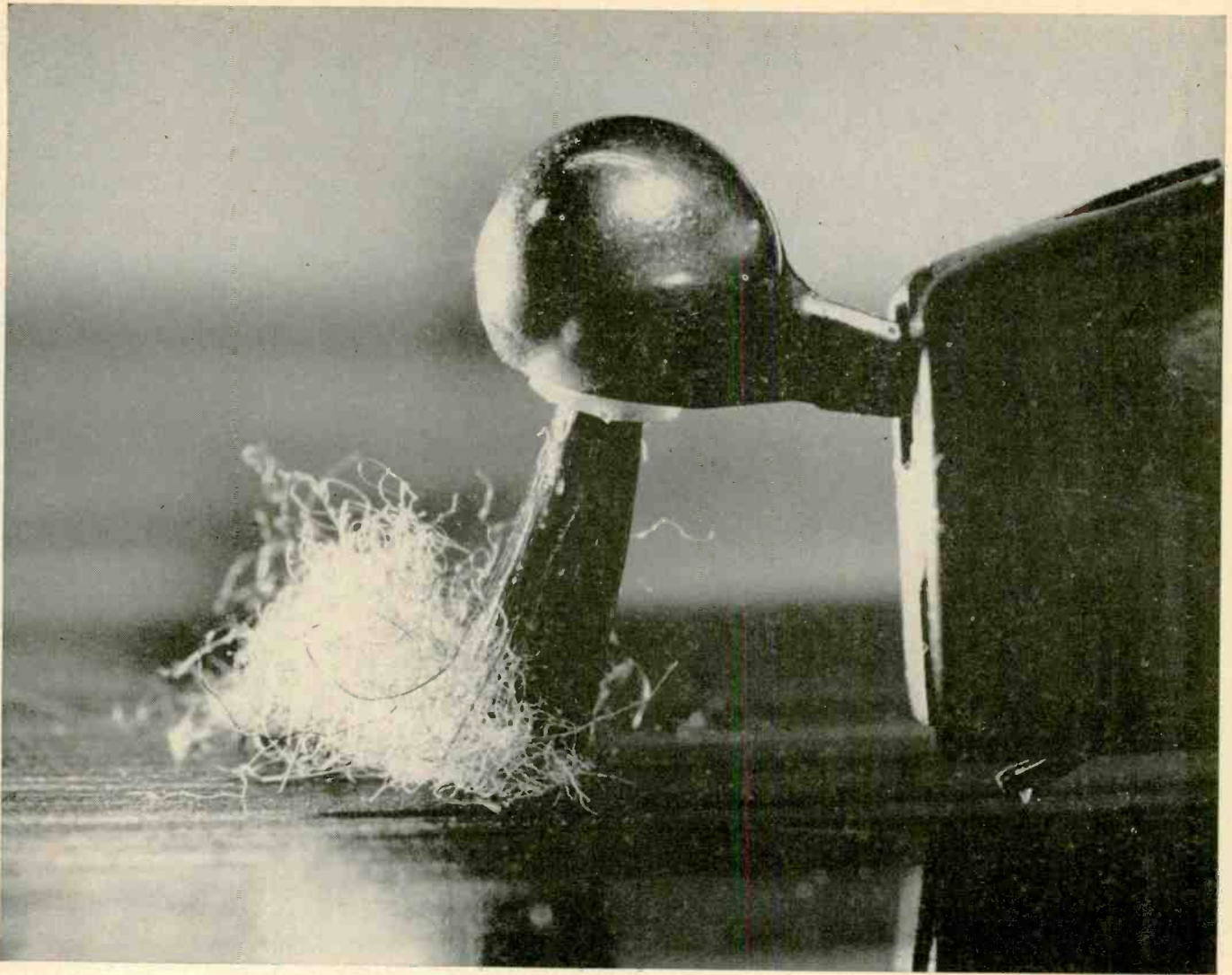


Fig. 3-6. Complete circuit, with alternative over-all feedback connections (one using R_1, R_2, C_1, C_2 and the other using R_3, R_4, C_3, C_4).



You are looking at the world's only true **longhair** cartridge.

In this unretouched photograph, the long, black hair of the brush built into the new Stanton 581 is shown in action on a rather dusty record. Note that all the loose lint, fuzz and dust are kept out of the groove and away from the stylus. That's why the Longhair is the ideal stereo cartridge for your Gesualdo madrigals and Frescobaldi toccatas. Its protective action is completely automatic, every time you play the record, without extra gadgets or accessories.

The stem of the brush is ingeniously hinged on an off-center pivot, so that, regardless of the stylus force, the bristles never exert a pressure greater than 1 gram and always stay the right number of grooves ahead of the stylus point. The bristles provide just the right amount

of resistance to skating, too.

But even without the brush, the Stanton 581 Longhair is today's most desirable stereo cartridge. Like its predecessors in the Stanton Calibration Standard series, it is built to the uniquely stringent tolerances of Stanton professional audio products. Its amazingly small size and light weight (only 5 grams!) make it possible to take full advantage of the new low-mass tone arms. And its frequency response is factory calibrated within 1 db from 20 to 10,000 cps and within 2 db from 10,000 to 20,000 cps. Available with 0.5-mil diamond (581AA) or elliptical diamond (581EL); price \$49.50.

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RECORD REVUE

Edward Tatnall Canby *



JUNIOR ELECTRONICS

Electronic Music. (Lewin-Richter, İlhan Mimaroğlu, Tzvi Avni, Walter Caros).

Turnabout TV 340045 stereo

This discful of intriguing sound is a kind of low-price junior counterpart to Columbia's recent electronic music album; both are products of the very "in" electronic music center at Columbia University, now handsomely foundation-aided and sporting the unique RCA Music Synthesizer. (Well, it's the only one of its kind made by RCA, anyhow.) The Columbia disc featured some of the bigger shots plus a brace of then-current student composers; this one, with the blessing of originator Vladimir Ussachevsky of Columbia, presents more students—from many lands.

Well, tape music is tape music, you'll be inclined to say. It all sounds alike—but then, so does Mozart. Who knows? Each of these works is, according to its author's own account, a monumental study in extremely careful sound-architecture, done with the typical deadly seriousness of the young experimenter. If there is humor (and you will be bound to laugh when you aren't supposed to), then it is not often admitted—though occasionally it is. I liked the *Tombeau d'Edgar Poe*, which breaks up the sound of a Turkish reader orating a poem about Poe—in French, by Mallarmé—treated "with the entire range of classic studio techniques" including plots, gurgles, belches, and gargles. Also *Bowery Bum*, whose earth-shaking noises apparently all originate from one rubber band, twanged. One piece has a vocalizing element (the composer's wife), another student composer pits a "live" flute and a "live" piano against electrical sounds in two of his pieces. (The "live" instruments are recorded, minus dickering.)

It's all settling down to a pattern, or should I say a vast complex of patterns. Now, if we could only begin to hear the Higher Organization for ourselves, we might be able to separate the electronic sheep from the goats! No doubt Posterity will be able to tell in an instant. I have my own ideas, but they probably aren't yours.

SPECIALTY BAROQUE

Henry Purcell: Music for the Chapel Royal. Soloists, Choir of St. John's College, Cambridge, Academy of St. Martin-in-the-Fields.

Argo ZRG 5444 stereo

Here's a British offering, one devoted entirely to the great Purcell and

the music composed for that giddy, sharp monarch Charles II, who was brought up in exile in France and came back to England full of French ideas and a decided taste for the new Baroque instrumental music, even in his Chapel. He was right on the crest of the musical wave of the time, the "modern" trend of the day. King Charles, and Purcell was right with him.

Purcell's anthems for the Chapel Royal are accordingly spiced with solo parts and orchestral music in a rich tapestry, though the traditional elements of an Anglican service are still there—boy solos, boy choir, countertenors and what-not. But what counts most, of course, is the persuasiveness of Purcell himself, the finest composer Britain produced for many an age. It shows. You can hear it.

Six anthems on the records, varying greatly in length and make-up. And an authentically British group of performers, right out of Cambridge, which is almost the same as being right out of Oxford.

Zelenka: Sonatas IV, V, VI for Two Oboes, Bassoon and Continuo.

Cambridge CRS 1814 stereo

They've found another lost composer, this one is quite a character, in his Baroque (1723) style a Bohemian—that is, a Czech—whose music is of the Bach-Vivaldi-Handel period, sounding more like Telemann than any of those. His music is unusual in its virtuoso writing for oboes and bassoons as well as for the length of the movements, which are as long as those of comparable Bach works. (Bach's music is not notable for brevity.)

The two oboes and bassoon, plus continuo of harpsichord and cello or, in one sonata, a second bassoon, make a rich, chortling melange of sound; oboists and bassoonists will be startled at some of the things these players must do. Pretty fancy interesting, solidly made harmony and good professional Baroque counterpoint—this man was no amateur. It's good, enterprising music any way you look at it.

Hay Tobman and Wilfred Burkle play the oboes, John Miller the solo bassoon, with Daniel Pinkham at the harpsichord, the whole recorded in Jordan Hall in Boston.

Heinrich Biber: Eight Sonatas for Violin and Continuo (1681). Sonya Monosoff, Melville Smith, hps., Janos Scholz, gamba.

Cambridge CRS 1812, 13 (2) stereo

Here's the same superb and winning combination that appeared awhile back in the big Cambridge album of *Scordatura* violin sonatas by this man Biber—a really first-rate "unknown" composer, master of the early Baroque, plus an extraordinarily musical lady violinist and an unusually fine sound produced by Cambridge's recording team.

Biber? A Bohemian-born composer who ended up in Salzburg, preceding

Mozart there by a century, a contemporary of the great Corelli (nine years older, in fact) and a German-Corelli-of-the-violin whose music is as good for my ear as that of the far better known Italian master. Moreover, it isn't copied—these splendid little sonatas with their virtuoso violin tricks were printed when Bach and Handel were minus-four years old and Corelli himself was not even yet established as a leading Italian composer. Quite extraordinarily rich music of its sort.

Monosoff? She plays with a gorgeous big tone and the most sensitive attuned pitch I've ever heard in a violin. The *continuo* accompaniment, harpsichord and viola da gamba, is excellent, too. It comes from the grave. Melville Smith died in 1962 shortly after these tapes were completed.

Julian Bream in Concert (Lute music of Dowland and Byrd; Dowland Songs) with Peter Pears, tenor

RCA Victor LSC 2819 stereo

Julian Bream is to the lute what... er, well, what Benny Goodman was to the Clarinet in the bad old days. He sure can play a mean lute. Quite seriously, he "brings it to life" where many an earlier present-day performer merely made it sound antique. The Elizabethan music sparkles with color and expression. Guitarists in particular (including folk-type) will want to hear what this man can do with the instrument but anybody can go along with its lively sound.

The first side here is worth the whole. Excerpted from Bream concerts, it includes just enough of his highly humorous commentary (with audience reaction) to inform and to break a lot of ice for you. Excellent! The second side, featuring Peter Pears, the eminent British tenor, is not so happy. Pears, alas, is no longer as young as he once was and the singing here is far from accurate, often tired sounding and physically out of tune. Those who know Dowland and/or have a good intuitive ear will love the songs, but this performance is not for the newcomer.

Forget about Side 2—buy the record for Side 1. Well worth it.

Italian Organ Music of the 17th and 18th Centuries. Luigi Ferdinando Tagliavini, Serassi organ, Piscogne. Music Guild MS 129 stereo

This is a first-rate disc of its kind and at a bargain price. It's one more example of the new Economic Law for records: the more abstrusely connoisseur-like the music, the cheaper the disc! Music Guild was once a rather exclusive connoisseur's label; now, as part of Westminster, it has been whisked in a jiffy to the new Bargain-Basement Baroque price slot. Who can complain? Not me!

An unusual collection of "early" Italian organ works played on a fine old organ (though a bit "late" for the music—mid-19th century) by a man who can



Enjoy it.

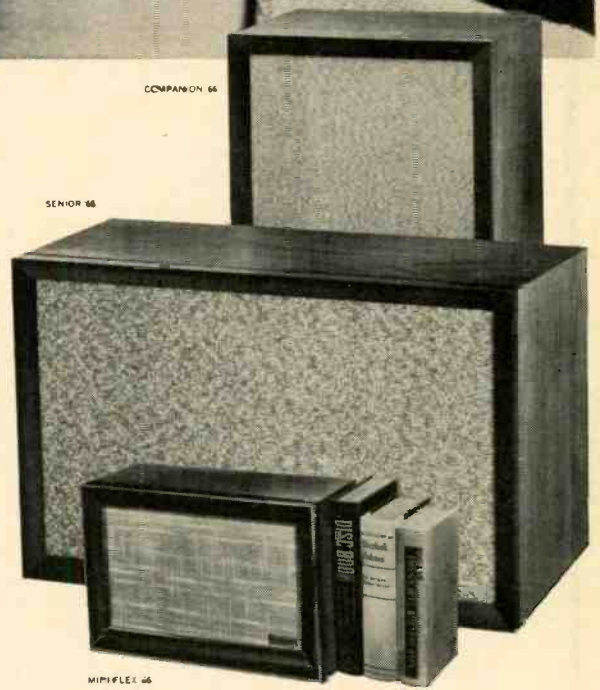
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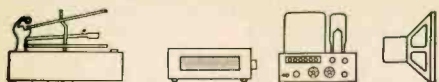
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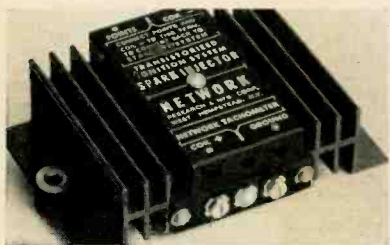
from the February, 1965, issue?

"NETWORK" SPARK INJECTOR

With the curiosity indigenous to a long-time hi fi enthusiast, this observer was naturally intrigued by the advertisement of this product in a recent issue. "High Fidelity" performance from an automobile appeared to be a new category of criteria.

Accordingly we obtained one for "test," not knowing just exactly how one would measure performance of such a device with the sort of objectivity we attempt to attain with the usual hi fi component.

In the first place, installation is slightly simpler than claimed in the advertisement, since it took just eight minutes to put it in place, connect the four wires, and start the car—a 4600-lb 1961 model. It started off immediately—better, if anything, than usual. Then, before essaying any long-trips, we "broke it in" around town for long enough to have confidence that it would continue to work—no real problem if it hadn't, really, since it is only necessary to move two wires from their usual terminals to a third one, all of which are readily accessible, to restore the normal ignition system to operation.



After sufficient local driving to establish confidence, we went on a couple of 450-mile trips. There was no noticeable performance difference up to 60 mph, but above that when acceleration usually drops off, it was another story. Step on the gas at 60 and the car simply jumped—about like it usually did at 30. With the usual test figure of time to reach 60 from a standing start, we measured 10 seconds, and another six from 60 to 80—sports-car performance from the "family sedan." A more important figure for the user is the gasoline mileage, which showed an increase of 13 per cent over the normal ignition system. This was on a reasonably accurate controlled test. On a 500-mile trip, one way was with the Spark Injector and the return on normal ignition.

We had previously used another type of transistorized ignition for some 15,000 miles without changing plugs or points, and both were still like new—no point wear at all. With no stress on the points they should last until mechanically worn out, but not from pitting of the contacts.

Later we had the opportunity of observing a bench comparison of the Spark Injector with a normal ignition system. At engine speeds of over 4000 rpm, the normal-system spark became erratic, and ceased altogether at about 5000. With the Spark Injector, the spark was still "fat" up to 7000 rpm, which is well above any speed a normal engine ever reaches.

With increased gasoline mileage, snappier acceleration at high speeds, easier starting, and longer spark-plug and point life, we are most enthusiastic over the Spark Injector.

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really bring out the sense of the rather difficult organ music of the 17th century.

The first side, all 17th-century, centers on Frescobaldi, the "father" of organ music, but also includes three items each by Trabaci and Merula. Most organists can make nothing out of these masses of rapid scale passages, ornamenting obscure and modal-sounding harmonies. Our man, instead, thrives on the stuff—and so do we, as listeners. It makes sense.

The second side is easier because later; but it is still enterprisingly unusual. Two D. Scarlatti sonatas, ordinarily heard on the harpsichord but excellent on organ manuals, plus listenable items by Pasquini, Rossi, Zipoli—three by the last-named.

An excellent idea to play not one but three items each by three lesser composers. Gives us a good sense of their musical personalities.

BIG BAROQUE

Bach: The Six Brandenburg Concertos. South-West German Chamber Orch., Friedrich Tilegant

RCA Victor LSG 7038 (2) stereo

Some few months after Vox's excellent omnibus box of Brandenburg concertos and Bach concertos for violin (AUDIO, Oct. 1965), big old RCA Victor barges into the High Baroque with this Brandenburg album—and it's good. Very good.

RCA, indeed, is beginning to show signs of an awareness that Baroque is here to stay on records and that the standard American or European symphony orchestras aren't going to do it justice. Instead of the Chicago or Boston Symphony here, we have an "unknown" German outfit—probably at a much lower cost to RCA. And the results are tops. The style is good, the music is lively, beautifully played and beautifully recorded in non-Dynagroove.

Vox's Brandenburgs are good, too. (SVEX 567). The two albums are gratifyingly within an over-all tradition of knowledgeable performance. RCA's is the cleaner sound, in a more expansive acoustics, in fact quite lovely, all golden sheen. The Vox sound is more chamber-like—which is a 100 per cent OK option, and very authentic. Even so—I found the expansive RCA sound quite thrilling, especially at loud volume. There is a good close-up clarity and separation for the many solo instruments and it goes well with the over-all bigness.

Recorder players (the musical instrument!) will note with interest that Vox uses two solo recorders in No. 4, rightly. RCA's version has two flutes, instead.

Vivaldi: The Four Seasons. New York Philharmonic, Bernstein.

Columbia MS 6744 stereo.

Not bad! Not bad at all, considering. It's a very touchy thing for the big American symphony orchestras, this new craze for Vivaldi and for Baroque in general. They are dismally unsuited to it, out of a wholly different tradition, the big 19th century symphony ensemble grown even bigger in the 20th. Most of our players (and a lot of conductors) are almost totally ignorant of present Baroque goings-on elsewhere. Not good.

And so Bernstein has done relatively nobly here. A small string group, of the right size, definitely (or so it sounds—which is what matters). He plays his own harpsichord *continuo*, and does it nicely, with a minimum of ostentation. His violin concert master, John Corigliano, plays the main violin solo and does it well, in spite of obstinately wrong ornamentation. The other (anonymous) Philharmonic solos are good too.

Only the *ripieno* players, the "back-ground" orchestral strings that play the loud *tutti* parts, are not really up to present Baroque-style standards else-

where. They remain, so to speak, unconvinced. They still bounce out the fast parts as though the stuff were hack work and dull. It sounds that way under their treatment. And, too, they tend to ham up the more vividly pictorial sections, the summer storms, the winter freezes (with Bernstein's connivance)—as though to make up for Vivaldi's deficiencies as compared with, say, Richard Strauss! That gets us nowhere, and it shows up negatively in performance. Vivaldi is Vivaldi. And he was no latter-day Romantic.

Nevertheless—this adds up to a good version of the piece, alongside of any body else's; which is saying a great deal, let me tell you.

Maybe the N.Y. Philharmonic will be the first great orchestra to survive the Big Change that is manifestly on the way—when the present young people grow up, make their piles and begin Supporting Culture with Cash. Most of them intensely dislike all Romantic music, and symphony orchestras in particular! They dig Baroque instead—any old Baroque. So *something* must be done, some day, to keep our live music alive! Here's a start.

Bach Organ Favorites, Vol. 2. E. Power Biggs, Flentrop Organ.

Columbia MS 6748 stereo

Favorites can mean any old thing—in this case it refers to some of the biggest of all Bach organ works, and no sissy-music, either. The huge "St. Anne" Prelude and Fugue in E Flat, and the "Great" Prelude and Fugue in A Minor, plus the F Major Toccata, Pastorale in F and the Chorale Prelude *Schmücke dich*. It's a super-colossal program: for in fact it largely duplicates an 1840 program played at St. Thomas' Church in Leipsic on Bach's own organ—by, of all people, Felix Mendelssohn, the modern rediscoverer of Bach. Interesting. The program is slightly rearranged, to fit the LP record (and one item, the C Minor Passacaglia, is to be found on another Columbia Biggs recording).

E. Power Biggs has superb organ ideas. This is a brilliant one, as were his pioneering travel-albums to Europe's famed Baroque organs. His organ, at home is a good one too, right in style. His playing on this disc is, as usual, technically fleet and stylistically correct but musically not all it could be. Bach isn't as big here as he must have been when Mendelssohn played the same music. Big enough to be enjoyable, even so.

Bach: Goldberg Variations. Martin Galling, harpsichord.

Turnabout TV 340155 stereo

At a \$2.50 list price in stereo this is surely a bargain "Goldberg," though it is not exactly an inspired performance.

It is not in any way inept, or out of style. Far from it. Martin Galling is one of those classic Germans who leave no stone unturned. He is a finished pianist and also a finished harpsichordist, of the modern no-nonsense school, who knows all about proper ornaments and harpsichord technique, is easily capable of whirling off these difficult keyboard pieces, and sails through the Goldbergs with never a hitch or lapse, in the most correct fashion you can imagine.

That's it. What does *not* come through here, unfortunately, is the greatness of the Goldberg Variations. For all Mr. Galling conveys, they might be no more than inspired finger exercises.

Oddly enough, that is exactly what they are! Does one have to be "Romantic" in order to "bring out" the profundity of the music, the over-all dramatic shape, the inner contrasts? If correctly played, don't the notes themselves tell their own story?

Superficially, yes. One may be very "Romantic" with these superb little pieces in a great big framework—wit-

(Continued on page 64)

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MODEL SX-1000T

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■ The SX-1000T has a built-in highly sensitive protective circuit—a "must" in transistorized sets—made up of a transistorized switch and relay. Damage to the transistors, such as in the case of overloading due to a short circuit of the speaker terminal, are prevented with this protective circuit.

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■ As for versatility, a full range of inputs and outputs is provided. These include those for tape head, tape line, magnetic or crystal phono, stereo headphones and for tape recording. If your tape recorder has a DIN connector socket, then all you



need for stereo recording and playback is a single cable for all connections.

■ Other features include: a precision tuning meter for pinpoint tuning, replacing the conventional tuning eye; a cascade front-end for the FM tuner section using space-age nuvistors for super-sensitivity: 2 microvolts for 30 db of quieting at 30% modulation; completely independent tone controls for each channel, to provide the exact shades of tones you want; a muting circuit for elimination of annoying between-station noises; a large stereo indicator lamp for quick recognition of stereo broadcasts.

■ The handsome exterior design features a brand-new, attractive satin-silver and dull-black finish to match any decor; and controls and switches are laid out for maximum ease in handling, another point bound to please the non-mechanical-minded. For further details, contact:

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SOUND AND SIGHT

HAROLD D. WEILER

FROM A RECENT ISSUE of the *New York Times*, we find that a group of young men began a training program in Hollywood to prepare themselves for jobs which could eventually pay \$500,000 a year and more. They were the first recruits in a new apprenticeship program established by the Directors Guild of America.

This is the first time that members of a major Hollywood craft have recruited and trained newcomers from outside the industry. One of the trainees had been attempting to become a director for ten years.

The apprentices will start at \$125 a week; if after a short period their ability merits, they will become second-assistant directors at more than double this salary. After three years they can be promoted to first-assistant directors, earning about \$500 a week.

Eventually the trainees will have the opportunity of becoming full-fledged motion-picture directors, a delightful prospect, with a salary ranging up to \$500,000 for a single film, or television directors who may make \$1,500 or more for a single, half-hour TV show.

These men were selected only after a protracted series of interviews with officials of the Directors Guild and a seven-and-one-half-hour examination designed by professors from the University of Southern California.

"The old system (of obtaining new directors) is simply outmoded," said George Sidney, president of the Directors Guild. "Some sort of a systematic, organized training program had long been overdue."

This news item indicates the serious lack of top-flight personnel in entertainment filming. This lack is even more pronounced in the field of non-entertainment filming for science, industry, education, and religion. The imminent arrival of video re-

ording in these fields will further increase the demand for trained personnel, as we indicated in an earlier column.

More on Edison's Early Work

From the material in the Edison Archives and other contemporary sources, we are able to further reconstruct Thomas A. Edison's early experiments which eventually led to the invention of the motion picture as we know it today.

Thomas A. Edison's early attempts at combining sound and sight make it quite obvious that he and his associates were either not aware of or chose to ignore the basic principle of "moving pictures."

The illusion of motion is created primarily through our persistence of vision—the eye requires a fraction of a second to record the impression of an image and transmit it to the brain. Once this impression is received by the eye it is retained for 1/20 to 1/10 of a second after the image which created it has been removed. For this reason any device which is to be employed to view or project motion pictures must include some provision for moving the previously recorded images past the viewing lens with a stop-and-go motion. The pause must be of sufficient duration to allow the eye to receive and record the impressions of the images and transmit them to the brain. The eye then retains each image long enough for the following one to be received and recorded. When these images are viewed at the rate of more than 12 per second we fuse them into the illusion of continuous motion. When the viewed images are not allowed this momentary pause the received impressions are blurred.

This is exactly what occurred with Edison's first experiment for the method of viewing did not incorporate a stop and go mechanism. However, Edison was not dis-

couraged; he felt that the comparatively insensitive emulsion employed for coating the photograph cylinder was at fault. He was correct in blaming the speed of the emulsion; however, as we know today, this was only one of his problems. They tried three or four different types of emulsions. The most successful evidently was the still very insensitive collodion/silver-bromide.

It was Marey, one of the early moving-picture experimenters, that we can thank, and Edison did credit him for the next step in the invention of motion pictures, for in his Chronophotographs, he employed gelatin silver bromide plates which were considerably more sensitive than the collodion emulsion Edison had employed in his previous experiments. These, in addition, were made even more sensitive by ammonia acceleration.

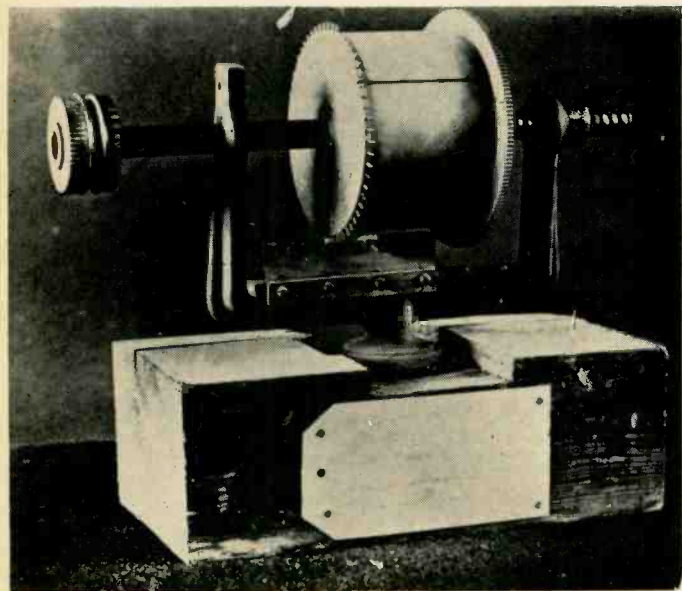
To again quote Dickson's *Century* article, "A bold leap was made to the gelatin/bromide-of-silver emulsion." A distinct improvement was noted when the microphotographs were viewed as "stills" for this emulsion was much more sensitive. However, the grain of the pictures was understandably much more noticeable and most objectionable. The pictures were, of course, still blurred due to the continuous motion of the cylinder during recording.

The next step was obvious—since the grain was objectionable due to the large magnification required, why not make a larger image which would require less magnification and thereby result in less grain. This did not solve the problem, however, for the cylinders still moved continuously. In addition, Edison was confronted with a new problem—due to the increased image size and curvature of the photographic cylinder the microscope employed for viewing could not be focused evenly and only the center of the picture was in focus. The next experiment employed a larger photographic cylinder, one whose greater diameter would provide less curvature—it was built and the experiment continued—unsuccessfully. There was evidently still too much curvature, for Dickson writes (September, 1933, J.S.M.P.E.), "I have not mentioned some of my earlier failures, such as the use of vertical disc, which, however, being flat, got rid of the distortion of the drum." Edison's insistence upon combining sound and sight was to cost him almost a year's delay in obtaining the first successful moving pictures.

As Dickson was to comment later in the *Century* article, "The establishment of harmonious relations between the kinetoscope and the phonograph was a harrowing task and would have broken the spirit of inventors less inured to hardship and discouragement."

Incidentally, this *Century Magazine* article written in 1894 makes most interesting reading, for it contains descriptions which better fit the modern home video recorder than they did the Edison kinetoscope of the period. For those of our readers who are interested, this most prophetic article appears in June, 1894, issue, and can be seen in most larger public libraries. It is also one of the best contemporary accounts of Edison's invention of the kine-to-phono-

(Continued on page 60)



An early Edison photographic cylinder.



Now, there's a tape that lets you



record twice the music per foot.

**How? It's so sensitive you can cut
recording speed in half with no loss in
fidelity. Your budget will applaud.**

Savings start with this box.



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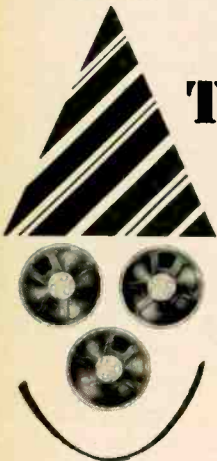
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Circel 125 on Reader Service Card



HERMAN BURSTEIN

Send questions to:

Herman Burstein
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Wantagh, N. Y.

Include stamped, self-addressed envelope.

Headphones Across Speaker Connections?

Q. I have a Tandberg Model 64 and wish to connect high quality stereo headphones to its outputs. Can I use the headphones for connection to the speaker outputs of my amplifier?

A. You require high-impedance headphones to avoid overloading the Tandberg. Although there will be substantial signal loss if these headphones are connected to a power amplifier, there might be sufficient signal for your purposes. Connect the headphones to the highest output tap of the amplifier (16 ohms or perhaps higher). If the high-impedance headphones don't work satisfactorily at the power amplifier output, you can try step-up transformers between this output and the headphones.

Copying Tapes

Q. I have been taping opera broadcasts with my Ampex 601. I also have an Ampex 936. I would like to exchange tape copies of broadcasts, and would like to know the requirements to get really top-quality duplicates. I've read somewhere that the treble has to be boosted to compensate for losses in the copying process.

A. For copying a tape with your equipment, simply connect the output of the 601 into the high-level input of the 936, or vice versa. At 7.5 ips the treble loss will probably be negligible if you go through just one or two generations of copying. Of course, you can make as many copies as you desire from your original tape. With respect to the legalities of exchanging tapes of broadcasts, I suggest that you consult an attorney.

Distortion vs. Frequency Range

Q. I am trying to choose between two tape machines. According to test reports, one of them has low distortion at 3.75 ips but also a relatively limited frequency range, while the other has a more extended range but also higher distortion. Please tell me what you suggest to select the better machine.

A. I think the best way out of your perplexity is to listen carefully to both tape recorders and choose the one that sounds best to your ears, regardless of how it measures with instruments.

In operating at slow speed, such as 3.75 ips, the designer must achieve a compromise between extended treble response and low distortion. The better he wants the treble response to be, the more treble boost is required in recording, with a resultant increase in distortion. Another factor in distortion is tape motion. Wow and flutter, particularly the latter, contribute to IM distortion. It is harder to maintain good motion at slow speed, so that distortion rises.

Recorded Tape Problems

Q. Enclosed you will find a recorded tape which was bought six months ago. At that time it was played back several times and was in perfect condition with a beautiful sound. Afterwards it was stored with the rest of my tapes. A few weeks ago I played it back but it sounded terrible, with a lot of wow. If you inspect the tape you will notice some waviness at the edges, which is causing the wow. I have had the same trouble with some other tapes of different companies, but not on all my tapes. What do you think is causing these wavy edges? Is there a humidity problem? Are acetate tapes less affected by humidity than Mylar tapes? Can the use of a metal or plastic tape storage can solve the problem? Is there a chance that the recording company might replace the useless tape?

A. I have played your tape on my machine and find that Track 1 (upper edge) is very badly distorted due to deformation of the tape, while Track 4 (lower edge) is also distorted but not as badly. The inside tracks (2 and 3) seem all right. As a guess, the stretched edges are due to your having rewound the tape at high speed and then stored the tape in a very warm place; the stresses accumulated in the tape caused the tape to acquire a "set" under the storage conditions. I noticed that when I wound you tape from one reel to another at high speed, the tape wound into an oval rather than circular form. This indicates that the tape was subject to considerable stress.

So far as I know, Mylar tapes are less subject than acetate ones to the problem you have experienced. I don't know that

(Continued on page 63)

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777

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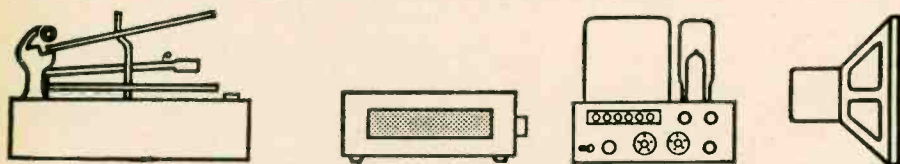
The new, limited edition Sony 777 was conceived for the truly discriminating audiophile who will settle for nothing less than the finest stereo instrument. Only 500 are being hand-crafted, each bearing its own Certified Specification Chart. In construction, design and performance, the Sony 777 is conspicuously outstanding. Priced at \$695.

Features & Representative Specifications: Frequency response 30-16,000 cps \pm 2 db @ 7½ ips. Signal-to-noise ratio 50 db or better overall. Wow & flutter 0.09 @ 7½ ips. Military type modular circuit boards with all playback and record adjustments centralized on one panel having tilt-out construction for greatest accessibility. Professional VU Meters. Automatic Tape Lifters. Outside rotor supply reel motor. Superscope, Inc., 8150 Vineland Ave., Sun Valley, Calif.

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EQUIPMENT



PROFILE

VIKING STUDIO 96/RP 120 TAPE RECORDER SYSTEM

This is the cream of the Viking line and sweet cream it is too. This is not "sub-professional" equipment; it is, by all standards, broadcast grade. As the heading indicates, there are actually two units involved here. The Studio 96 is the transport and the RP 120 the all solid-state stereo record/play amplifier.

The Transport

The Studio 96, upon first examination impresses one with its solid bulk. It weighs in at 50 pounds and that's heavy even for such a deck. The front of the transport is distinguished by its lack of clutter, as seen in Fig. 1. There are the two reel platters, set far enough away to accommodate 10½-inch reels. There are the two head covers separated only by the slot into which the tape falls. A three-position digital counter is located in the upper cover. Finally, across the lower portion of the transport are four telephone-type switches. Each of these has three positions. The first switch, from the left (facing the transport), selects the proper hold-back tension for the feed reel, 10, 7 or 5 inches. The second switch is the speed selector. Its three positions are labelled HIGH, OFF, and LOW. This con-

trols only the capstan speed. Our sample had as its high speed 7½ ips. and, as its low speed, 3¾ ips. Transports are also available at 15-7½ and 3¾-1½.

The third switch is labelled PLAY, STOP, CUE. And, the final one is called out at FAST FORWARD, STOP, and REWIND.

Under the grey hammertone, 5/32-in. steel panel are the real complexities of this transport. Figure 2 shows the rear, with the three motors. Two, for take-up and rewind, are hefty 1-amp, 6-pole units. These use extensions of their rotors as the center of the tape reel. The third motor is a two-speed, hysteresis-synchronous unit of inside-out construction. This drives the capstan via a triple belt arrangement that wraps around the 3½-lb. capstan flywheel. It should be pointed out that this drive motor is considerably larger than the usual run-of-the-mill phono-type motors.

All mechanical operation is by solenoids or relays. One solenoid operates the pinch roller in the play mode. A second offers a unique fail-safe service. Braking on the Studio 96 is by direct current application to the appropriate motors. So too, is the hold-back tension. These, of course, would become inactive in the event of a power failure during operation. So there is a separate solenoid connected to a pair of mechanical brakes. These are normally on. When the deck is activated, the solenoid

pulls the brakes off. Should power fail, the brakes are applied instantly. The solenoid also has the secondary function of acting as a bleeder resistor for the d.c. power supply.

Latching relays and a memory-latching relay are in use for the various tape motions. As a result it is possible to move to FAST FORWARD or REWIND without disengaging the play switch. When the tape is stopped, the pinch roller solenoid will not be reactivated until the reels have fully stopped.

There is an additional relay system, using a light activated photo-electric cell to sense the physical position of the tape. If the tape should run out, in any mode of operation, or break, the d.c. brakes are instantly activated. Clear portions of tape can thus be used as stop cues at any point on a reel.

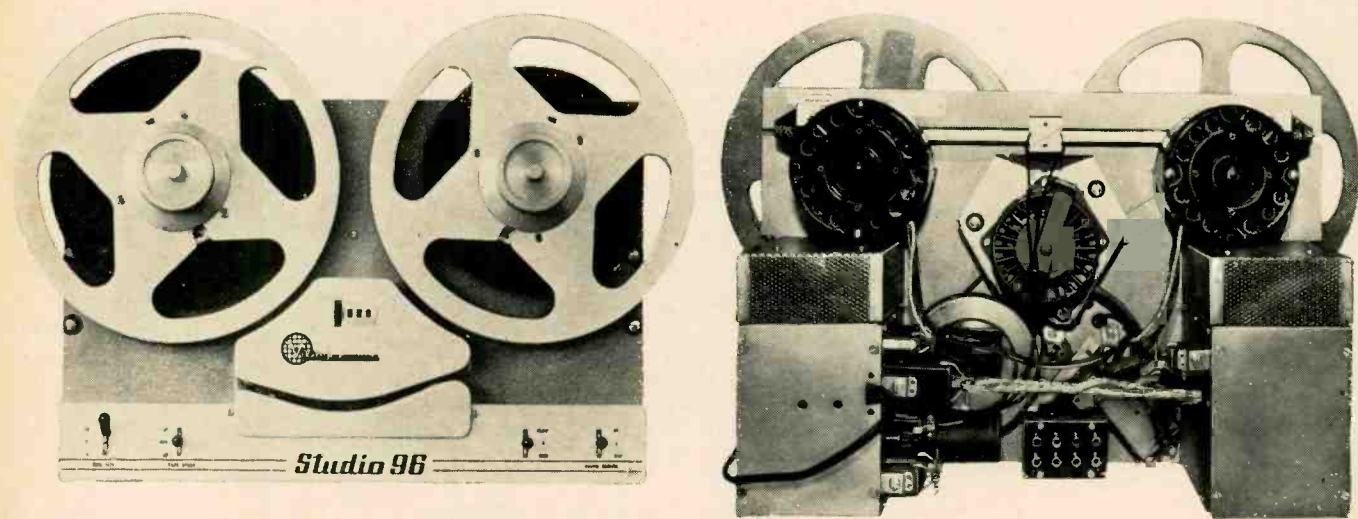
As a result of the interaction of these relays the deck becomes as close as possible to completely foolproof. It just won't snap a normal tape. Note that word normal. The excellent Viking manual that accompanies the deck warns against the 0.5-mil and thinner tapes. The high forward and rewind speeds, and their concomitant high braking forces, can do harm to these tapes. These tapes *can* be used, but special care must be taken to prevent full high-speed motion by mechanically hand braking the reels.

These reel tables have an interesting feature. They are normally set for the standard small reels. However, they contain pull-out hubs to fit the large NAB standard. Also, Viking supplies two excellent screw-on reel locks that will fit all types of reels.

The RP 120 Preamplifier

This is a physical match to the transport. Like it, it is equipped to fit a standard 19-inch rack mount, as shown in Fig. 3. Also, it has the same grey hammertone finish, though the panel is thinner metal. The over-all *feel* is entirely in keeping with the professionalism of the entire unit.

The external appearance is dominated by two *true* VU meters. Flanking these on the outside are respectively, an equalization selector (also the a.c. on-off switch),



Figs. 1 and 2. Front and rear views of the Viking Studio-96 transport.

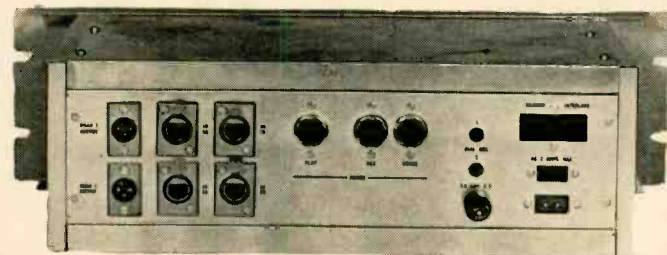


Fig. 3 (left). Front and rear views of the RP-120 amplifier.

and a monitor selector. On the inboard side of the meters are two push buttons used to activate the record circuits. The three lower knobs for each channel are for mike, high-level inputs and for playback level. Finally there is an earphone jack designed to accept the standard three-contact stereo plug.

The rear panel has all other connectors. In addition to the feeds from the transport, there are the two sets of inputs and the pair of outputs. These use standard three-contact Cannon XL type connectors. Normal input is for high-impedance microphone and unbalanced lines. Viking has provision, and accessory plug-ins, for converting to low impedance and balanced-line input from 600 ohms. The output is also unbalanced and at high impedance. And, again, there is a plug-in transformer available for conversion to broadcast-line requirements.

The RP 120 is entirely solid-state in design. A total of 20 silicon planar transistors; one germanium power transistor; 6 silicon diodes; 8 germanium diodes; and one Zener diode are employed. The bulk of these are to be found on five circuit boards. These boards are: a bias oscillator, stereo record circuit, stereo play circuit, stereo input circuit, and stereo output circuit. These boards slide into plug-in contact holders. Thus they are instantly replaceable if necessary.

Servicability seems to be one strong point of both the deck and the preamp. Whenever possible, Viking has provided sectional plug-in design. For example, in addition to the circuit boards, there are plug-in control boxes for the transport. The over-all approach seems to be that of a unit that will suffer a minimum of downtime in any professional application.

Test Results

It must be first stated that the transport/preamplifier performed as easily and as surely as the most fussy user could require. Tape motion is faultless. There is no tape slap, even if the start follows a rewind motion. What with the memory relay system, it apparently takes considerable skill to arrive at a situation where you can break a tape—a skill which we

lacked. Tape would not break and it would not spill. Even pulling the a.c. plug in high-speed motion will do nothing since the mechanical relay comes into play to brake the reels to a stop.

The preamp offers the same satisfactions. The VU meters in addition to being electrically flat, have the kind of ballistics we like in a volume indicator. The respective gain pots are positive, smooth, and non-binding.

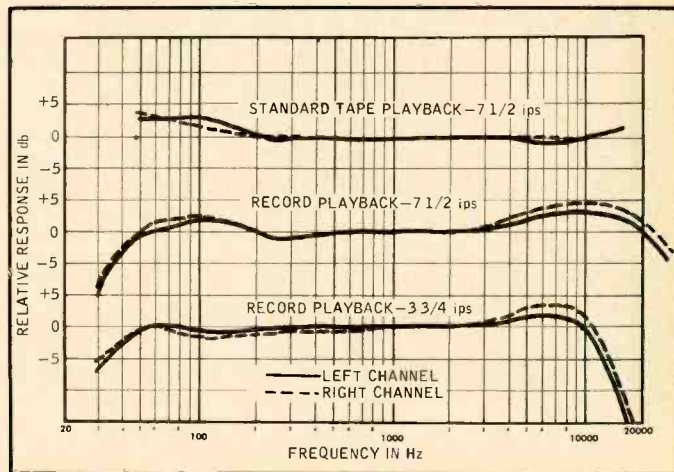
Fig. 4 shows the 7½-ips NARTB response to Ampex Test Tape 31321-01. Except for the slight rise in the bass region, it could hardly be improved upon.

Also shown is the over-all record playback response at the two speeds. They were taken at a -10 dB record level on Scotch brand 111 tape.

What the curves do not show is that waveform purity was exceptional. Even at the extraordinary high frequency extremes harmonic distortion was extremely low. We also made specific measurement of IM distortion at various record levels. At a 100 per cent equivalent figure, IM was 2.8 per cent. Note that this is playback off the tape. This is indeed an excellent figure.

Total signal-to-noise unweighted was -47 db left and -45 db right. This is below a maximum 1000 Hz signal and also represents an excellent figure for quarter-track heads.

Fig. 4 (right). Frequency-response curves of the Viking Studio-96/RP-120 tape recorder system.



Flutter and wow measurements came up with figures that exceed the manufacturer's specifications. At 7½ ips, flutter was 0.08 per cent; at 3¾ ips, it was 0.2 per cent.

Separation at 1000 Hz was in excess of the signal-to-noise ratio. At 10,000 Hz the channels were still 46 dB apart. At the extreme of 20,000 Hz separation was a highly satisfactory -41 dB.

Finally, we checked the fast forward and rewind speeds. 1800 feet on a 7-inch reel took 1 minute 28 seconds. A bit slower than we expected but certainly satisfactory.

At \$598.95 for the Studio 96 and \$399.00 for the RP 120, much is to be expected from this system. What the specifications fail to tell, and our physical examination did, is that these units are built to last. One of the prime demands of a professional piece of gear is a long-term reliability. This is something that is difficult indeed to test in the laboratory. However, we can see the quality of componentry used. Good solenoids and relays are expensive. But to the professional that expense is an economy since down time is lost money. These Viking units show every evidence to the effect that down time will be a rarity. Further, the units are readily serviceable. Add, to this the fact that our ears fully agree with that which our instruments have found. The net result is a pair of units that have every right to that much abused word "professional."

Circle 200

MATTES SSP-200 AMPLIFIER

Listening to premium amplifiers these days is rather the same as sampling several different vintage wines from the same province. There may well be subtle differences in flavor and bouquet—but the acknowledgement of greatness is there. So is it with this amplifier. We do not subscribe to the concept that all good amplifiers sound alike. None of them is yet perfect, and imperfection is all too audible. Still, the really good product, as with the great wine, offers immense satisfaction.

This Mattes amplifier is a first product for a new company. If it is a portend of things to come, we await them with eagerness. Certainly, this amplifier sounds as good as any we have heard. Maybe even better.

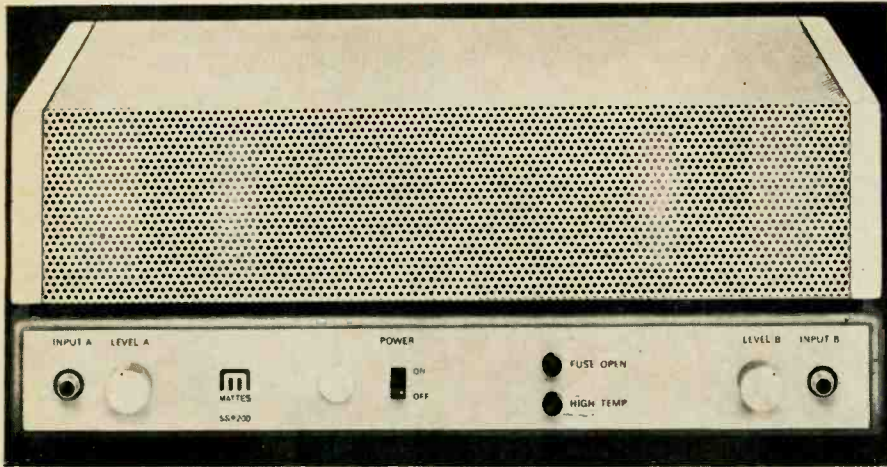


Fig. 5. Mattes SSP-200 amplifier, a solid-state model with an output of 100 w/chan.

There are many innovations here. For one, this is the first quality amplifier we know of that will deliver an honest 100 watts of distortion-free sound per channel. Second, it is an all-solid-state product and the first one, again that we know of, that would seem to be completely fail-safe against the usual transistor hazards. Is there another amplifier that will allow you to place a screwdriver across the output terminals, leave it there for a few minutes, all while the amplifier is being driven to overload (115 watts) at 20,000 Hz and suffer no ill effect at all!!!! This one will.

The basic circuitry of this amplifier is based on principles not in general hi-fi use. There is *no* bias on the output transistors. Latching diodes are used for controlled isolation of the power stage from the driver. Study of the schematic will reveal many other interesting features (For a full discussion of the Mattes amplifier, the reader is referred to the Journal of the Audio Engineering Society for July, 1965.)

We must confess to having had considerable scepticism regarding the need for 100 watts of power per channel. After all, average home levels rarely exceed 1 or 2 watts RMS. A ten or even twenty times distortion-free peak factor is more than adequate to handle the dynamics that are possible from recordings. So it would seem that there should be no *power* sound difference between this amplifier and a good 30-watts-per-channel that we have used with our medium efficiency speakers.

There is a *large* sound difference. There seems to be no end at all to the power limits available from this product. We had begun to develop fear for the safety of our speakers, yet the Mattes pushed on as if it were merely loafing. (It was.)

This is a low-distortion amplifier. The *worst* IM figure, the downfall of many solid-state amps, was 0.3 per cent. This was at about half a watt. At other levels right up to full output IM was under 0.1 per cent. 1000 Hz THD too, was very low at all power levels including maximum. At 20,000 Hz, waveforms were well nigh perfect up to within 1 db of maximum power.

Over-all 1-watt frequency response is +0, -2 dB from 12 to 40,000 Hz. Full-power response was +0, -2 dB 10 to

22,000 Hz. Square-wave observations bore this out. There also was no visible overshoot. At 1000 Hz, a square wave was completely flat-topped. 20,000 Hz showed smooth rounding off and 50 Hz showed a straight tilt of 30 deg.

When we first hooked up the amplifier we were distressed to hear a fair amount of hum in our speakers. Then we realized that it was *preamp* hum (and our preamp has *very* low hum). It only takes 0.9 volts to drive the Mattes to full output. So, even a few millivolts of hum became audible. However, Mattes has provided input pots to the first stage. We were able to turn these down to the point where the hum was squelched but there still was plenty of gain. The amplifier itself had total noise 92 db below 100 watts.

All measurements were made at 8 ohms. As with all amplifiers using transistors, the load presented can have a profound effect on available power. Thus, the SSP-200 will deliver 121 watts into 4 ohms and 56 watts into 16. So, no one is likely to feel a lack of power.

The rear panel contains a three-way switch. Normal play is in the 8-16-ohm position. If 4-ohm speakers are used, the equivalent position should be employed. When the amplifier is first installed, the high power capabilities need controlling lest a connection transient blow out a speaker. So, Mattes has provided a third position. Labelled *TEST*, it limits maximum power to a safe 12 watts.

Output connections are via three-way terminals. Dual General-type plugs, banana plugs, spade lugs or just plain wire ends are all accommodated. Input is by standard phono jack. Mattes has conveniently given us parallel sets of inputs—one set on the front panel, one on the back.

The front panel also contains two lights. One comes on if the main fuse should blow. The other comes on, if in the event of a long-term short, the output stage overheats, temporarily shutting itself off. We tested the fuse light by pulling the fuse. The other light, however, never went on for us. Not that it didn't work. Rather, we gave up trying to overheat the transistors after about two minutes with a full power short.

It all comes down, in the end, to sound.

This Mattes hurtles itself to the top-of-the-heap category at once. It is an amplifier with which we could live indefinitely. That is saying a lot, and it says enough. The price is \$375.00 Circle 201

WHITECREST BOOKSHELF SPEAKER SYSTEM, MODEL W-2

One the most difficult items to profile is the bookshelf speaker. With the exception of the most elaborate models—that is, the 3- and 4-way systems—they are much of a sameness. With no practical way to evaluate loudspeakers objectively, particularly with respect to the potential owners' acoustical environments, it becomes almost subjective, which brings the reviewer's personal preferences into the picture. Most of us who are charged with the responsibility of reviewing speakers will have, assuming we have been "in the business" for a number of years, accumulated for our own system a speaker which we must consider well nigh perfect. If we didn't, we'd undoubtedly upgrade it to something we considered better.

With all of this in mind, it must be admitted that the Whitecrest W-2 came somewhat as a surprise. In the first place, it was completely free from the usual mid-range deficiency which is so common in small enclosures, it had a smooth high end, and reasonably adequate bass. The mid-range deficiency is apparently acceptable to most ears, particularly in small rooms, (since so many are sold), and this is probably due to the apparent reinforcement of the mid-range by typical reverberation characteristics of the "average" living room—say, 10 x 12 ft. However, in rooms of larger dimensions—and they are becoming more common every year—the mid-range hole is noticeable. The Whitecrest W-2 seems quite smooth and well balanced, extending down to around 50 Hz at the bottom, and quite audible at 14,000 Hz, above which we don't hear much from *any* speaker.

Measuring only 12 in. wide by 18 in. high and 9½ in. deep, the W-2 is relatively compact. Its components include an 8-in. extended-range bass/mid-range cone and

(Continued on page 69)

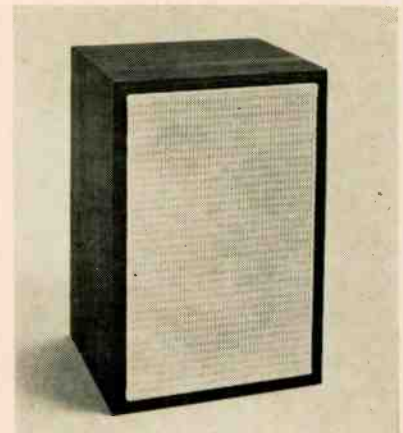


Fig. 5. Whitecrest Model W-2 Bookshelf speaker system.

PRETTY
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Model 641

NEW ELECTRO-VOICE HEAVY DUTY DYNAMIC MICROPHONES

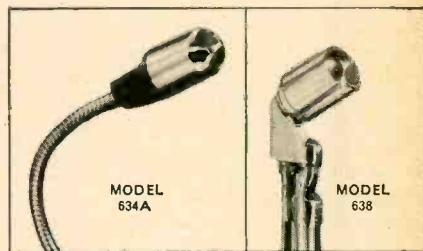
(E.V.) Now! Three exciting new answers to your most demanding microphone needs: The Electro-Voice Model 634A, 638, and 641 dynamic microphones. Handsome new style, wedded to rugged, dependable performance. They look good anywhere...sound great everywhere.

Specify the Model 638 or 641 for floor or desk stand use in school sound systems, tape recording, or industrial application. Or choose the Model 634A for custom mounting on boom or gooseneck in language laboratories, paging systems, or wherever semi-permanent mounting is required.

All models feature a precision dynamic element with the remarkable E-V Acoustalloy® diaphragm for smooth, peak-free response and unparalleled reliability despite shock, moisture, or heat. The generous diaphragm diameter plus a high-energy magnetic structure offers excellent sensitivity for every application.

This precision element is carefully "packaged" in a high-density die casting, finished in satin-chromium to stay attractive for years despite daily abuse. Models 634A and 641 also utilize modern, unbreakable "Cyclac" plastic for added utility and beauty. On-off switch on Model 641. Choice of Hi-Z or balanced Low-Z for all models.

In every way these fresh dynamics set new standards of appearance and performance...yet the price is surprisingly low! The difference is in advanced engineering plus the most modern and efficient production facilities in the industry. Put these hard-working new beauties to work for you, today!



SPECIFICATIONS: Omni-directional. Response 70-10,000 cps. Sensitivity: -57 db. Specify Hi-Z or balanced 150 ohms. 16-foot cable (6-foot, Model 634A). 5/8" -27 mounting thread. List price: Model 634A, \$30.00; Model 638, \$33.50; Model 641, \$35.00 (Normal trade discounts apply).

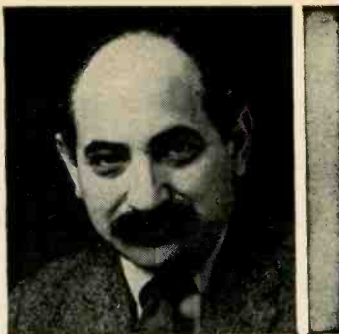
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JAZZ and all that

Bertram Stanleigh



S EVEN RECORDS from a new label—ESP—are the occasion for taking special note of this entrant into that small group of independent record firms that devote their output to the very latest developments in jazz. As a matter of fact, even the term “jazz” is a bit too old hat for ESP; they prefer to call their output simply “the new music.” Whatever you call it, you’ll have to concede that the young men represented on these new recordings have a lot to say, an abundance of enthusiasm, and all the technique necessary to put their ideas across. The results are always interesting, frequently stimulating, but some of the aspects of their first productions are a bit amateurish and the length of some of the musical material has been stretched out beyond the limits justified by its creative elements. Don’t however, overlook these platters because they aren’t representative of the ultimate in highly-polished sophistication. Their major merit is in the very lack of the sort of high lustre that comes with repeating the same tired ideas over and over again. ESP has a host of young musicians with new ideas, and the very real impact of these records is in the direct simplicity with which they make their points.

It’s clear from the packaging as well as the music that ESP is trying hard to do something absolutely new and different. To this end they have experimented with a number of graphic techniques not commonly found on disc jackets and have made innovations in label design and pressing material. They have also had the courage to dispense with the conventional pseudo-scholarly blather that is generally carried on the liners of serious jazz discs.

If the reviews that follow pose reservations about one or another aspect of these new releases, please bear in mind that these are simply matters of detail. The broad effect of these recordings is imposing, and it is clear that ESP has launched an ambitious program that aspires to the most creative jazz standards. These are not easy discs to listen to. They aren’t agreeable background music; they’re not always even agreeable foreground music, but they do have a lot to say. Not many new records can make that claim.

Albert Ayler Trio: Spiritual Unity

ESP mono 1002

Albert Ayler, sax, Gary Peacock, bass, and Sunny Murray, drums, are heard in four improvisations. Two of these are sets of variations on a rather romantic, folksy theme by Ayler called *Ghosts*. The other two numbers are also Ayler compositions:

The Wizard and Spirits. For all the supernatural sound of the titles, there is nothing of an eerie or mystical sound to these pieces. Everything moves along at a lively clip with Albert Ayler’s upper register carrying most of the weight. Peacock’s bass has not been recorded with the prominence it deserves, and more’s the pity because the present platter offers some of the most moving, introspective performances by this former Miles Davis collaborator. Sunny Murray’s contribution is notable for some particularly stylish cymbal work.

Albert Ayler Quintet: Bells

ESP stereo 1010

The physical appearance of this disc is almost as deserving of attention as its contents. Pressed on clear, colorless vinyl, it bears no labels but has the title motif of the record jacket imprinted in cherry red on the back of the clear plastic record. The jacket has the same design silk-screen printed in bright yellow on a matte-black background. The recording, made at a May 1, 1965, Town Hall concert, features Albert Ayler and Charles Tyler on sax, Donald Ayler, trumpet, Lewis Worrell, bass, and Sunny Murray, drums. The title number comprises the entire contents of the disc; it’s an alternation of violent, cacophonous riffs with a round-like theme imitative of bells and rather like a medieval folk song, sort of a cross between *Frère Jacques* and *Sur le Pont D’Avignon*. Stereo balance and low-frequency response both suffer due to the live concert recording, but none of the intruding noises that often disturb concert recordings is present. A word of warning—this is a one-sided record; anyone who tries to play the flip side may damage his stylus.

Pharaoh Sanders Quintet: Pharaoh

ESP stereo 1003

Two side-long compositions by Pharaoh Sanders, *Seven by Seven* and *Bethera*, are given attractive performances by an extremely agile, well-balanced group consisting of Sanders, sax, Stan Foster, trumpet, Jane Getz, piano, William Bennett, bass, and Marvin Pattillo, drums. The pace is a briskly swinging one that slows down for a long solo by Bennett on *Bethera*. Sanders, Foster, and Miss Getz work tightly together, never allowing the pace to flag or the ideas to grow stale. The recording by Jerry Newman is well spread out and even in balance. More discs by the same performers, recorded with the same natural clarity, would be most welcome.

New York Art Quartet

ESP stereo 1004

The outspoken and talented poet-playwright, LeRoi Jones, is heard in a recitation of his *Black Dada Nihilismus*, a characteristically bitter, white-hating message read to the accompaniment of Lewis Worrell, bass, and Milford Graves, drums. The balance of the quartet, Roswell Rudd, trombone, and John Tchicai, sax, join in at the end of the reading in Rudd’s rather wailing number called *Sweet*. Similar wailings in *Short* are relieved by an extended bowed-bass solo with rim-shot accompaniment. A considerably more extrovert attitude is expressed on side B in Rudd’s *Rosmosis* and Tchicai’s *No. 6*, both of which give Milford Graves opportunity for percussion solos that are worthy of note.

Paul Bley Quintet: Barrage

ESP stereo 1008

Paul Bley, piano, Marshall Allen, alto, Dewey Johnson, trumpet, Eddie Gomez, bass, and Milford Graves, drums, are heard in six compositions by Carla Bley. Graves imaginative percussion is the chief distinction on a platter that demonstrates lots of nimble playing but is somewhat short of ideas. Credit is given on the cover to Alfred Wade, Jr., for special engineering on the title tune, *Barrage*, but aside from one brief second near the start of that number when the music is displaced by a sound that resembles a skidding locomotive, I was unable to detect any unusual effects.

Bob James Trio: Explosions

ESP stereo 1009

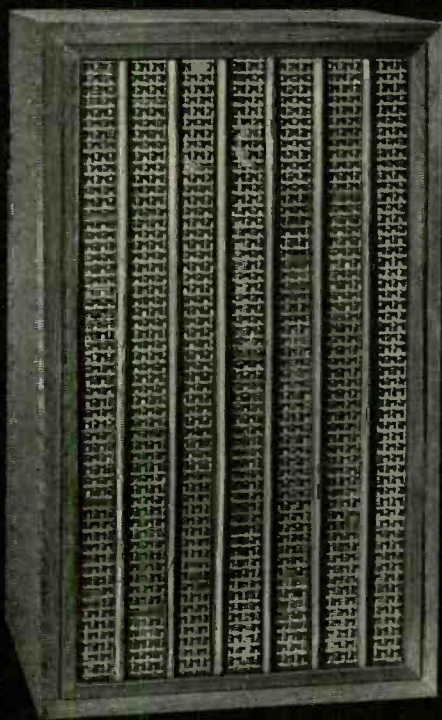
Bob James, piano, Barre Phillips, bass, and Robert Pozar, drums, are heard in a group of compositions that make use of a number of technical effects that include taped sounds on one or another channel and directional shifts in the source of sound. Both the musical ideas and the directional devices make for interesting listening. However, the electronic sounds are all of a conventional variety that have been rather extensively exploited by electronic composers. If they had been more closely related to the rhythmic pattern of the music played by the performers, they might have been a worthwhile element within the compositions. As it is, they sound like outer-space intrusions.

Ron Blake Plays Solo Piano

ESP mono 1011

A solo performance by a jazz pianist without bass and drum accompaniment is rather a novelty these days, but when the pianist has the full tone that Ron Blake manages to coax from a keyboard, no rhythm background is required. Indeed, it would be almost impossible for assisting musicians to keep pace with Blake’s constantly shifting tempos. Each of the ten numbers in this fascinating recital is imbued with a tonal and rhythmic variety that makes it a complete expression. At the same time, the grouping of works has been planned so that they make a unified statement as a suite. The recorded sound does full justice to the superb timbre that Blake draws from his instrument. It compares favorably with the best stereo recordings of solo piano. Æ

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Circle 128 on Reader Service Card

NEW PRODUCTS

● **Compact Music System.** Handsome is the appropriate word for the new Harman-Kardon SC-440 system. In the main cabinet are to be found a sensitive AM and FM (mono and stereo) tuner, master control amplifier, and automatic record player. The two other cabinets contain the speakers — each a two-way acoustic-suspension-woofer system. The turntable is a four-speed automatic by



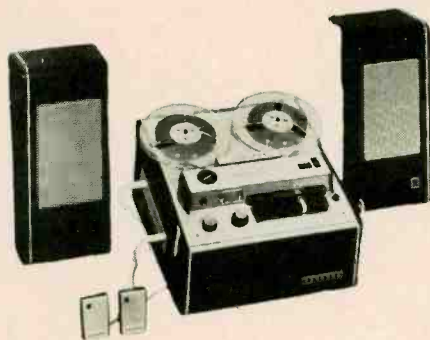
Garrard fitted with a high-compliance magnetic cartridge. The amplifier/control center offers 36 watts of IHF power output. The tuners offer sensitivities of 2.9 μ V IHF on FM and 50 μ V/meter on the AM band. The speakers each contain a 10-inch woofer and a 3 $\frac{1}{2}$ -inch curvilinear ultra-wide-dispersion tweeter. List price of the system is \$399.00. The tuner/amplifier portion alone (sans enclosure) is the model SR-400 at \$289.00. **Circle 210**

● **All Solid-State FM Receiver.** Moderate cost and all transistor design are combined to make the new Fisher 440-T a major rival to that manufacturer's popular tube-type 500-C. Many innovations are to be found on this receiver. The FM front end has a four-gang design that promises low distortion and excellent overload characteristics. All controls are logically grouped on the front panel and include separate program and mode selector controls. Automatic FM mono-stereo switching, an extremely versatile stereo control panel, time-division multiplex, and a silicon-powered stereo amplifier complete this unit's



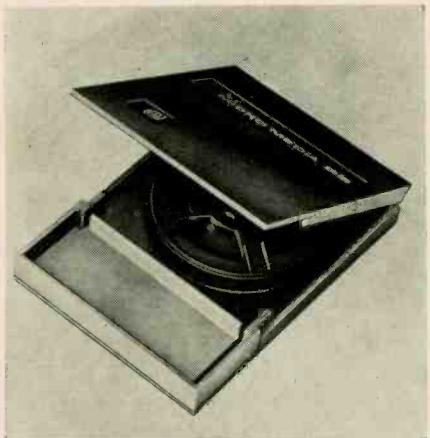
armaments. One unusual feature is the addition of TAPE L and TAPE R positions to the mode switch. This makes it possible for the user to listen to only a single track of a four-track tape, without manipulation of the tape recorder. Important specifications include: 2.0-microvolt sensitivity (IHF); 50 watts IHF into an 8-ohm load; harmonic distortion at 1000 Hz and full-rated output is 0.8 per cent; over-all frequency response is 20-20,000 Hz \pm 1.5 dB. Amplifier response alone is 18-25,000 Hz \pm 0, -2 dB. The 440-T is only 16 $\frac{3}{4}$ in. wide, 5 $\frac{1}{2}$ in. high and 11 in. deep. Weight is 21 pounds. List price: \$330.00. **Circle 211.**

● **Versatile Push-Button Tape Recorder.** Following the trend to all-transistor design, the new Concord Model 555 offers a host of practical features at a modest price. The dress plate is heavy stainless steel. Separate extension speaker systems in the split lid provide stereo separation adjustable to the listener's tastes. Built-in sound-with-sound permits dual-track recordings of separate sound sources for simultaneous playback. There is also facility for multiple recording on the same track without erasing. Separate VU-type meters, record monitoring, automatic-record-equalization shift with speed change, a digital counter and two dynamic microphones



are among the features that point this recorder directly at the serious hobbyist. Three speeds are provided: 7 $\frac{1}{2}$, 3 $\frac{3}{4}$, 1 $\frac{7}{8}$ ips. Total wow and flutter is less than 0.2 per cent; total power output is 10 watts. Frequency response at maximum speed is 30-20,000 Hz \pm 2 dB. THD is quoted as 2 per cent at 3 dB below rated output. Finally, signal-to-noise is claimed as better than 50 dB per channel. Dimensions are 11 $\frac{1}{2}$ in. x 13 $\frac{3}{4}$ in. x 14 in. deep. Weight is 34 $\frac{1}{2}$ lbs. Selling price of the Model 555 is less than \$250. **Circle 212**

● **Super-Long-Play Tape.** Micro Media 25 is the name of a new ultra-thin audio tape being marketed by the Magnetic Media Corporation. A $\frac{1}{4}$ -mil ten-silized polyester base combined with a high-density magnetic coating makes



possible playing times longer than heretofore possible. A standard 3 $\frac{3}{4}$ -inch reel will hold up to 1200 feet of this new tape. Packaging of this reel is in a molded plastic container complete with a recording time chart and product warranty. **Circle 213**

● **Earphone Control Unit.** Lafayette Radio has just released a remote stereo headphone control unit. Designated as the "Stereo-Trol," this unit enables the user to control accurately the amount of channel separation thus making earphone listening as enjoyable as speaker stereo listening. Separate controls affect



volume, balance, and "dimensional stereo" mixing of each channel. There is also a speaker on-off switch. Two sets of low-impedance earphones may be inserted into the front panel jacks. The unit is mounted in an oiled-walnut finished cabinet and sells for \$24.95. The stock number is 99-1041. **Circle 214**

● **Special Feature Magnetic Tape.** Ferro-dynamics Corporation has announced improvements in the performance and characteristics of their FerroTape line. Available in lengths of 300 to 2400 feet, 1.5-mil and 1.0-mil acetate; 1.5-mil, 1.0- and 0.5 mil Mylar®; these tapes have now been fitted with special leaders.



Each reel now contains a front and rear leader that has head cleaning properties.

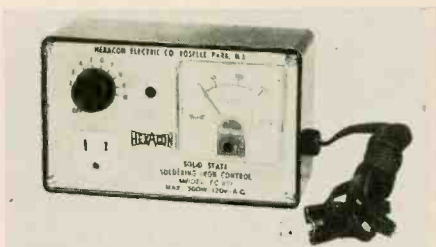
In addition, each reel has front and back reversing/stop tabs for the new automatic bi-directional machines. Ferro-dynamics is also claiming improved quality and frequency response of their tapes due to important advances in formulation of the magnetic coating. **Circle 215**

● **Tape Accessory Kit.** The TAK-100 is a new package from American Recording Tape that contains the following: A 1500-foot reel of American tape; a recorded tape featuring musical hits by big-name artists; a heavy-duty take-up reel; a 350-foot Mail-A-Tape in a handy self-mailing



container; a head-cleaning kit including liquid, applicators, and brush; a professional tape splicer; pre-cut splicing strips of Mylar; a reel of leader tape; and a 16-page book of care and usage of tape recorders. List price of the kit is \$17.95. **Circle 216**

● **Soldering Iron Heat Control.** An all-solid-state heat control system for soldering irons has been released by the Hexacon Electric Company. Controlled a.c. input is provided for voltages from 0 to 95 per cent of line voltage. The package is compact and features built-in fuse protection and a three-wire grounded receptacle. The nominal position mark-



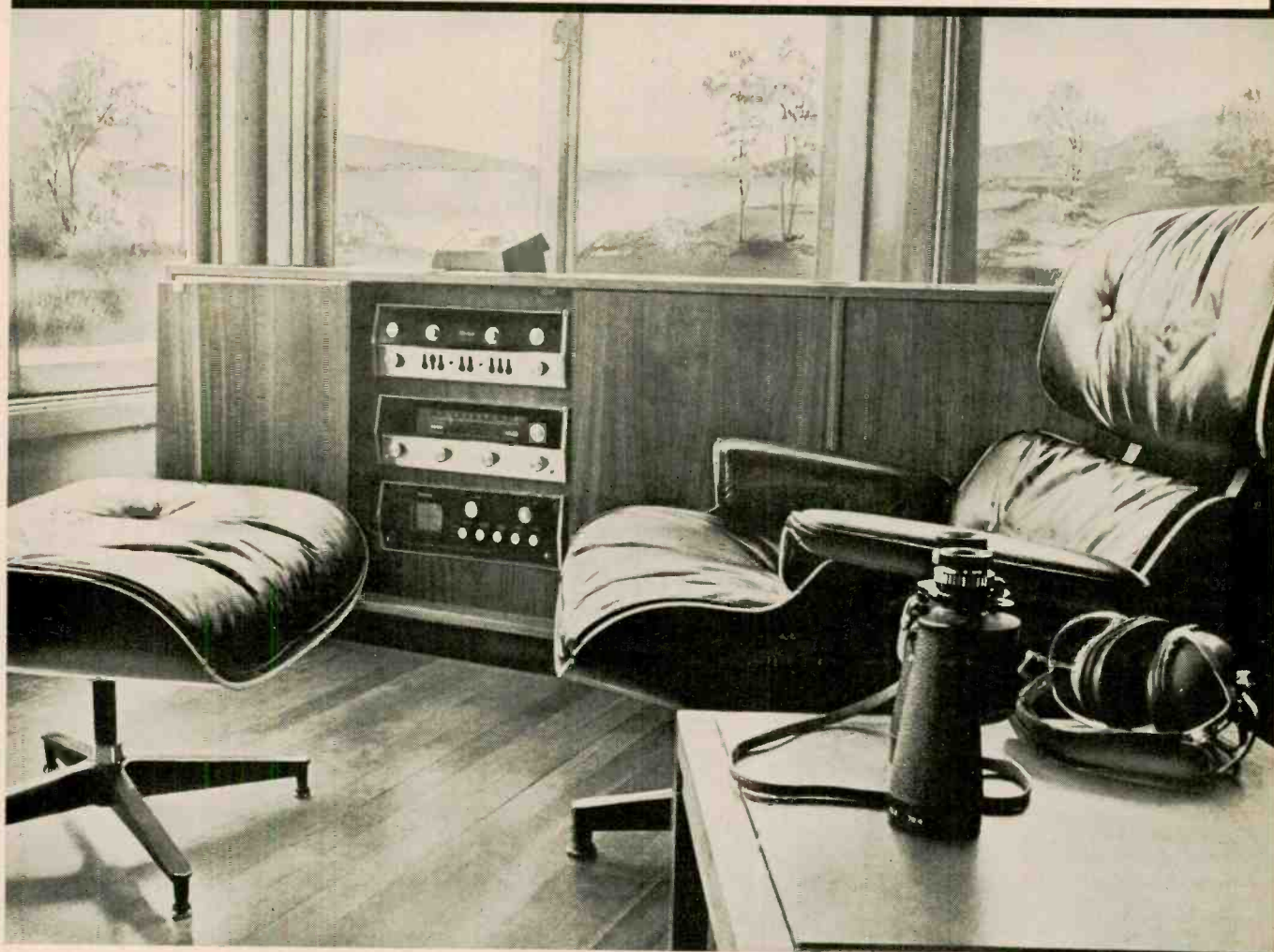
ings of the control knob may be marked with calibrated settings for both idling current and thermal working zones as required by government specification. In this way, one iron may be used for a wide variety of jobs, each requiring its own thermal conditions. **Circle 217**

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SUPERLATIVE SOUND



FM-3 Stereomatic Tuner—\$99.95 Kit; \$154.95 Assembled.

"High Fidelity" cannot be defined numerically. Good music reproduction depends too much on little known and difficult to specify relationships between physical laws and auditory pleasure.

Those factors which determine the quality of the reproduced sound are rarely described in the specifications because they are too difficult to quantify. The stability of an amplifier under varying speaker loads; transient and overload performance; the proportions of higher order distortion components in what is already vanishingly low total distortion; lowest phase shift through all stages including tone control networks: these are some of the crucial design aspects of vital concern to the Dynakit engineer. The results of designing for such subtle characteristics are evident in the repeated demonstrations of Live vs Recorded comparisons where thousands of critical listeners have found it difficult to distinguish the real musicians from the reproduction of their music through Dynakit amplifiers and preamplifiers.

Make one of these listening tests yourself with a Dynatuner. While differences between the best amps and preamps are not as easily detected by the casual listener, tuner differences stand out in typical home use tests. The Dynatuner has been universally recognized as providing notably superior FM and Multiplex stereo reception to tuners which cost far more, and which advertise much fancier specs. WHY?

The answer in part is lower distortion on very weak and very strong signals; exceptional ability to reject the effects of multipath, ignition and other interference; superior AM rejection; near-perfect volume sensitivity; vastly superior acceptance of over-modulation; stereo sensitivity within 3 db of mono specification; and unexcelled ability to maintain separation with even the weakest stereo signals. Most important, though, is its minimum phase shift design which delivers lower distortion reception of normal signals, too, and makes possible accurate home alignment of all stages to preserve peak performance—a Dynatuner exclusive.

Prove it for yourself at your nearest Dynakit dealer's showroom, and take advantage of the Dynatuner's newly lowered prices—a bigger bargain than ever before.

Write for descriptive literature and complete specifications.

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SOUND AND SIGHT

(from page 48)

graph, and as such should be of interest to anyone in the video tape or motion picture field.

For the next step in the invention of motion pictures we must travel 5000 miles to Polish Lissa, there Ottomar Anschutz, a professional photographer, was working on a similar problem, employing an entirely different approach. His apparatus was completely described in Eder's *Yearbook of Photography* for 1888, and employed the vertical disc referred to by Dickson. Edison's natural curiosity and tremendous interest led him to build a similar device. Perhaps it would provide a clue!

The device, the Electrotachyscope, as it was called by Anschutz, employed glass diapositives arranged at the outer edge of a circle on a steel disc which rotated. The disc was supplied with a number of contact pins, so arranged as to project under the center of each picture. At the rear of the disc was a Geissler tube connected to the secondary of a transformer. The projecting contact pins were connected to the primary. When the picture was centered in the peep hole for viewing, the pins closed the circuit providing a momentary flash of light which enabled the observer to see the picture.

The device worked—it provided a better picture than Edison had obtained—but only for a few seconds. Edison's goal was pictures which could accompany his sound cylinders, each of the cylinders recording sound and sight for the same length of time. Anschutz's crude device, however, did provide some important clues. (Anschutz in his later models (1890) was also to reach the same conclusion for they too employed a cylinder instead of a disc.)

Edison returned to the cylinder once again. He had a larger photographic cylinder built as illustrated. The images were photographed on an emulsion coated plaster sleeve. For viewing, however, the images were illuminated this time by the intermittent light from a Geissler tube.

A substantial improvement resulted—the eye saw the image only when it was centered in the peep hole and illuminated by the Geissler flash. The forward motion of the cylinder to the next image was concealed by darkness. As soon as the following image appeared at the center of the peep hole it was again illuminated by the Geissler flash and could be seen.

The photographic images, while far from perfect, were now sufficiently clear for more detailed analysis. It was evidently discovered that all blurring of the images was in a vertical direction only, as they would be if a still camera were jerked downward at the moment of exposure. It then became obvious that this blurring was due to the rapid continuous movement of the photographic cylinder while recording the images.

The solution was simple! The motion of the cylinder must be arrested momentar-

ily at the time of exposure. We know today that the film must be made to pause briefly at each exposure for a sufficient length of time to permit it to receive and record the image, Edison obtained still another clue from Anschutz's device—persistence of vision would compensate for the intermittent motion and provide the illusion of continuous motion.

Still another model of the camera was built. We are able to describe it in detail from Edison's notice to the patent office: "The invention consists in photographing continuously a series of pictures occurring at intervals, which intervals are greater than eight per second, and photographing these series of pictures in a continuous spiral on a cylinder or plate in the same manner as sound is recorded on the phonograph. At the instant the chemical action on the cylinder takes place the cylinder is at rest and is only advanced in rotation a single step. This motion takes place while the light is cut off by a shutter. Thus, there is practically continuous rotation of the cylinder but it takes place step-by-step and at such times no photographic effect takes place." This was the most successful model built thus far. Edison was evidently sufficiently satisfied to write on October 8, 1888, his Caveat 110 which was sent to his patent attorney on October 17 with a notation on the margin to "rush this" for he was getting "good results."

It was probably at this point, after Edison had discovered that intermittent motion was required to record and view images, and that it was incompatible with the continuous motion required for recording the sound, that he decided to concentrate for the time being on the moving picture aspect and return to the sound aspect after he had perfected the pictures.

We will continue the historical reconstruction of Edison's motion picture experiments next month. Æ

AUDIOCLINIC

(from page 4)

which I might like very well except for one or two pieces of equipment. You can see the various combinations of likes and dislikes which can develop between you and your friends, relations, and so-called experts.

The main thing to consider is that if you are selecting the system, you are the one who must live with that system.

There are various considerations which dictate a choice in equipment. There is the matter of the features contained in the equipment. Some equipment contains features which you may well decide that you will never use. On the other hand, someone else might want this very same piece of equipment because of the features it contains. The performance of the equipment must be good, both as it appears in brochures and as it sounds to you. All of this must be balanced against the space available for the equipment and against the money available. Æ

TRANSISTORLESS SOUND



SCA-35 Amplifier—\$99.95 Kit; \$139.95 Assembled.

Yes, we mean it! No Dynakit uses transistors. Further, they do not sound as if they have transistors, nor do they have any other characteristic sound—not if we can help it. Our philosophy has always been that Dynakit equipment should not have distortion of any kind, limitations of bandwidth, noise, or any other effects which can intrude on the accurate reproduction of the original. Further, it should be rugged and reliable, good for many years of trouble-free service. Last, it should be of fair value with superior quality at the lowest possible cost.

Right now, we can adhere to this philosophy best with tube equipment: PAS-3's, Stereo 70's, SCA-35's and Dynatuners which have been installed in more home music systems, laboratories and test facilities than any other similar components, and which have won the respect and praise of countless reviewers, hobbyists and consumer testing organizations.

Present tube designs have been refined through decades of steady progress, while audio transistorization is still in the guinea pig stage. Dynaco is fully aware of the potential capabilities of properly designed solid state components, and we have been working for several years with transistorized hi fi products. Dynaco will offer solid state components when we are convinced that transistors are equivalent to our current tube designs in both absolute performance and relative value, or when they are superior to tubes in either of these respects. We value our customers, not as guinea pigs for field testing experimental circuits, but as our best advertising medium for our proven designs.

Current technology indicates that solid state components are steadily improving in reliability, quality and economy. In such units as portable radios and tape recorders, their advantages are manifest. Further progress will undoubtedly make them suitable for critical high fidelity applications, particularly as transistor uniformity and reliability improves.

Comparison of sound quality, specifications and price will prove that Dynakits offer the most logical choice of any components—regardless of whether they are designed around transistors or tubes. It is the end result which counts, not the novelty of the ingredients.

Write for descriptive literature and complete specifications.

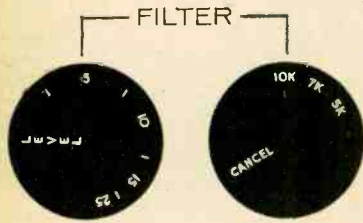
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AUDIO, ETC.

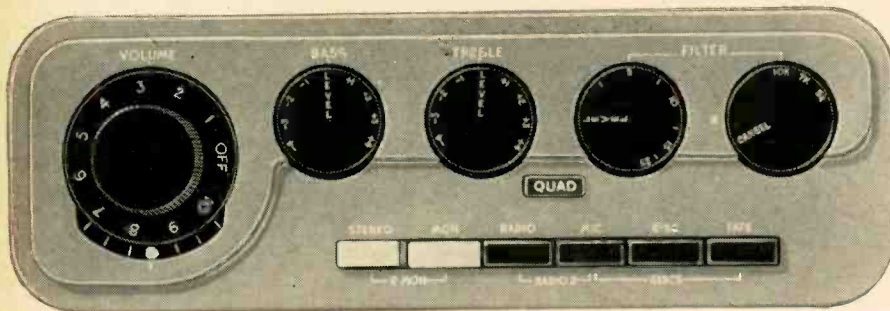
(from page 14)



More of the music and less of the distortion!

The processing and production of discs produces a waveform in which distortion rises extremely rapidly as the upper frequency limit is approached. To obtain the best quality under such conditions the very high harmonics must be attenuated at a rate which is a function of the rate of rise of distortion.

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croops up again and again has to do with labor relations, which are often quite audible in the broadcast news. The word is *employee*—and just you guess how it must now be pronounced, if the air waves are right. Nope, you couldn't guess. It's *EM-PLO-eee*. Yep. Heard it a dozen times if I've aheard it onct.

Next thing you know, they'll have to get Management to adopt the vanishing Y too. Then we'll not only have the present em-PLO-ees but also the managerial em-PLO-ers. So far I haven't caught that one—but I will, don't you doubt it. The vanished Y.

In fact I heard Nos. 5 and 6 in a single sentence one day. Said the announcer, "just CON-sider the em-PLO-ees' budget." That rocked me back for fair.

7. Well, *ee-nuff* is *ee-nuff*, but I still have another category of audio English. That's the converted word. It's a word that is common enough in one form, say, as a noun, which gets converted into another, say, a verb.

Now this goes on all the time in our dynamic language; but on the air waves the principle gets a dizzy workout. We're long since used to such items as *the hi fi* (or *the stereo*), which are nouns made out of adjectives. Or *finalize*, a verb made out of an adjective. Or *normalcy*, still another noun out of an adjective. The editor here-about disapproves of convertible words made with *-wise*, like *business-wise* (*Ah show duz*. Ed.)—though there's a real oldy of that sort which Shakespeare probably invented—*sidewise*. The New Deal's pre-war alphabet soup and the postwar period's officialese, both descendants of something called gobbledegook, are as nothing to what is coming up now—but I'm giving way my story.

I give you two examples of currently convertible word forms, taken right off the air and free to every listener. The first has to do with the oldest advertising dodge in existence, the ultra familiar stall tactic, to introduce an ad. The old-fashioned forms are now standard English. "But first, etc." ("But first . . . a word from our sponsor," or even simpler, "Bomb blows up White House, Russians reach the moon, Vesuvius destroys Italy, typhoon Annie swamps Guam, details of these and other stories in JOHST WON MINNIT.")

My first convertible used for these introductions, is sort of anticlimactic. I heard it in connection with a staid, stuffy classical music program. It went like this. "We invite you to *momentarily* listen to Mozart's 'Haffner' Serenade . . ." (followed by a discreet commercial, for two minutes).

Now quite aside from splitting a beaut of an IN-finitive, I just don't see how you can listen "*momentarily*" to anything, much less listen while a commercial is playing! But let it pass. It's merely an adverb made out of a noun, *moment*—or an adverbial phrase, *just-one-minute*.

My other example derives from the com-

monest of all familiar terms of immediacy. When we were all kids, the cry, Hot dogs—COMING UP! was as common as kids camping. And every dog wagon had its version: "Two and one on rye over, COMING UP!" And up it came, and slid across the counter.

Radio, of course, couldn't leave this one alone. So in no time at all, the thing got turned into a bona fide adjective—*upcoming*. Made the whole thing sound much more serious. "The upcoming conference at Geneva, according to most *expeuht* opinion, is CON-sidered crucial for world *ee*-eventualities." But that wasn't enough. *Upcoming* is, after all, a present participle. That means it could be a verb. So why not *upcame*? Or *upcome*? I heard just that very verb, the other day. Like this:

"In just five minutes, the news upcomes—after the following message."

I almost upcame all over the floor.

Pepper MINT

P.S. NYC SPECIAL. Inhabitants of the Big City, Eastcoastwise, (*ouch*. Ed.) delight in their own special broadcast accents—unmistakeable once you catch on. Of course, our local announcers are highly professional and very polished and all that. But they give themselves away every time on just one syllable, always the same, the one that sounds like the green stuff you put in juleps and on roast lamb. MINT.

What happens in NYC is that all syllables of every sort ending with an N sound are given the MINT treatment. Everything from *-int* to *-ent* to *-ant* and even *-onn* and *-unt* come out sounding like so much peppermint. I give you a few phinetikilly spelled ixamples:

Gov-mint. Kin-siderible. Min-hattin. Kin-etti-kit. Apottmint. Pridicimint. Kin-sensis of opinyin. Depotmint of Gas & Ee-lectricity.

EE-nuff? Dicididly. And don't ever tell me that audio on the air isn't influinsing thee pure Americin spokin languidge. Uhpoddin me. I mean in-FLU-insing. Almost forgot that one. Æ

TAPE GUIDE

(from page 50)

storage in any particular type of can will solve this problem.

There seems no harm in asking the recording company to replace your tape free of charge, but I have no way of knowing how the company will respond. I think you should first conscientiously ask yourself whether the fault was yours owing to the manner in which you stored the tape (perhaps in a very hot attic, above a radiator, in the trunk of an automobile on a hot day or the like).

Response Change

Q. My problem, in simplest terms, is a loss of high-frequency response and an apparent increase in bass response. Recorded tapes do not exhibit this trouble; only my own recordings do. The tape heads are cleaned regularly, and since the tape machine is less than six months old,

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The NEW — THORENS TD-150AB Integrated Turntable. You pay no more for Thorens Traditional quality. Features galore: COMPLETELY SILENT OPERATION . . . two speeds, (33½ and 45 rpm). An integrated tone arm that incorporates the latest safety lowering device with hydraulic damping action. An extra-light, low-mass aluminum plug-in shell with *exclusive adjustable vertical tracking angle* . . . *An Industry First!* A handsome slim-line chassis. A unified suspension of turntable platter and tone arm. Speed regularity better than ±0.1%. Tracking Error below 0.2% c m radius. A low speed double synchronous motor (375 rpm) drive system. Only \$99.50. You receive everything you ever wanted in an integrated Transcription Turntable, especially Thorens quality.



TD-150 AB

The THORENS TD-124 HAS CHANGED! We've changed the color . . . we've changed the knobs . . . we've changed the motor mounts and, by popular demand, a non-ferrous turntable. We didn't change another thing, not even the model number. NOT because we couldn't, simply because no other change would be an improvement. The TD-124 SERIES II *still* has more performance features, more built-in extras than any Transcription Turntable available today. Still \$125 less arm. See it at your dealer. (Illustrated with the Ortofon RMG-212 tone arm)



TD-124 SERIES II

Don't settle for less than the best when you're upgrading or starting a music system. Have the proud knowledge that you own the best . . . insist on a THORENS.



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head wear does not appear to be the cause.

A. Inasmuch as the treble loss occurs only in recording, it appears that the trouble may be due to one or both of the following: (1) Insufficient treble boost; this should be somewhere between 15 and 20 db at 15 kHz. (2) Excessive bias current supplied to the record head; the amount of current can be measured by inserting a 100-ohm resistor between the record head and ground, measuring voltage across the resistor, and computing current by Ohm's Law. Treble boost can be measured across the same resistor; but first disable the oscillator so that you will be reading only audio current and not bias current.

RECORDS

(from page 46)

ness Landowska (harpsichord) and Glenn Gould (piano). The music can take it. But there are other ways, too, of indicating the bigness of concept, in a more literally exact performance. Subtleties of tempo and registration, of pauses—but most of all, *awareness*.

I just don't hear it here. The "big moments" sound exactly like the (equally important) lesser moments. It's all the same, from beginning to end. For my ear, the thing is shapeless and slack, if technically excellent.

Too bad—for he plays so well, his harpsichord is such a lovely one, and Vox's Turnabout sound is so good.

Bach: The Six Sonatas for Violin and Harpsichord. Erick Friedman, vl., Bruce Prince-Joseph hps.

RCA Victor LSC 7033 stereo

Here is home-grown U.S. Baroque, with all its faults and virtues. Erick Friedman "has appeared with most of the major American orchestras—the Boston Symphony, the Chicago Symphony, The New York Philharmonic . . ." Exactly! How should he know, then, of the German-continental tradition in which these sonatas are played in a pure, self-effacing violin style, the fiddle blending into the keyboard sound as though it were almost an extra stop on the harpsichord? Even Yehudi Menuhin, in England, knows a bit about that (on Angel). Friedman attacks the violin parts with sincerity, in good Carnegie Hall concert style. His ear is good enough to prevent disaster, but some of his emotional lungings and slidings will make Bach lovers cringe.

RCA—next time you try this, why not present your soloist with a pile of rival recordings and make him listen? He's under contract, after all, isn't he?

N. B. Bruce Prince-Joseph, of New York, is much too knowing an all-around keyboardist to play a poor harpsichord second here and much of his work is just fine. But he doesn't mix with Friedman—it's physically impossible—and so his own playing is sometimes loose-jointed, perhaps in unconscious protest. Who knows!

MISCELLANY

Lowell: Benito Cereno (from "The Old Glory"). American Place Theatre prod.

Columbia DOS 719 (2) stereo

Incomplete report here too—I played the first side of this and found it so unsympathetic that I listened no further. Sorry.

Like music festivals and live concerts, stage plays do not always adapt literally to the recorded medium, especially when they are highly charged emotionally, or are "controversial," with some special significance. What goes over splendidly in front of a sympathetic large audience sounds mawkish in the private living room.

That's part of the trouble here. The play, out of a novelette by Melville, is all about slavery and it is racially "hot." Fine—but art is art, even in the drama, and when the young sailor here began mouthing such meaningful speeches is "Aye, aye, Sir" and "Yes, Captain," as though they were passages from the bible I gave up. Didn't like the Captain either.

Again—why not try for yourself? There's a slave massacre, they say, before the thing ends.

My feeling is that the cause of racial equality is much too serious a thing to merit less than superb writing and acting, with depth and subtlety. Melodrama gets it nowhere.

Favorite Romantic Waltzes. Phila. Orch., Ormandy.

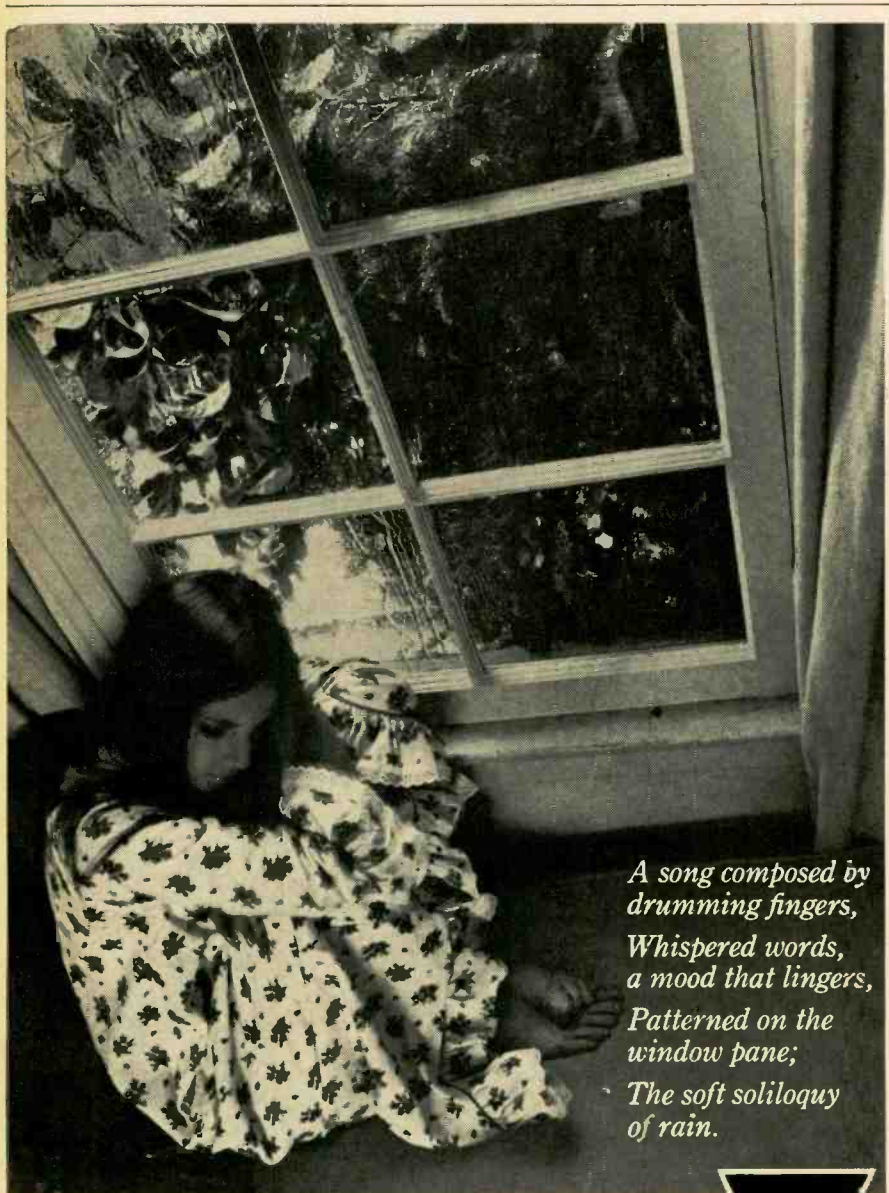
Columbia MS 6687 stereo

Music of the Strauss Family (Johann Jr., Josef). Eduard Strauss and his Orch.

Vox SVBX T600 (3) stereo

Here are two approaches to the Waltz. Columbia's is big, smooth, silky and avoids the Strausses entirely—the record runs to Chopin, Delibes, Tchaikovsky. Offenbach, all ultra-familiar works. This is listening waltz music, recorded by a huge concert-hall orchestra in a suave and rather distant fashion (speaking acoustically). Like most Ormandy music, it is utterly polished and glib, perfectly tailored and quite without profundity. Why not? It's that kind of music when detached from the ballets with which all of these pieces are associated. Fine background music.

As for the Strauss album, it is another of Vox's monumental efforts—three



*A song composed by
drumming fingers,
Whispered words,
a mood that lingers,
Patterned on the
window pane;
The soft soliloquy
of rain.*

Sounds that whisper, sounds that roar.

The quality of sound you hear from your high fidelity system depends on the sensitivity and efficiency of the loudspeakers and other component parts. Sometimes that quality lacks the full dimension of life. JBL components are meticulously crafted to work together as an organic unit, to express the widest spectrum of sound you can experience.

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whole LPs and a good booklet on 19th century Viennese life. Eduard Strauss is a descendant, fortunately a very musical one. The orchestra is fine, the style solid, the impact (with plenty of big bass) rather pronounced—much more positive than the Ormandy stuff, and rather better for foreground listening, or even dancing. No point wasting all this on discreet low-volume background listening!

Dylan. Alec Guinness, Kate Reid, etc. Pefer Glenville prod.

Columbia DOL 3013 mono
(also DOS 701 stereo)

As I always say—better late than never. In the normal course of recording there are many plays put down today and available for home listening; enough, of course, to keep a specialized drama reviewer busy 100 per cent of his time. So I finally tried this one on the spur of a moment. It knocked me for a loop. Terrific. Or so it hit me.

I once spent part of a day watching the original Dylan Thomas make recordings, out of a near-total drunk (on beer). He couldn't stand—but the instant the signal was given, he pulled himself up and recited flawlessly in that famous voice that, once heard, is not to be forgotten. Since then, of course, I've kept up with the Dylan Thomas legend as well as his many recordings.

This is a play, though. Not the real Thomas but Alec Guinness, substituting. I didn't think I could take it.

Instead, it turned out to be a wonderfully moving, easy-going, never overdone treatment, bringing out the full tragedy of this amazing man. And I never hope to hear a better, more subtly "staged" LP recorded production—even though my copy is mono.

If you want an evening that will leave you shaken out of yourself and aston-

ished at the power of the recorded word used wisely and dramatically, just try this.

O'Neill: *Strange Interlude*. Quintero prod.

Columbia DOL 288 (5) mono

This is *very* late—and only by proxy. It came out almost two years back—and I just couldn't face the size of it. I'm no O'Neill fan, anyhow. But a proxy has just listened and reported to me—he heard "all five hours" of it with his family, one of whom is conveniently an active invalid with time to burn. The verdict left me wondering whether maybe I wasn't right: "Like all the soap operas you ever heard, put together into one!" That's what they felt.

Well—'tis a great classic, or so they say. So if you don't like my report, go right ahead and try for yourself! Five very well-loaded LP's, ten full sides.

Debussy: *Pelléas et Mélisande*. Erna Spoorenberg, Camille Maurane, Geo. London, Guus Haekman, L'Orch. de la Suisse Romande, Ansermet.

London OAS 1379 (3) stereo

It isn't often I can take a whole evening to listen to one of London's many full-length stereo operas, what with so much folk and Baroque and what-not. On the rare occasions, I really revel. Debussy's "*Pelléas*" is an opera like no other ever written and it is particularly lovely in living room stereo, for much of it is an intimate, conversational sort of music that lends wings to the imagination and makes scenery and "action" almost superfluous. Especially if you can follow a bit of French—in the complete libretto, with English translation in parallel columns.

There are really only three personages that count in this atmospheric work—the tenor, *Pelléas*, the soprano,

Mélisande, and the older Golaud, *Pelléas*' half-brother. Plus, of course, the conductor. Here we have a first-rate conductor (and lovely recording of his orchestra) plus a *Pelléas* who is a splendid French-style tenor with diction so clear you can get everything, a fine tone and perfect musicianship. Golaud, the baritone, is marvelously well done by the American George London.

Only *Mélisande* is a bit strange. She is Dutch, and though her musicianship is good and her sincerity unquestioned, she does not have that peculiar French voice production that is so necessary for this strange, frail, mysteriously feminine nymph of the woods. Her frequent anguish is, in the Italian manner, often out of tune, her French diction is not as clear as it might be. She is not bad; and yet she is the one flaw in an otherwise lovely production of the Impressionist masterpiece.

Dvořák: *Serenade in E for Strings, Op. 22*
Mozart: *Divertimento in D, K. 136*. Princeton Chamber Orch., Harsanyi.

Decca DL 710109 stereo

The finest in European string-orchestra tradition, transplanted to Princeton, N. J., and Decca has grabbed it for one of those rare domestic-made recordings. It's a beautifully performed disc, too though the recorded sound itself is (by present standards) somewhat distant and undefined.

Two all-string pieces. The Dvořák *Serenade* is pure late-Romantic gold, a memorable and lovely work. The Mozart, neatly and humorously played here, is one of those whimsically perfect little entertainment works of the youthful Salzburg period. About 20 players in this group—just right for recording and just right for the music.

ACOUSTICAL REARGUARD



D-12

Range: 40-15,000 cps
Response: \pm 3db over entire range
Dimensions: 5 $\frac{1}{2}$ " x 2 $\frac{1}{4}$ " x 2 $\frac{3}{8}$ "
Data sheet available on request

Insensitive to sound reaching this dynamic microphone from the rear...An exceptionally pronounced cardioid pattern produces an acoustical shield of approximately 180° that effectively isolates unwanted sounds originating from noisy audiences, feed-back or reflection.

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C-60



Range: 30-18,000 cps (cardioid)
30-30,000 cps (omni-directional)
Response: \pm 2.5 db over entire range
Dimensions: $\frac{3}{4}$ " Dia. x 4"
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A high quality condenser microphone for music and speech. Its characteristics provide truest fidelity for reproduction and recording. The C-60's many uses and users attest to the unusual versatility of this microphone. Available with either cardioid or omni-directional capsule.

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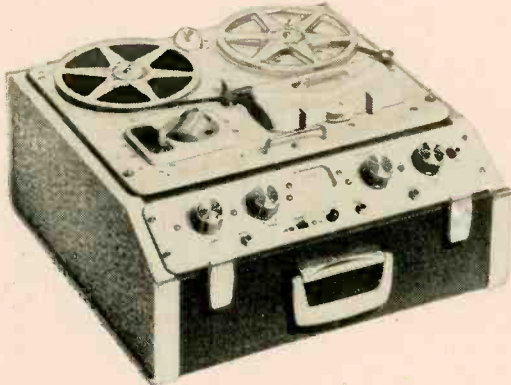
AUDIO VIDEO PRODUCTS

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Model 631 (Mono) \$468 | Model 634 (Stereo) \$597

If you want chromium trim, light weight, eye-catching colours and built-in obsolescence—if you read exciting specifications and pretend they are true—if you acquire a recorder solely to keep up with the Joneses—the Ferrograph is not for you.

Ferrograph tape recorders are built in a tradition of engineering that believes the weight of the instrument, within reason, to be of small moment—that you cannot have quality without amply designed components—that there is no easy way to achieve quality.

The Ferrograph is designed for the man who wants a tape recorder to perform as well some years hence as it does when first delivered to him. He is concerned with the pleasure—the enduring pleasure—a quality instrument adequately designed and well engineered will give him. He is a discerning character who is able to appreciate quality when he hears it, recognize engineering skill when he sees it—in a word, he is a connoisseur.

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NEW LITERATURE

● **Retail Catalog.** The annual Lafayette Radio Catalog is now available in its 1966 edition. As always, the book is free. This is volume No. 660 with 512 pages offering a comprehensive retail listing of stereo equipment, citizens band, tape recorders, ham gear, test equipment, auto accessories, radios, TV sets, cameras, optics, marine equipment, tools, electronics and other books—in fact, just about everything electronic for the home, industry, and laboratory. Specification and retail price listings are offered for most major manufacturers and, of course, Lafayette's own equipment. **Circle 220**

● **Wire/Cable Harness Systems.** A new four-page brochure describes the complete line of the Electrovert Company. Included in this publication are listings of cradleclip harnessing systems, strapping wire, and cable tying systems; Spirobond—a spiral wire-wrapping system; markers for all sizes of wire and cable; self-locking permanent-type harness, and grommet strip. Each of these systems is fully described and illustrated. Tables, catalog numbers, dimensions, physical and chemical properties, and suggested applications are also included. **Circle 221**

● **Packaged Sound Systems.** This is the Ampli-Vox Catalog No. B278. It describes five systems available that can solve a wide variety of sound-systems installation headaches. The five units are a sound-column lectern, a portable rostrum, an attache-cased portable PA system, an automobile paging and announcing system, and a compact 35-watt paging and background music system. The catalog describes these systems fully, along with a full line of accessories that increase the versatility and application of them. **Circle 222**

● **Component Speaker Listing.** A new color catalog from Jensen Manufacturing Division/The Muter Company describes the newest in their high-fidelity loudspeakers, headphones, speaker systems, and speaker-kits. Complete acoustical and dimensional specifications and prices are given. There is no charge for this 24-page booklet. **Circle 223**

● **Switch Catalog.** Engineers and purchasing agents are hereby alerted to release of the new Grayhill 24-page catalog. It contains complete technical data on several new series of ultra-miniature and miniature rotary switches and push-button switches. Also included is a handy rotary switch reference guide. This two-page spread lists all the technical parameters of these switches in tabular and readily comparable columns. Other products listed in this catalog include a new transistor socket, a pencil tube socket, bi-pin lamp socket, and thermosetting plastic module cases and headers. **Circle 224**

● **Audio Products Catalog.** A new sixteen page catalog from Sonotone Corporation outlines in detail that company's audio products. It includes items sold to distributor and OEM markets. Technical details and illustration of the Sonotone ceramic and crystal cartridges, replacement needles, tonearms, ceramic microphones, and learning-lab microphone units are provided, making this a valuable booklet for those engaged in the replacement service field. In addition the catalog lists the Sonotone line of loudspeakers and the new compact high-compliance speaker systems. All of the Sonotone products listed are factory-packed and fully guaranteed by Sonotone. **Circle 225**



LECTURE RECORDING

(from page 20)

are mixed together, introducing improvements on the right one and feeding the signals thus mixed onto another tape. Editing can be done directly through skillful use of pause and stop controls, and again, a cue sheet is essential. However, as two machines are involved, editing at this stage can be quite tricky. It can be done much more easily through cutting and splicing of the re-recorded tape.

In the actual dubbing the master tape is played back on a stereo machine. Level for the left channel (lecturer) is adjusted and generally left constant. The signal from the right channel (audience) is here given a second boost in gain (first one was in the actual recording) depending on the strength of the recorded signal. Again, a cue sheet is essential. This second channel, due to increases in gain and acoustical conditions, is affected by: 1) considerable ambient auditorium noise which generally produces a boomy sound which is mostly due to lower frequencies of the audio spectrum. 2) In-

creased tape hiss. To cut down these spurious noises somewhat, the signal is passed through filters. Cut-off settings we have found quite satisfactory for most conditions are 120 and 5000 Hz. Thus, most of the noise is considerably reduced and an adequate range of frequencies is maintained so as to preserve voice naturalness. During the dubbing, each channel can be handled separately so as to obtain a perfect balance. For example, if a question from the back rows of the auditorium comes out too weak, the volume can be increased and the filter settings changed at will. These are some of the great advantages of having a master with two independent channels.

After the filter stage almost any kind of mixer can be used. If no mixer is available, even a "Y" adapter could be used. The mixed signals are then fed as a mono program to another machine. Figure 3 is a simplified block diagram of the dubbing process:

Summary

The results of this technique are remarkable. Questions from way back in the auditorium, sometimes spoken in a soft voice that the lecturer himself has trouble understanding, can be handled in such a way that on the mixed broad-

cast tape they can be heard almost as clearly as the voice of the lecturer himself. Besides, having a master tape with two independent channels has the advantage that for second or third dubbings, the quality of the re-recording can be improved on the basis of observations of the previous trials. Æ

UHER 4000-S

(from page 28)

the unit is plugged into the recorder socket. The two leads from pins 3 and 5 are brought to the top terminals of R_{10} - R_{11} , and from pin 2 to the ground ends of both. The latter lead is continued to the ground terminals of R_{14} - R_{15} , and thence up to the ground hole on the amplifier board. R_{12} and R_{13} are connected from the arms of the dual pot, R_{14} - R_{15} to the tops of the microphone-level pot, also a dual unit but with an attached SPST switch, and thence to the two output jacks. The two arms of R_{14} and R_{15} are connected together, and thence to the output terminal of the circuit board. The positive terminal of the series-connected batteries is led to the ground terminal of the circuit board,

an eye opener for those who seek NEUMANN quality...

but think they
can't afford it!

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Once again, NEUMANN proves its leadership! The linear admittance capsule... a new condenser element concept two years in development ends usual cardioid mid-range deficiency for non-centered sound sources. This important innovation is enhanced by another exciting feature... NEUMANN quality at new lower prices. Six U-64's from 6-way power supply—\$260 per mike, dual/stereo system—\$310 per mike, single system—\$360. For any cardioid application the U-64 is the best answer and your best buy! Ask your franchised dealer for a demonstration or contact:

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and the negative terminal goes to the switch, and thence to the -18-V terminal of the amplifier board. All this wiring is made with solid hookup wire, and serves to support the amplifier. The unmarked terminal on the board is used as a support for the back end of the board, with the other end of the wire being soldered to the plug shell. Fig. 8 shows the underside of the panel section. Two knobs and the two batteries complete the construction. A little spray paint and decal markings give the panel and cabinet a finished appearance. The location of the plug is such that it mates

with the recorder socket, and a small hole on the left side of the housing engages the handle button of the recorder. Four adhesive rubber feet, from 3M, can be applied to adjust the height of the housing to permit the plug to match the recorder socket. Microphone connection is made by way of a Preh 6998 socket (obtainable from Switchcraft jobbers) mounted on the front apron.

Operation

In use, the lecturer has control over the level of the recorder signal, and

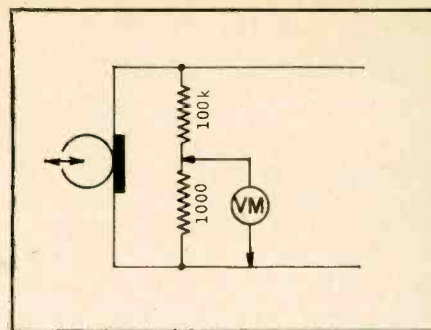


Fig. 9. Diagram of circuit specified by Uher for the measurement of bias voltage. This gives a value which is 1 per cent of the actual bias voltage, and eliminates the shunting effect of the input capacitance of the a.c. voltmeter.

“It Takes Two To Speak The Truth— One To Speak And Another To Hear”

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Choosing the right speaker is an exciting adventure in seeking truth. If clean beautifully balanced sound makes you glow and twinkle... Have a fling... Listen to the superb new WHITECREST W-2* Speaker System... and fall in love again...

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The truly astonishing big system sound of the W-2 is not the result of a happy accident. Consider the five unique technical features not found in any other one speaker system regardless of price:

1. Specially designed 8" edge damped and reinforced low and mid range driver
2. Four-circuit air-core dual-coil L.C. network
3. Oil-filled capacitor
4. Special 9500-cycle crossover point
5. Unique damping technique, instrument precision controlled.

Other great features: Unique portings for perfect loading. Cabinet resonance below audibility. Extremely low distortion. Plastic 3" domed spherical tweeter. Carefully designed and constructed cabinet. Response extremely smooth from 30 to 20,000 cycles.

Size 18" x 12" x 9½". Finished on all four sides in oiled walnut. Price: \$69.50



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whenever he wishes to speak, he simply turns up the microphone control, which switches the battery on and adjusts the speech level. There is adequate output level for lecture work when feeding the coupling unit directly into a basic stereo power amplifier and thence to two loudspeakers.

If it is desired to use the recorder without the coupling unit, make up a cable with the 5-pin Hirschmann plug and three shielded cables, with all the shields connected to pin 2, and one "hot" lead to each of pins 3, 4, and 5. The amplifier in the recorder can then be turned on by slipping shorted female phono socket onto the plug from pin 4.

Recorder Bias Adjustment

With the recommended stereo head, Nortronics I202, it will be found that there is too much bias on the record head for the normally flat response of which the Uher 4000 is capable. Instructions indicate that a bias signal of 0.25 volts should be measured as shown in Fig. 9. This is too much, and will cause a reduction in high-frequency response when recording. It is suggested that the bias be reduced, as described in the alignment instructions, so that a signal of 0.13 to 0.15 volts is measured in the



Fig. 10. Rear view of the auxiliary coupling unit.

circuit of Fig. 9. This should give flat response within a dB or so up to 20,000 Hz.

PARTS LIST

C_1, C_3, C_5 5 μ f, 25 v., Sprague TE-1202
 C_2 20 μ f, 25 v., Sprague TE-1206
 C_4 50 μ f, 3 v., Sprague TE-1058
 J_1, J_2 Switchcraft 3501 FP phono jacks
 J_3 Preh 6998 panel mounting socket (Switchcraft)
 P_1 Hirschmann MAS-5S plug
 Q_1, Q_2 GE 2N508 transistors
 Q_3 GE 2N322 transistor
 R_1 100 k ohms, $\frac{1}{4}$ -watt resistor
 R_2 150 ohms, $\frac{1}{4}$ -watt resistor
 R_3 15,000 ohms, $\frac{1}{4}$ -watt resistor
 R_4 150 k ohms, $\frac{1}{4}$ -watt resistor
 R_5 68,000 ohms, $\frac{1}{4}$ -watt resistor
 R_6, R_7 1500 ohms, $\frac{1}{4}$ -watt resistors
 R_8 8200 ohms, $\frac{1}{4}$ -watt resistor
 R_9 4700 ohms, $\frac{1}{4}$ -watt resistor
 R_{10}, R_{11} Dual pot, 250 k ohms; IRC A-254, MA-254
 R_{12}, R_{13} 47,000 ohms, $\frac{1}{4}$ -watt resistors
 R_{14}, R_{15}, S_1 Dual pot, 100 k ohms, with switch; IRC A-104, MA-104, 76-1 switch
 Battery mounting bracket, Keystone, for VS-323 battery
 B_1, B_2 RCA 9-v. transistor batteries, VS-323
 Case Bud 2106A Minibox, $5\frac{1}{4} \times 3 \times 2\frac{1}{2}$ in. Æ

EQUIP. PROFILE

(from page 54)

a 3-in. high-frequency "resonator," which we assume means tweeter. Two independent frequency-dividing networks are employed, and the cabinet is well damped to prevent any resonances. Over-all weight is 19 lbs. List price is \$69.50

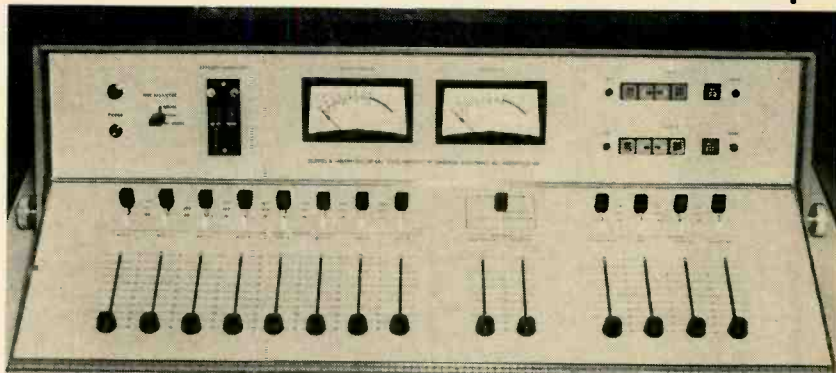
The apparent smoothness of response of this system is helped by a slight—3 to 4-dB—rise at around 300 Hz, which is where most small speakers show their deficiency. It is truly a pleasure to find one that is free of this particular fault. Circle 202

SHURE M55E STEREO CARTRIDGE WITH ELLIPTICAL STYLUS

Phono cartridges are a second class of component that is difficult to profile. There are quite a few really good ones, and the differences in the easily measurable parameters are not great. In the areas of not-so-easily-measured parameters, principally distortion, the differences are more likely to appear, and to influence the over-all sound, which likely accounts for the coloration which may be attributed to a cartridge. What makes it difficult to judge quality is that we have no means for knowing just exactly what "coloration" is in the record itself, and this makes it imperative that any listening assessment of a cartridge be based on a large number of records, preferably from different companies.

Among the cartridges recognized as of excellent quality is the Shure V-15, one of the earliest to appear on the market with a 15-deg. vertical stylus angle, and with the elliptical stylus. This model, which

ALTEC'S new studio equipment makes the beauty of these custom consoles more than skin deep!



CUSTOM CONSOLE DESIGNED AND BUILT BY COMMERCIAL ELECTRONICS, INC., INDIANAPOLIS, INDIANA

Though they're located many miles apart, one in Michigan and one in Indiana, these beautiful new custom control consoles have one thing in common—Altec's most recent studio products.

For example, one console utilizes 43 Altec 9470A solid-state plug-in amplifiers, the other 14! The reason for choosing this advanced, all-silicon amplifier is immediately apparent from the description below. Other Altec components in these sophisticated consoles include 9550A solid-state power supplies, 9061A program equalizers, and the advanced straight-line attenuators.

These are just a few of the many new products with unique advantages available for your custom console from the world's largest manufacturer of sound equipment exclusively. Before you build your "dream console," be sure to take a look at the latest and the best—from Altec!



CUSTOM CONSOLE DESIGNED AND BUILT BY CLEVELAND RECORDING COMPANY, CLEVELAND, OHIO

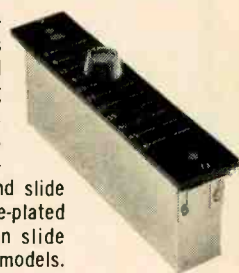
NEW ALTEC 9470A AMPLIFIER

This unit can serve as preamp, line, booster or program amplifier with no internal changes. All-silicon transistor circuitry delivers 0.5 watt; Frequency response, 20-20,000 cps \pm 0.5 db; THD, less than 1%; 20-20,000 cps @ +27 dbm; Noise level (unweighted, 10-25,000-cps bandpass), equivalent input noise, -127 dbm (input unterminated); Overload recovery, 5 μ s for 100% overload.



NEW ALTEC STRAIGHT-LINE ATTENUATORS

Extremely low-noise attenuators feature gold-tipped bifurcated sliding contact brushes. Sliding bearings are made of friction-free Delrin and slide on polished chrome-plated shaft. Available in slide wire and step type models.



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6. Names and Addresses of Publisher, Editor, and Managing Editor: Publisher, C. G. McProud, 190 Mineola Blvd., Mineola, N.Y. 11501. Editor, C. G. McProud, 190 Mineola Blvd., Mineola, N.Y. 11501. Managing Editor, none.

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was given the de luxe treatment in packaging, along with a price of \$62.50, was well accepted for its reproduction quality, and has made a notable place for itself amongst music lovers, and most audio buffs managed to include a Shure V-15 in his cartridge kit—it being well recognized that the serious audio hobbyist is likely to have at least a half dozen cartridges available.

But with plenty of cartridges available at around \$20, it takes some convincing to elicit \$62.50 from the potential purchaser. But with 100 per cent inspection and an actual listening test for each individual cartridge, the price was inevitable.

Now comes the M55E, which this observer dubbed—and requested permission to say so publicly—"the poor man's V-15."

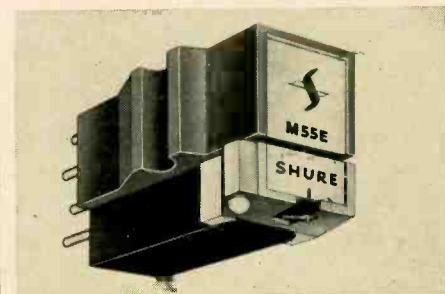


Fig. 6. Shure M55E stereo cartridge with elliptical stylus.

In comparative listening tests, it would be next to impossible to tell the difference. According to Shure engineers, the two are essentially identical, differing primarily in that the M55E is not given the same 100-per cent quality control as the V-15. However, we have "lived with" two separate M55E's over the past few months, and they are as alike as the proverbial two peas in a pod.

The M55E has an output of approximately 1.3 mV/cm/sec, and tracks perfectly at 1 to 1.5 grams stylus force. It is pleasant to listen to, apparently free of distortion, crisp and brilliant with a minimum of peak in the highest frequency range.

In technical terms, channel separation is in excess of 25 dB at 1000 Hz, and about 15 dB at 20,000 Hz. Its compliance is high, even by today's high figures, and is stated as 25 x 10⁻⁶ cm/dyne. A soft plastic bumper prevents damage to the record in case the cartridge is dropped accidentally. In all, the Shure M55E is a very listenable and serviceable cartridge.

Circle 203

AUDIO AMP

(from page 42)

did not prove necessary. Whenever one mixer stage is being pulsed, the other one is a good safe margin inside its conduction range, so the minute positive-going pulse derived from the driver collectors has no effect, except when it's supposed to. The positive fed-back pulse

only affects the transistor that is ready for it at that instant, which makes things simpler. It enables us to continue using the single negative-feedback arrangement to control amplitude near quiescence, which is a convenience.

But the negative-pulse feedback did not behave quite as simply as we had hoped. With the first circuit, it just dropped in like magic and did what we wanted it to, even though it needed a minor change when we hooked the output transistors on. But now it not only cut the amplitude, it also broadened the pulse. We tried changing the positive and negative feedback in every conceivable combination (working on one 'side' of the push-pull pair, while leaving the other alone, so we could compare the effect of changes we made), but we just could not get a sharp signal of half amplitude, or of any amplitude short of full, in fact.

The solution, at this stage, proved to be using a capacitor to bypass the base-feed resistor of the series-feedback transistor (dashed line connection, Fig. 2-8). We had tried this with the original circuit, but then found that any capacitance in shunt with the base resistor produced instability, indicating that resistance only was needed; now the capacitor sharpened up the pulses magically and the resistor needed to

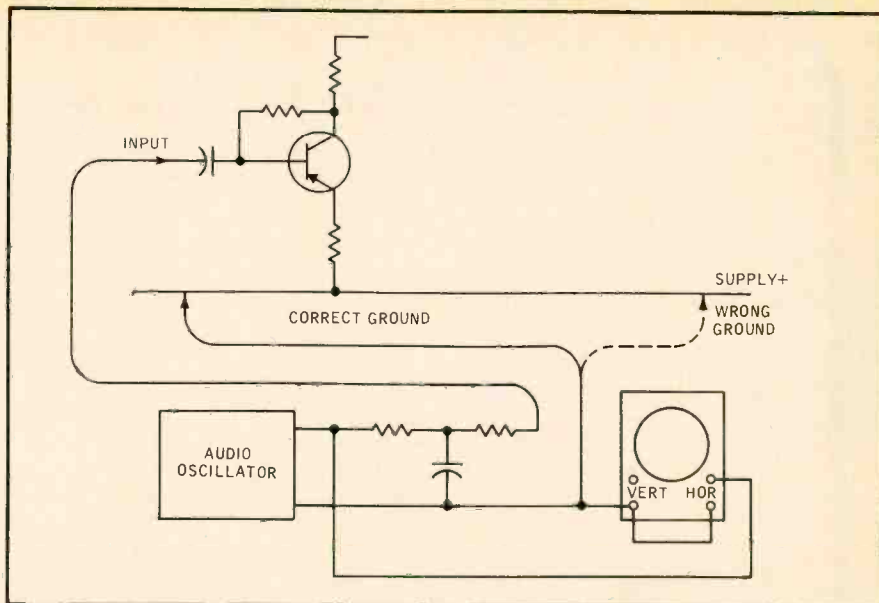


Fig. 3-7. A mistake in test connection that caused instability—improper grounding; we should have known better!

be of much larger value. Apparently the capacitor was what provided the negative feedback at each pulse occurrence, and the resistor served to discharge it again by the time it was needed for the next pulse. A time constant of about half the ultrasonic period proved ideal, which confirmed this functional explanation.

Now we're again ready to try it with output transistors. But this time we've really got instability when they're coupled on. And nothing will cure it short of a few farads decoupling on the phase inverter stage. We actually tried a 5300 μf capacitor that we had lying around and that didn't quite stabilize it, but made it slightly less violent. Well, we

great stereo

at low, low price; in tiny, tiny 'baby' size.



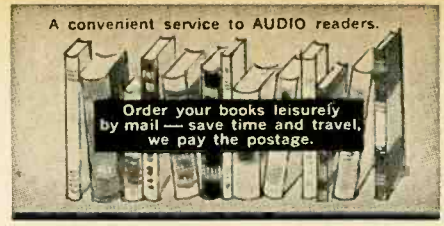
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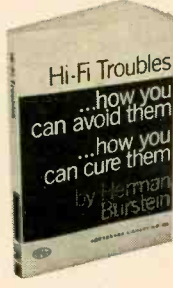
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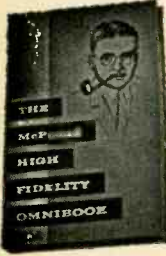
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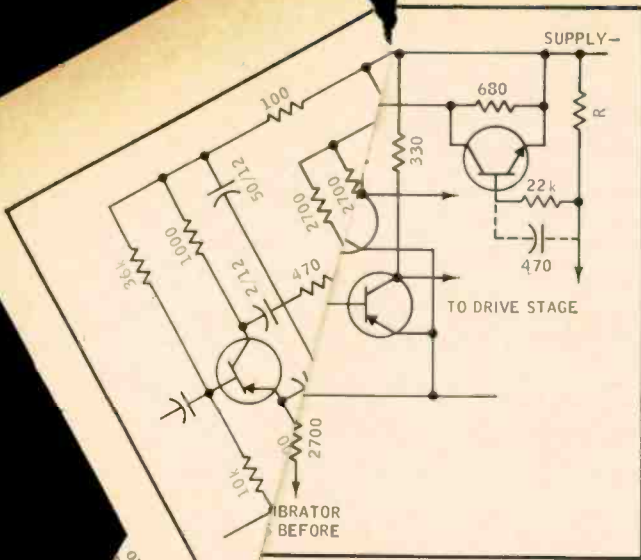
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Herman Burstein
 Written in "plain talk" for the man who has, or wishes to buy, a tape recorder. It answers the myriad questions raised by tape recording enthusiasts. Its chapters cover every phase of operation and maintenance—from adding a tape recorder to the hi-fi system, to a thorough dissertation on microphones. Lots of practical information on how to buy. 176 pages.
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Fig. 3-8. Revised modulation section, that proved much less dependent—in fact completely independent of transistor characteristics, provided they work at all. But it introduced its own instability problems when connected to the output stages.



anything that
alize that stage,
other "answer."
out of space for

this month, and it took us quite a bit
of experimentation to find the way, so
we'll save that for the next and final
installment. Æ

Industry Notes and People

3M Electronic Sound Corporation—an importer, distributor and manufacturer of home entertainment products, has moved its executive offices, factory, and research and development facilities from Westbury to 40 Smith



Street, off Route 110 Farmingdale, New York. Pictured here is the new plant.

The company will expand its research and development in an effort to manufacture new products for the home entertainment field.

The company was formed by Mr. Benjamin five years ago with G. T. Thalberg.

● **Minnesota Mining and Manufacturing Corp. (3M)** has just introduced a commercial background music system which is revolutionary for a number of reasons: 1. It will be sold outright, not leased as are the majority of background music systems available today. 2. It employs cartridges each containing 700 individual selections and will play for 26 hours without repeating a single selection. 3. Most important to the commercial user, the sales price of a cartridge includes all performance royalties for a period of three years. 4. Purchasers of the unit will be offered a \$35 per year service contract which will be handled by 3M's Thermofax national service organization.

We believe this new concept in background music systems will greatly broaden their use by making them available to small locations which previously could not afford a leased service.

Playing music from its own stored sound tape library, the 3M "Cantata" does not depend upon a central studio and does not require external telephone lines or complex antenna systems.

The 3M "Cantata" 700 operates at a speed of 1 1/2 ips. and automatically switches channels to provide a continuous 26-hour program. The operation is completely automatic and requires no

threading, rewinding, or tape handling. It employs a 6-watt transistorized amplifier capable of driving 32 speakers at the levels normally employed for background music. Additional amplifiers are available for localities requiring more than 32 speakers. The entire playback unit only requires a space 15 x 7 x 12 inches.

The Model 700 is priced at \$429 (suggested retail price) including one cartridge. Additional cartridges are available at \$100 each, this price includes all performance royalty payments for three years.

Additional information can be obtained by contacting 3M Company Background Music Systems, Building 220-7, W. 2501 Hudson Road, St. Paul, Minnesota 55119.

● The Wharfedale Sales Division of **British Industries Corp.** announces the appointment of Larry Epstein as Manager of this rapidly expanding division. In his new position Mr. Epstein will be responsible for all matters concerning the product and sales aspects of the Wharfedale line. George Cohen, former occupant of the chair now taken over by Larry Epstein, now moves on to product responsibilities for the entire BIC line.

● **Paul R. Abbey** has been appointed consultant for **Denki Onkyo Co. Ltd.**, Tokyo, Japan. The company is one of Japan's principal producers of tape recorders and has been manufacturing the Concertone models 800 and 400 as well as their own Dokorder brand.

● **Louis J. Crispiano** has been appointed marketing and planning manager for the Products Engineering Division of **Sony Corporation of America**, according to Dr. Sam Mabuchi, vice president. Mr. Crispiano brings to Sony a background of experience in the marketing of electronic products. Prior to joining Sony, he was manager of the commercial products department of ITT Distributor Products, and product line Sales Manager for ITT Components Division.

● **Robert Bach**, (Bach Sales Company) of Old Bethpage, New York, was cited as "Salesman-of-the-Year" by John C. Koss for the outstanding work done on Koss and Rek-O-Kut lines. Bach has represented Koss Stereophones in the New York-New Jersey area since they came on the market in 1958, and has continually maintained a high position among Koss representatives. He took over the Rek-O-Kut line a year ago. Bach received a new Mustang as his prize for winning the award. Presentation was made at the New York Hi-Fi Show.

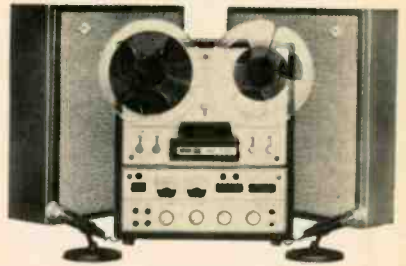
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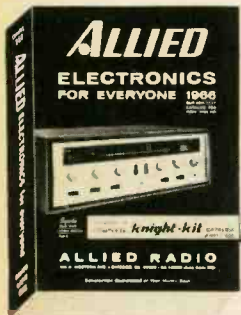
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LIGHT LISTENING

(from page 8)

to sing the praises of a masculine native. Ray Ellis is the musician in charge of arrangements and conducting chores. By far the best rapport in the Horne-Ellis collaboration occurs in the very nimble treatment of "Hello Young Lovers". This is popular singing in a highly advanced stage of development.

Judy Garland/Liza Minelli: Concert at London Palladium

Capitol SWBO 2295

Where was the well-known British reserve while this concert was being taped at the Palladium? It apparently was relegated to the same ash bin used by American fans to shed their inhibitions whenever Judy Garland or daughter Liza Minelli appear in public individually. Since this London event was their first concert appearance together, Capitol Records was on hand to capture the outpouring of audience sentiment along with the generous quota of entertainment on stage. Under the circumstances, it is somewhat pointless to attempt to divorce the recorded performances of Judy and Liza from the event itself. Separately and in duet, mother and daughter flail the audience with the all-out Garland brand of showmanship. Rafter-bending medleys are followed by hushed ballads as the audience goes wild at the first note of each old favorite or the special lyrics inserted into the act for the occasion. In the welter of togetherness that fills the two-record album, few people will stoop so low as to draw comparisons between the singers. About all that can be said is that similarities in voice provided by Mother Nature to two members of the family have been emphasized by the response curve of the hand-held mikes used in the concert. Either singer could have benefited under circumstances where less stage movement would have permitted use of stationary mikes. **A**

PHONO CARTRIDGE

(from page 25)

example, a cartridge with a limited response range may be perfectly suitable for a single singing voice, but may be very poor for an orchestral work. The cartridge which may play well for a basso profundo may not do so well for a mezzo soprano. Since the same argument applies to the loudspeakers, it is often well not only to play a variety of records, but to do so with several loudspeakers.

The evaluation of a phonograph cartridge based on a listening test is difficult to define since we cannot use numbers, but must resort to adjectives. It is helpful to develop some agreement as to standard adjectives. Table II shows some suggested terms which may be used. When this type of table is employed regularly, the listeners tend to use the same words for what they hear.

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STEREO-REVERBERATORS for experimental applications, \$7. Cal's, Box 2, Dearborn, Mich.

Collector wants World, Associated, Muzak, MacGregor, Standard transcriptions, catalogs. ERP1-WE transcription player. Bob Nicholas, 4200 Blackthorne, Long Beach, Calif. 90808.

FOR SALE: McIntosh C-11, \$150; 2 McIntosh MC-30's, \$170; Citation IIX tuner, \$150; Viking 88 RMQ H.M.S., \$250; 2 J.B. Lansing LE14C's, \$130. H. W. Davis, 6040 Sheridan, Chicago, Ill.

AUDIO Magazine, 1953-65. Complete excepting 1/58, 12/62, and most of 1957 (Feb. only). 4 bound volumes, others in heavy cardboard. \$50 plus shipping. J. Grauer, 8 Garden St., Great Neck, N. Y. 11021.

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KSC-3 speakers, walnut, excellent condition, 6 months old. \$235 for pair. Fair Trade new price, \$390. John McBride, 2626 Boxwood Drive, Wilmington, Delaware 19803.

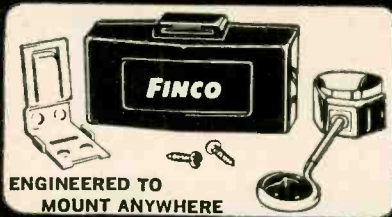
QUAD full-range electrostatic speaker. \$150. Olsen, 310 Bode Road, Hoffman Estates, Illinois 60173.

FOR SALE: Fisher 80C preamp, \$50; 80-AZ power amplifier, \$40; FM-90 tuner, \$75; Garrard AII with stereo cartridge, \$40; Bogen 901 and Heath AJ-21 AM tuners, \$20 each. Don Schroder, 3405 Telford, Apt. 26, Cincinnati, Ohio 45220.

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Sidney Simonson, formerly of Rek-O-Kut, is available for consulting with a manufacturer having engineering or production problems of mechanical or electro-mechanical devices. Sidney Simonson, 137-14 233 St. Laureton, N.Y. 11422 Telephone: 212 LA 8-4626.

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Conclusion

We have discussed a number of the important criteria related to measuring the performance of a phonograph cartridge. The final evaluation of the quality of the cartridge must be based on the consideration of all of these factors. While it is impossible to assess the relative importance of the various characteristics, the reproducing quality must certainly be one of the major considerations. Measurements of frequency response, separation, and distortion help in evaluating the reproducing quality, and must therefore be considered as being of major importance.

Probably the weakest factor related to our measuring techniques is the correlation between measurements and listening tests. Our measurements provide a good indication of whether one cartridge is better or worse than another, i.e., a relative indication. The measurements do not provide a good absolute indication of whether the cartridge is good or bad. The definition of good or bad must be made in terms of listening tests, and this is where the correlation has not been satisfactorily made.

Finally, we wish to re-emphasize the importance of reproducibility in measurements. To make measurements meaningful, it is extremely important that test conditions be standardized. Gross variations in measured performance can occur because of differences in test records, measuring equipment, and environmental conditions. Unless all of these factors are carefully controlled, the measurements are meaningless. **AE**

¹Tracing Distortion in Stereophonic Disc Recording, M. S. Corrington and T. Murakami, *RCA Review*, June, 1958, p 216

²Stylus Mass & Distortion, J. Walton, *Wireless World*, April, 1963, p 171

³Psychoacoustics—The Determining Factor in Stereo Disc Distortion, J. Jacobs and P. Wittman, (Presented at Annual Meeting of Audio Engineering Society, October, 1963)

⁴A Study in Tracking-Angle Errors in Stereo Disc Recording, J. G. Woodward and E. C. Fox, *IRE Transactions on Audio*, July, 1963

⁵Reducing Distortion in Stereo Phono Systems, J. G. Woodward, *Audio*, February-March, 1964

⁶Stereo Disc Recording Comes of Age, D. C. Cooper, *Audio*, January, 1964

⁷Further Thoughts on Geometric Condition in the Cutting and Playing of Stereo Discs, C. R. Bastians, *J.A.E.S.* Jan. 1963

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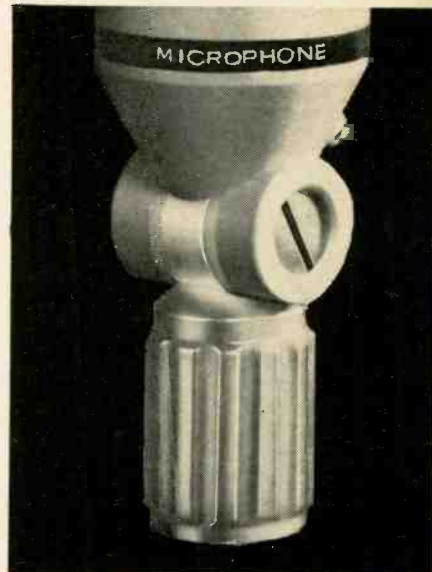
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