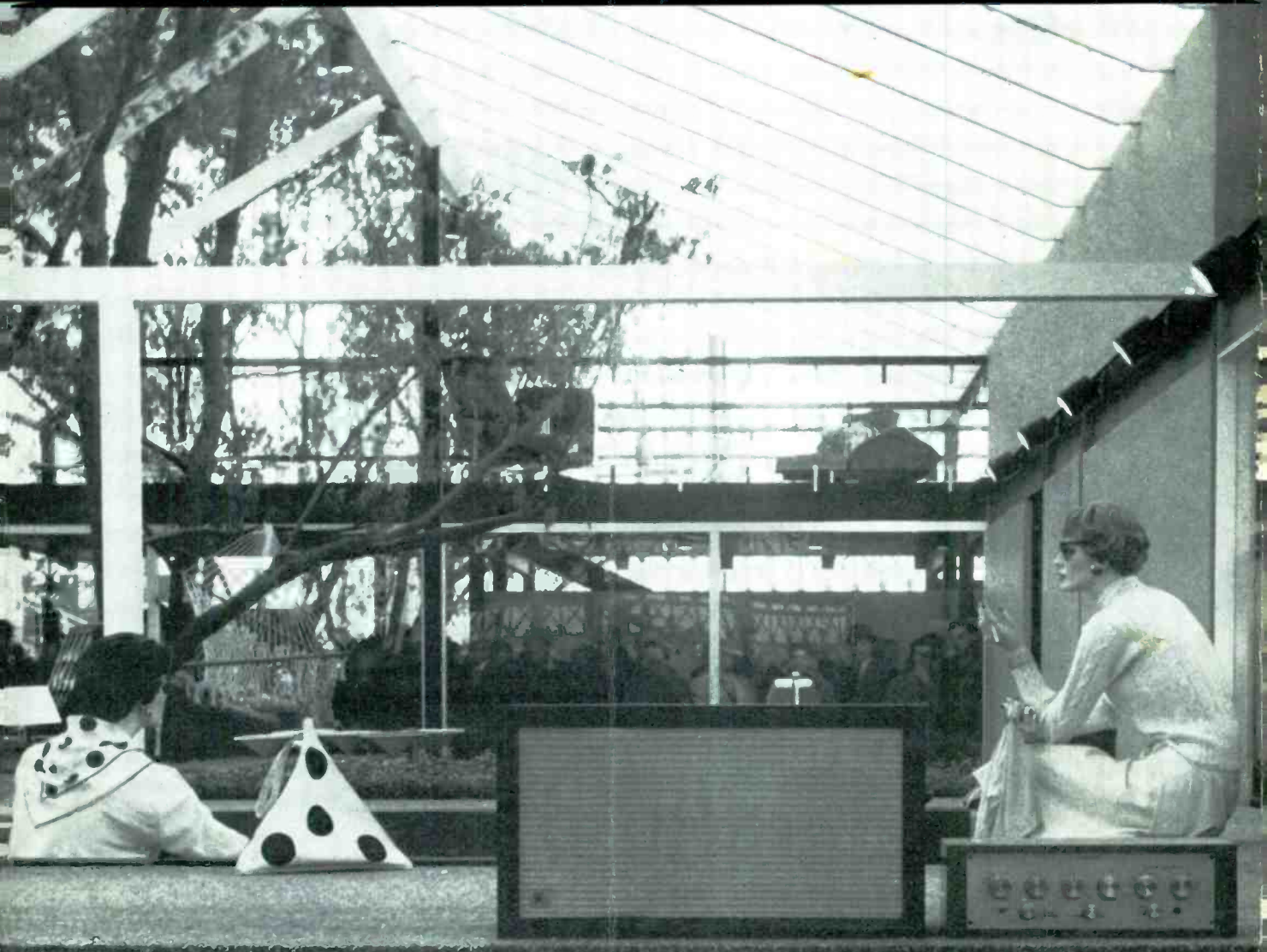


# AUDIO

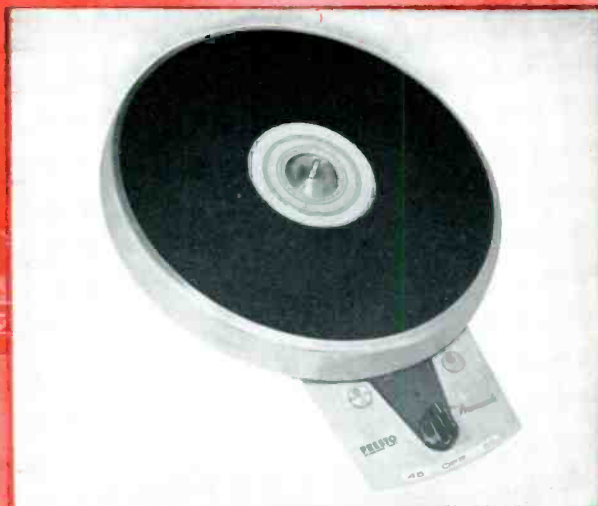
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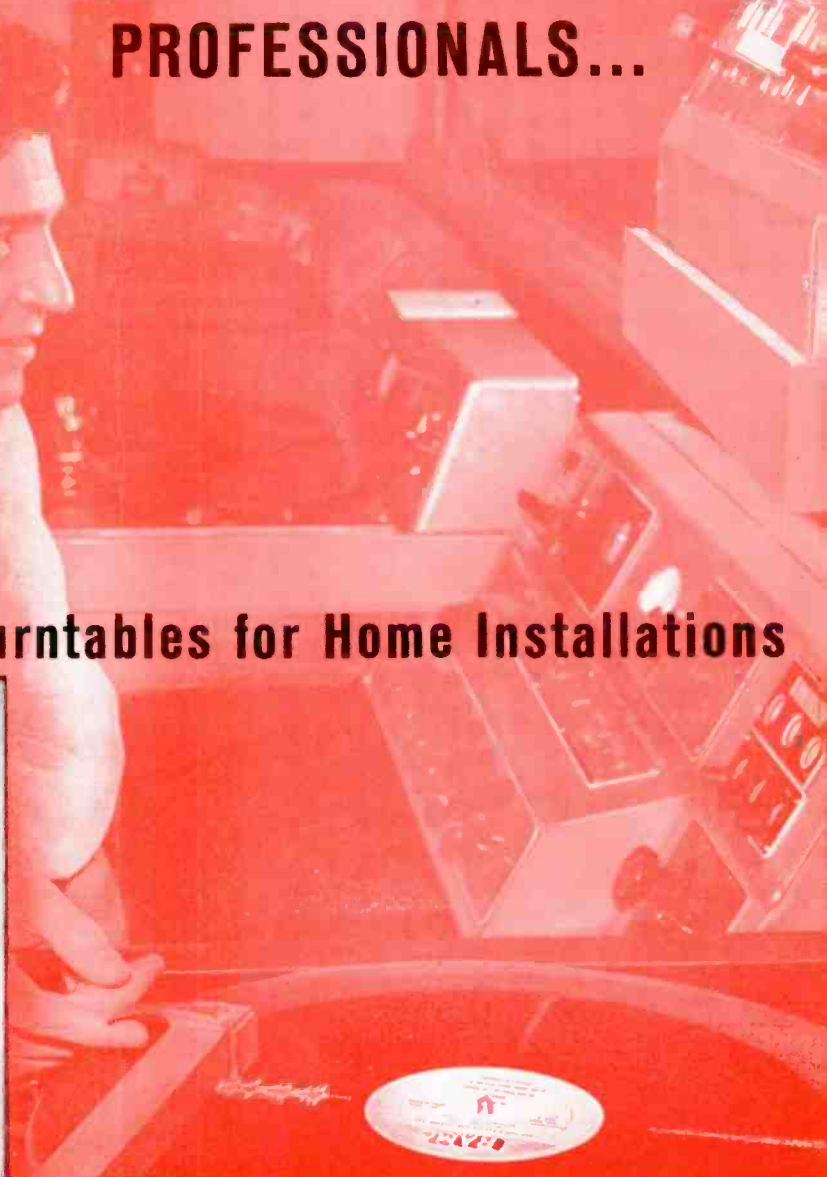
A crowning achievement in engineering design—the T-2 two speed model offers superb high-fidelity performance at modest cost. Its heavy, balanced aluminum turntable and rugged drive system eliminate wow, flutter and rumble. The interchangeable idler wheels disengage in the "off" position to prevent flats. Heavy-duty, 4-pole motor insures accurate speeds. Shift mechanism permits quick change from 33 $\frac{1}{3}$  to 45 r.p.m. while table is spinning. Comes equipped with built-in strobe disc, 45 r.p.m. adapter, and rubber record mat. *Only \$59.50*

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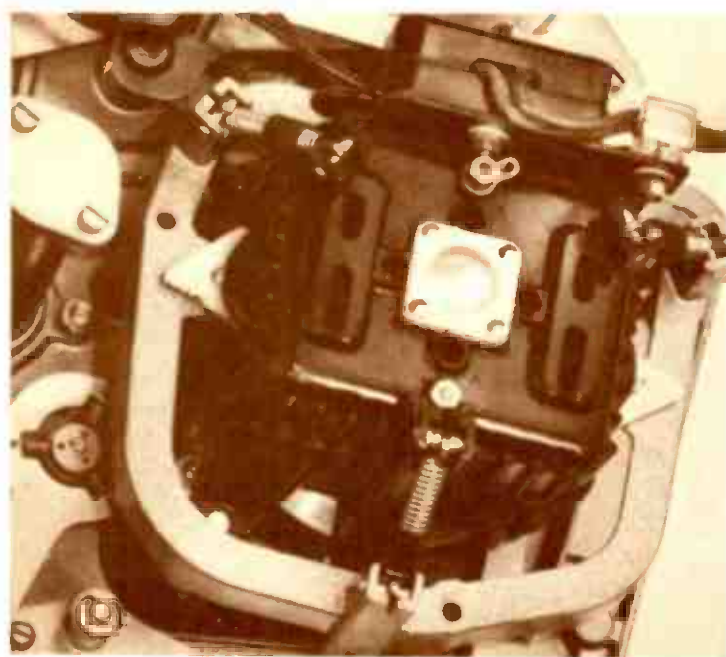
# Garrard



A simple explanation of the thinking behind this great turntable!

**I**N any transcription turntable, there are two potential sources of noise which produce the effect commonly termed "rumble". These are the motor . . . and the spindle on which the turntable itself revolves. Since any turntable and motor rotate on bearings which create heat and noise, the problem is to reduce the noise to a point of inaudibility, first by minimizing the source and then by isolating it.

The motor used in the Garrard Model 301 is a precision-engineered, dynamically-balanced 4-pole unit, encased in a heavy die-cast frame. Designed by Garrard, it is also built in Garrard's own plant. This guarantees its quality. However, in any motor, some vibration may be evident. Therefore, the 301 motor is completely isolated from the unit plate, suspended by three tension and three compression springs, so that it is actually isolated in a 360° sphere. This method of suspension is unique, and it is one major reason why the Garrard 301 is so remarkably free of vibration.



In addition, the one lever which connects the motor to the unit plate (the speed control lever) is also ingeniously suspended within three springs, rather than by using a conventional bushing or pivot. The Garrard 301 is the only unit wherein the motor is entirely suspended by springs from *every* lever and even from the unit frame itself!

(OVER)

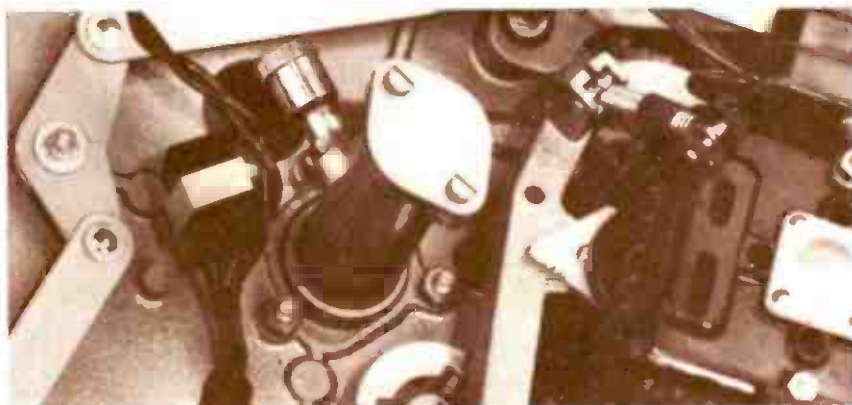
*The Sounding Board*

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# The Sounding Board



The 301 turntable weighs a full 6½ lbs. and it is made of precision-machined cast aluminum. Being heavy and dynamically balanced as well, it imparts flywheel action, which tends to override a variation in speed.



The all-important turntable spindle is polished to mirror finish. This minimizes any turning noise. Then, by setting the spindle in a die-cast housing which is completely filled with a special lubricant under pressure, even that minimum of noise which remains is isolated and prevented from reaching the turntable or unit plate. This, in turn, also prevents vibration from reaching the pickup.

In order to insure that the spindle is at all times under the influence of strong damping pressure, a reservoir for the lubricant is built into the housing. By simply turning a knurled knob, a new supply of grease is forced into the housing whenever required.



Another 301 feature is the method of setting the precise speed.

After the major speed selection has been made, a control knob on the top of the unit can provide an additional 2½% variation, plus or minus. This magnetic speed control operates as an eddy current brake. Two permanent magnets are set on either side of a rotating disc, which is attached to the motor armature. By increasing or decreasing the distance of the magnets from the center of the discs, the field strength of the magnets is varied and reflects in the speed of the motor. The eddy current method of control is instantaneous, precise, permanent and fool-proof.

The wow, flutter and rumble specifications of the 301 are well below those required by the NARTB. The 301 was developed in conjunction with the highly critical British Broadcasting Corporation, and it is used in their broadcasting work. This great product meets all the qualifications which are desirable in a turntable. It is quiet, precise, rugged and proven through countless hours of use under the most arduous conditions.

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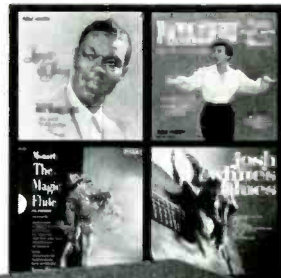
**COVER PHOTO:** Shown in the lounge of the Fashion Show exhibit at the World Fair in Brussels are two of the units chosen to represent U. S. hi-fi industry manufacturers from the standpoint of good design—the AR-1 loudspeaker and the Marantz Audio Consolette. The models are presumably being entertained between shows.

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# AUDIOCLINIC??

JOSEPH GIOVANELLI\*

## Crossover Distortion

*Q. What is crossover distortion? William Adsen, Tampa, Fla.*

A. Crossover distortion is not, as might be supposed, an alteration of sound created within a network used to divide the frequency spectrum for use with two or three-way speaker systems. To make clear what crossover distortion is, we must re-examine some of the basic ideas concerning class-A and class-B amplifiers.

The tubes in a class-A amplifier operate approximately midway between the point where grid current flows and cutoff, where plate current flow ceases. This is a static condition which changes when a signal is applied to the grid circuit of the stage. At this time, the current in each tube no longer is equal to the current in the other tube of the push-pull pair. During the first half cycle, the current in tube 1 increases, while that of tube 2 decreases. During the opposite half cycle, the roles of the tubes reverse. The signal magnitude is such that the tubes are never driven into grid current, nor run down to plate current cutoff.

The class-B amplifier poses an entirely different problem, since the tubes are biased to cutoff. When a signal is applied to the grids of this stage, the following happens. During the first half cycle of signal, the grid of tube 1 becomes more and more positive, allowing more and more plate current to flow. As the signal voltage rises still higher, the grid becomes positive with respect to its cathode, and therefore draws current from the electron stream. The grid of tube 2, on the other hand, is driven more and more negative with respect to its cathode. The grid of this tube is already biased so far negative that no plate current can flow, and so this additional amount of bias causes no change in the operation of tube 2. As the polarity of the signal reverses, the roles of the tubes also reverse. It is obvious that in the class-B amplifier, only one tube at a time is operating.

If the tubes are biased to a point even more negative than cutoff, even by a slight amount there will be a point (where the signal is transferred from one tube to the other) where neither tube is handling the signal. This clearly is a form of distortion. Even when the tube is finally conducting, some distortion is present because a rise in grid voltage does not produce a rise (corresponding) in plate current near the region of cutoff.

The point where the signal is transferred from one tube to the other is known as the crossover point, and therefore, the distortion produced at this time is known as crossover distortion.

Nearly all high-fidelity vacuum-tube amplifiers operate at a point somewhere between class A and class B, usually closer to A. This condition is known as class AB. Because of this, the topic just discussed would have little more than academic interest to us, were it not for the introduction to the audio field of transistorized power amplifiers, which may contain one or more class B stages. They are used because they are more efficient than class-A circuits, since, when no signal is applied, no appreciable current flows. This greater

efficiency leads to cooler operation, which is necessary to prevent excessive heat from damaging transistors.

Crossover distortion is minimized in these circuits by large amounts of feedback which make the base-collector relationship more linear.

## Peak Inverse Voltage

*Q. The tube manual shows that a tube has a peak inverse voltage rating of so many volts. Of what significance is this? Andrew Harris, Schenectady, N. Y.*

A. Most tubes are wired to a d.c. source in such a way that their plates are positive with respect to their cathodes. This means that the tubes will pass current, when their heaters are properly lit. Diodes and power rectifiers are connected differently, because it is usually their function to convert a.c. into d.c.

The plate and cathode of a diode are effectively wired to opposite sides of the device supplying the a.c. During half of the cycle, the plate is positive with respect to the cathode, while during the other half cycle, the plate becomes negative with respect to the cathode. Under the latter condition no current can pass through the diode, because the plate voltage repels the electrons coming from the cathode. Suppose that means were available for making the plate more and more negative with respect to its cathode. A point would soon be reached where arcing within the tube would occur, and, in all probability, the tube would be ruined. The maximum peak inverse voltage rating of a tube is the maximum voltage which can be applied between plate and cathode, with the plate negative with respect to cathode, before the tube will be damaged. There is usually a small amount of leeway with conventional vacuum (high) rectifiers, but there is none with mercury-vapor units. A scrupulous observance of all ratings of these tubes is mandatory.

## Radio Volume Control Considerations

*Q. When the volume setting of my radio receiver is changed rapidly, I notice a considerable delay between the time I make the volume change and the time when the change becomes audible. What could cause this? Madelain Gold, Chicago, Ill.*

A. Figure 1 shows a typical volume control circuit of an AM radio receiver. The potentiometer,  $R_1$ , is a portion of the diode load and is therefore carrying a steady (Continued on page 6)

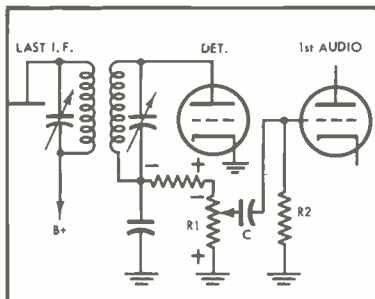


Fig. 1

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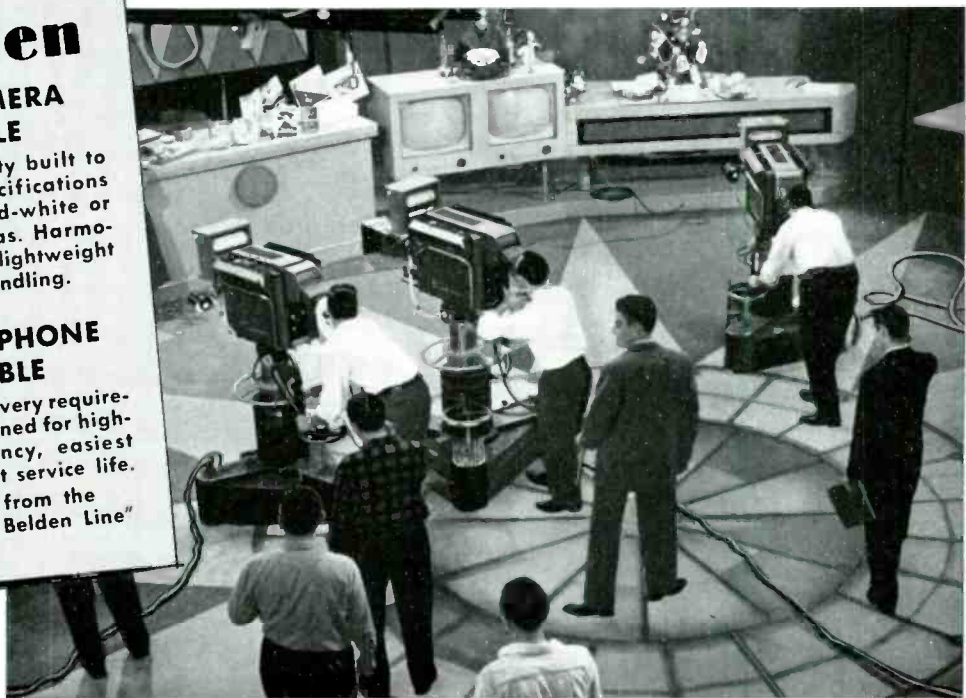
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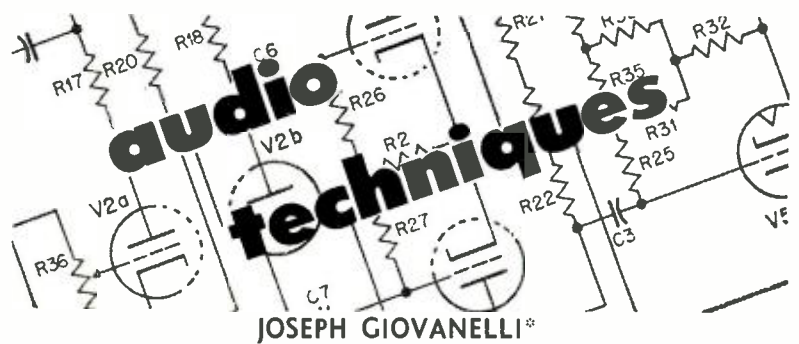
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JOSEPH GIOVANELLI\*

**NOTE.** Last November, the first article in a series known as AUDIO TECHNIQUES, appeared in this magazine. This is the second in that series. I have received many letters wishing the column well. However, it can only appear when there are enough suggestions and contributions to it from you, the readers. If you have any suggestions which you feel will be of interest to most readers, pass them along. All suggestions will be acknowledged.

**Tube Aging Equipment**

The April, 1958, installment of AUDIO CLINIC which appeared on page 2 of AUDIO for that month, contained a question on component life. Since I have received requests for a fuller discussion of the equipment to be used to age tubes, it seemed a fit topic for inclusion here.

It is well known that, with proper aging techniques, the life expectancy of tubes can be greatly extended. Because of the time required for this aging process, the manufacturers of tubes must content themselves with a process of rapid aging, known as flash aging. This process consists merely of applying a voltage which is somewhat higher than normal to the filament of the tube for a short period.

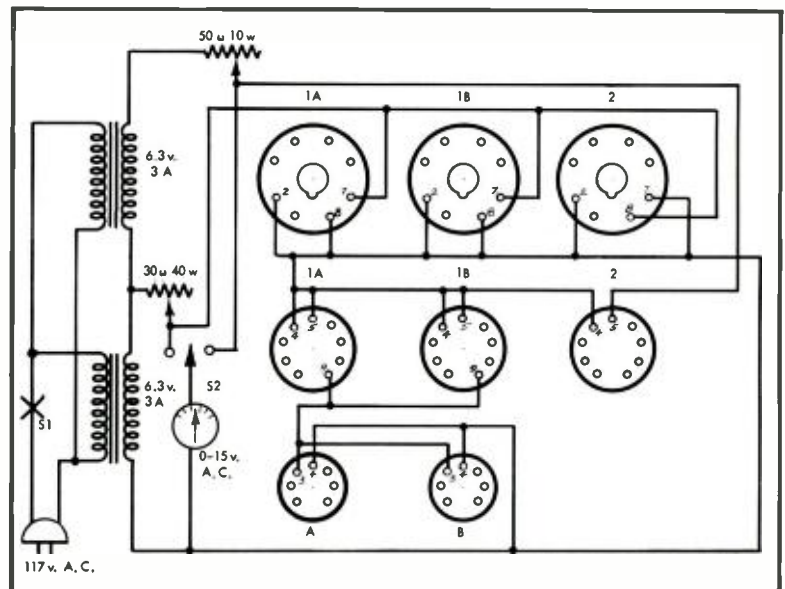
A better aging process involves the gradual boosting of filament voltage, until a point is reached where the voltage being supplied to the filament is that of the normal operating voltage for the particular filament being aged. Since there are many varieties of tube bases and terminal ar-

rangements, provision must be made in the tube ager to accommodate as many of these as is practical. The equipment must have means for turning the power on and off. It must provide a means for adjusting the voltages to suit the needs of the tube or tubes being aged. A means must be included to enable you to know at all times the voltage being applied to the filaments. You will have to decide how many tubes are to be aged at one time. The unit must be suitably housed.

The figure below is a schematic which can meet most practical requirements of the home user. An examination of the diagram will show that changes can readily be made to suit the requirements of a particular individual. As an example of this, let us assume that you use a tuning eye which employs a seven contact, medium base, socket. No provision is made for aging such a tube in this equipment, but it could be easily added by connecting the proper pins (usually 1 and 7) to the proper points.

The unit may be housed in any standard utility box of convenient size, such as those made by Bud or ICA. Power is applied or removed by means of *S*<sub>1</sub>, located in one side of the primary of the power transformer. I found no need to fuse the transformers, since the danger of short circuiting is almost nonexistent. On one side of the secondaries (6.3 volts, 3 amperes) is connected to one side of the voltmeter, as well as to one side of each of the filament pins for each socket. The other side of this secondary goes to one side of the second secondary and to a rheostat, *R*<sub>1</sub>, whose output feeds all but the third noval socket. (The voltmeter can be almost any kind

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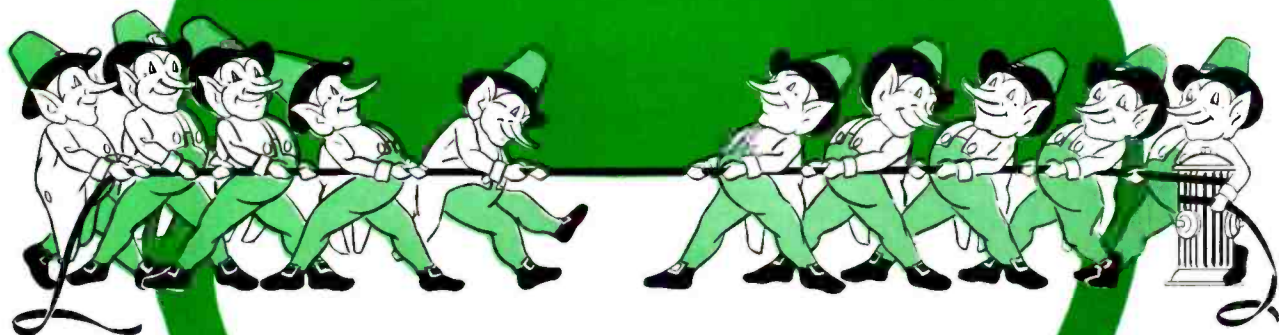


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of meter which can measure a.c. from 0 to 15 volts. The accuracy must be at least 10 per cent, and preferably 5 per cent. Accuracy is mentioned because tubes can withstand filament voltages which are 10 per cent above normal without damage, but no voltage in excess of this amount should be applied to the filaments.)

Since most of the sockets in use with high fidelity equipment are those of the 7-pin miniature, the octal, and the 9-pin types, I have confined myself to their use. You will note there are two of the 7-pin types, and three each of the 9-pin and octal sockets. Since almost all 7-pin miniature tubes use pins 3 and 4 for filaments, except of course those used in battery portable radio receivers, the sockets are wired using these terminals, and are in parallel. Most 9-pin tubes make use of pins 4 and 5, with pin 9 serving as the heater mid-tap. Thus, these tubes can be run as two filaments in series or in parallel. I chose the parallel hookup in order to operate the tubes from 6.3 volts. There are other 9-pin tubes which can be operated only from 12.6 volts, which is the reason for the third novel socket. Because of this, only one side of the heater terminal is wired to the rest of the heaters, while the other end goes to the far end of the second rheostat,  $R_2$ . If you use this type of circuit, be sure the filament transformers are connected in series aiding rather than series opposing.  $S_1$  is used to transfer the voltmeter to the 12.6-volt measuring point.  $R_1$  is a 50-ohm, 10-watt rheostat, used only when tubes having 12.6 volt filaments are to be aged. If you choose to age some of the tubes found in the universal AC-DC receivers, sockets may be added to this 12.6 volt branch of the circuit as needed. Remember, however, that if many such tubes are to be aged at one time, a rheostat with greater power-handling capabilities must be substituted for  $R_1$ . The two most common filament terminal arrangements for octal tubes are pins 7 and 2, and 7 and 8. Two of the octal sockets are wired with a jumper connected between pins 2 and 8, so that either filament arrangement may be placed in the socket, and illuminated. No danger to the element to pin 2 or 8, as the case may be, will result. The other octal socket, shown as 2 in the diagram, is wired with pins 2 and 7 jumped. This socket is intended primarily for use with rectifiers whose filaments are pins 2 and 8. (With most such tubes the voltages should not exceed 5 volts.) However, you

may also plug in tubes whose filament basing is 7 and 8.

To operate the device, place the tube in its socket, and connect the device to suitable power source. You may age as many tubes at one time as can be accommodated, provided the current rating of the filament transformers and the wattage rating of the rheostats are not exceeded. Tubes with differing current drains may be aged together if they all have the same filament voltage. The only exception to this rule is that it would be possible to age a tube whose voltage is 12.6 at the same time as one using 6.3 volts for its filament, since the voltage for each can be controlled independently. The meter is merely switched from one circuit to the other to read the correct voltage.

Place the tube in its socket. Gradually, over a period of time (allow about a week), raise the voltage to normal. Let the tube remain operating under this condition for 4 or 5 days. Since the effects of aging wear off gradually as the tube stands on the shelf, do not age until shortly before use.

Note that only the filaments are connected. All other elements are left floating. The octal sockets are exceptions to this, but since only one element is at filament potential, no harmful effects will result.

#### Watch Those Megs!

I ran into some confusion when building an Eico kit recently. Some of the resistances called for were 10K, 100K and 1M. Logically, I should have expected the next resistor to be one megohm, since the circuit referred to is part of a voltage divider in a VTVM. But I believed that M and K were used interchangeably for 1000. In fact, this was clearly stated in the McGraw-Hill book, "Radio and Television Repairing." I learned later from one of the engineers with whom I work that M is gaining increasing popularity as an abbreviation for megohm. I therefore suggest that you analyze carefully any part of a circuit which calls for a resistor of so many M. W. H. Focht, Tipp City, Ohio.

Editor's note. Let us hope that some agreement is reached concerning this M situation. At best it is confusing. Many kit builders who are unskilled in circuit analysis might well come to grief over a thing so small as an ambiguously coded half-watt resistor. AE

## AUDIOCLINIC

(from page 2)

direct current. As the control is advanced, a greater and greater charge is applied to coupling capacitor C, which charge is transferred to the grid of the first audio stage. If the grid resistor for this stage,  $R_g$ , were infinite, this charge could never leak off, and the tube would be cut off. As  $R_g$  is made smaller, the charge can leak off more and more easily. The size of the coupling capacitor also determines the time needed to discharge through  $R_g$ . If the capacitor is large it will have to take more time to discharge, since it took a greater charge initially. If the discharge rate is low there will be a negative voltage applied to the first audio grid every time the volume control is turned up, which may completely cut off the stage until balance is once again reached. Some may say that the capacitor is intended to block d.c. from ever getting onto that, which is true. Remember, however, that, so long as the capacitor is being charged, it does not exist. The process is something

like having a resistor substituted for the capacitor. When the d.c. is first applied, the resistance is zero, gradually rising to infinity, as the charge builds up to its maximum. In practice infinity is never reached, since there is always a certain amount of leakage present within the capacitor itself.

#### Note:

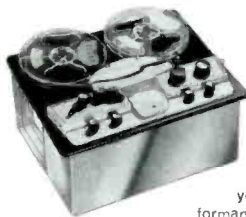
I should like to mention my other column, AUDIO TECHNIQUES, which starts on page 4 of this issue. The column contains hints and ideas on many aspects of the art of sound reproduction. These hints are, for the most part, supplied by you, the readers. Should you have suggestions which you think would be helpful to other readers, please send them to me at the address shown. Whether or not your suggestion can be included, it will be acknowledged, and you will be told whether or not it is to be included in a future column. AE

You've  
been  
asking for

  
**HEATHKIT**



**stereo sound equipment . . . and here it is!**



### stereo tape deck kit

HEATHKIT  
MODEL TR-1D **\$143<sup>95</sup>**

Enjoy the wonder of Stereophonic sound in your own home! Precision engineered for fine performance, this tape deck provides monaural-record/playback and stereo playback. Tape mechanism is supplied complete. You build only the preamplifier. Features include two printed circuit boards—low noise EF-86 tubes in input stages—mic and hi-level inputs—push-pull bias-erase oscillator for lowest noise level—two cathode follower outputs, one for each stereo channel—output switch for instantaneous monitoring from tape while recording. VU meter and pause control for editing. Tape speeds 3 $\frac{1}{2}$  and 7 $\frac{1}{2}$  IPS. Frequency response  $\pm 2$  db 40-12,000 CPS at 7 $\frac{1}{2}$  IPS. Wow and flutter less than .3%. Signal-to-noise 55 db at less than 1% total harmonic distortion. NARTB playback equalization. Make your own high quality recordings for many pleasant listening hours.

### stereo equipment cabinet kit

HEATHKIT MODEL SE-1  
(Price to be announced soon)

Beautifully designed, this stereo equipment cabinet has ample room provided for an AM-FM tuner—tape deck—preamplifier—amplifiers—record changer—record storage and speakers. Constructed of  $\frac{3}{4}$ " solid-core Philippine mahogany or select birch plywood, beautifully grained. Top has shaped edge and sliding top panel. Sliding doors for front access. Mounting panels are supplied cut to fit Heathkit units with extra blank panels for mounting your own equipment. Easy-to-assemble, all parts are pre-cut and pre-drilled. Includes all hardware, glue, legs, etc. and detailed instruction manual. Speaker wings and center unit can be purchased separately if desired. Overall dimensions with wings 82" W. x 37" H. x 20" D. Send for free details.



### DELUXE AM-FM TUNER KIT

HEATHKIT  
MODEL PT-1 **\$89<sup>95</sup>**

Here is a deluxe combination AM-FM tuner with all the advanced design features required by the critical listener. Ideal for stereo applications since AM and FM circuits are separate and individually tuned. The 16-tube tuner uses three circuit boards for easy assembly. Prewired and prealigned FM front end. AFC with on/off switch—flywheel tuning and tuning meter.



### STEREO PRE- AMPLIFIER KIT

HEATHKIT MODEL SP-1  
(Price to be announced soon)

This unique two-channel control center provides all controls necessary in stereo applications. Building block design lets you buy basic single channel now and add second snap-in channel later for stereo without rewiring. 12 inputs each with level control—NARTB tape equalization—6 dual concentric controls including loudness controls—built-in power supply.



### 55 WATT HI-FI AMPLIFIER KIT

HEATHKIT  
MODEL W-7M **\$54<sup>95</sup>**

First time ever offered—a 55-watt basic hi-fi amplifier for \$1 per watt. Features EL-34 push-pull output tubes. Frequency response 20 CPS to 20 KC with less than 2% harmonic distortion at full output throughout this range. Input level control and "on-off" switch provided on front panel. Unity or maximum damping factors for all 4, 8 or 16 ohm speakers.



### 12 WATT HI-FI AMPLIFIER KIT

HEATHKIT  
MODEL UA-1 **\$21<sup>95</sup>**

Ideal for stereo applications, this 12-watt power package represents an outstanding dollar value. Uses 6BQ5/EL84 push-pull output tubes. Less than 2% total harmonic distortion throughout the entire audio range (20 to 20,000 CPS) at full 12-watt output. Designed for use with preamplifier models WA-P2 or SP-1. Taps for 4, 8 and 16 ohm speakers.

**For complete information on above kits—Send for FREE FLYER.**

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easy-to-build

high quality

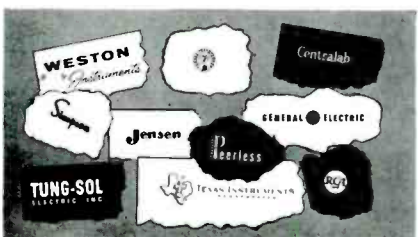
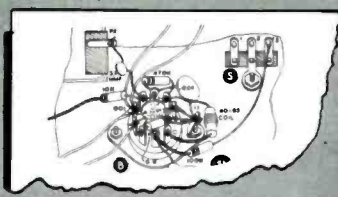
# HEATHKITS®

**Look** . . . how simply you can assemble your very own high fidelity system! Fun-filled hours of shared pleasure, and an everlasting sense of personal accomplishment are just a few of the rewards. Heathkits cost you only HALF as much as ordinary equipment and the quality is unexcelled. Let us show you how easy it really is! . . .



✓ Install a .001 µfd disc condenser from socket B7 (NS) to ground lug B11 (NS). Cut the leads so that they are just long enough to reach and dress the condenser close to chassis, over the wires already present.

Ⓛ Connect a 470 KΩ resistor (yellow-violet-yellow) from socket B7 (S) (2) to B8 (NS). Mount as close to the socket as possible.



**Step-by-Step Assembly Instructions** . . .  
Read the step . . . perform the operation . . . and check it off—it's just that simple! These plainly-worded, easy-to-follow steps cover every assembly operation.

**Easy-to-follow Pictorial Diagrams** . . .  
Detailed pictorial diagrams in your Heathkit construction manual show where each and every wire and part is to be placed.

**Learn-by-doing Experience For All Ages** . . .  
Kit construction is not only fun—but it is educational too! You learn about radio, electronic parts and circuits as you build your own equipment.

**Top Quality Name-Brand Components Used in All Kits** . . .  
Electronic components used in Heathkits come from well-known manufacturers with established reputations. Your assurance of long life and trouble-free service.



HEATHKIT

**bookshelf 12-watt amplifier kit**

MODEL EA-2

**NEW**

**\$27.95**

There are many reasons why this attractive amplifier is a tremendous dollar value. You get many extras not expected at this price level. Rich, full range, high fidelity sound reproduction with low distortion and noise . . . plus "modern" styling, making it suitable for use in the open, on a bookcase, or end table. Look at the features offered by the model EA-2: full range frequency response (20—20,000 CPS ± 1 db) with less than 1% distortion over this range at full 12 watt output—its own built-in preamplifier with provision for three separate inputs, mag phono, crystal phono, and tuner—RIAA equalization—separate bass and treble tone controls—special hum control—and it's easy-to-build. Complete instructions and pictorial diagrams show where every part goes. Cabinet shell has smooth leather texture in black with inlaid gold design. Front panel features brushed gold trim and buff knobs with gold inserts. For a real sound thrill the EA-2 will more than meet your expectations. Shpg. Wt. 15 lbs.

**TIME PAYMENTS AVAILABLE ON ALL HEATHKITS WRITE FOR FULL DETAILS**



## chairside enclosure kit

# NEW

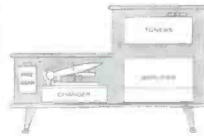
This beautiful equipment enclosure will make your hi-fi system as attractive as any factory-built professionally-finished unit. Smartly designed for maximum flexibility and compactness consistent with attractive appearance, this enclosure is intended to house the AM and FM tuners (BC-1A and FM-3A) and the WA-P2 preamplifier, along with the majority of record changers, which will fit in the space provided. Adequate space is also provided for any of the Heathkit amplifiers designed to operate with the WA-P2. During construction the tilt-out shelf and lift-top lid can be installed on either right or left side as desired. Cabinet is constructed of sturdy, veneer-surfaced furniture-grade plywood  $\frac{1}{2}$ " and  $\frac{3}{4}$ " thick. All parts are precut and predrilled for easy assembly. Contemporary available in birch or mahogany, traditional in mahogany only. Beautiful hardware supplied to match each style. Dimensions are 18" W x 24" H x 35 $\frac{1}{2}$ " D. Shpg. Wt. 46 lbs.



CE-1C Mahogany  
CE-1CB Birch



CE-1T Mahogany  
TRADITIONAL



CONTEMPORARY

Be sure to specify  
model you prefer

**\$43<sup>95</sup>**  
each



HEATHKIT

### high fidelity FM tuner kit

For noise and static free sound reception, this FM tuner is your least expensive source of high fidelity material. Efficient circuit design features stabilized oscillator circuit to eliminate drift after warm-up and broadband IF circuits assure full fidelity with high sensitivity. All tunable components are prealigned so it is ready for operation as soon as construction is completed. The edge-illuminated slide rule dial is clearly numbered for easy tuning. Covers complete FM band from 88 to 108 mc. Shpg. Wt. 8 lbs.

MODEL FM-3A \$25.95 (with cabinet)



HEATHKIT

### broadband AM tuner kit

This tuner differs from an ordinary AM radio in that it has been designed especially for high fidelity. A special detector is incorporated and the IF circuits are "broadbanded" for low signal distortion. Sensitivity and selectivity are excellent and quiet performance is assured by a high signal-to-noise ratio. All tunable components are prealigned before shipment. Incorporates automatic volume control, two outputs, and two antenna inputs. An edge-lighted glass slide rule dial allows easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 9 lbs.

MODEL BC-1A \$25.95 (with cabinet)



HEATHKIT

### master control preamplifier kit

Designed as the "master control" for use with any of the Heathkit Williamson-type amplifiers, the WA-P2 provides the necessary compensation, tone, and volume controls to properly amplify and condition a signal before sending it to the amplifier. Extended frequency response of  $\pm 1\frac{1}{2}$  db from 15 to 35,000 CPS will do full justice to the finest program material. Features equalization for LP, RIAA, AES, and early 78 records. Five switch-selected inputs with separate level controls. Separate bass and treble controls, and volume control on front panel. Very attractively styled, and an exceptional dollar value. Shpg. Wt. 7 lbs.

MODEL WA-P2 \$19.75 (with cabinet)

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"do-it-yourself"  
electronics



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**HEATHKIT 25-WATT**

MODEL W-5M

**\$59<sup>75</sup>**



**HEATHKIT 70-WATT**

MODEL W-6M

**\$109<sup>95</sup>**

**high fidelity amplifier kits**

To provide you with an amplifier of top-flight performance, yet at the lowest possible cost, Heath has combined the latest design techniques with the highest quality materials to bring you the W-5M. As a critical listener you will thrill to the near-distortionless reproduction from one of the most outstanding high fidelity amplifiers available today. The high peak-power handling capabilities of the W-5M guarantee you faithful reproduction with any high fidelity system. The W-5M is a must if you desire quality plus economy! Note: Heathkit WA-P2 preamplifier recommended. Shpg. Wt. 31 lbs.

For an amplifier of increased power to keep pace with the growing capacities of your high fidelity system, Heath provides you with the Heathkit W-6M. Recognizing that as loud speaker systems improve and versatility in recordings approach a dynamic range close to the concert hall itself, Heath brings to you an amplifier capable of supplying plenty of reserve power without distortion. If you are looking for a high powered amplifier of outstanding quality, yet at a price well within your reach, the W-6M is for you! Note: Heathkit model WA-P2 preamplifier recommended. Shpg. Wt. 52 lbs.

**HEATHKIT DUAL-CHASSIS**  
MODEL W3-AM



**\$49<sup>75</sup>**

**HEATHKIT SINGLE-CHASSIS**  
MODEL W4-AM



**\$39<sup>75</sup>**



**high fidelity amplifier kits**

One of the greatest developments in modern hi-fi reproduction was the advent of the Williamson amplifier circuit. Now Heath offers you a 20-watt amplifier incorporating all of the advantages of Williamson circuit simplicity with a quality of performance considered by many to surpass the original Williamson. Affording you flexibility in custom installations, the W3-AM power supply and amplifier stages are on separate chassis allowing them to be mounted side by side or one above the other as you desire. Here is a low cost amplifier of ideal versatility. Shpg. Wt. 29 lbs.

In his search for the "perfect" amplifier, Williamson brought to the world a now-famous circuit which, after eight years, still accounts for by far the largest percentage of power amplifiers in use today. Heath brings to you in the W4-AM a 20-watt amplifier incorporating all the improvements resulting from this unequalled background. Thousands of satisfied users of the Heathkit Williamson-type amplifiers are amazed by its outstanding performance. For many pleasure-filled hours of listening enjoyment this Heathkit is hard to beat. Shpg. Wt. 28 lbs.



**HEATHKIT**

**high fidelity amplifier kit**

MODEL A-9C **\$35<sup>50</sup>**

For maximum performance and versatility at the lowest possible cost the Heathkit model A-9C 20-watt audio amplifier offers you a tremendous hi-fi value. Whether for your home installation or public address requirements this power-packed kit answers every need and contains many features unusual in instruments of this price range. The preamplifier, main amplifier and power supply are all on one chassis providing a very compact and economical package. A very inexpensive way to start you on the road to true hi-fi enjoyment. Shpg. Wt. 23 lbs.

**HEATHKIT**

**electronic crossover kit**



MODEL XO-1 **\$18<sup>95</sup>**

One of the most exciting improvements you can make in your hi-fi system is the addition of this Heathkit Crossover model XO-1. This unique kit separates high and low frequencies and feeds them through two amplifiers into separate speakers. Because of its location ahead of the main amplifiers, IM distortion and matching problems are virtually eliminated. Crossover frequencies for each channel are 100, 200, 400, 700, 1200, 2000 and 3500 CPS. Amazing versatility at a moderate cost. Note: Not for use with Heathkit Legato Speaker System. Shpg. Wt. 6 lbs.



**"LEGATO"**


## high fidelity speaker system kit

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




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

**\$325<sup>00</sup>** each



**HEATHKIT  
BASIC RANGE**

**HEATHKIT  
RANGE EXTENDING**



**MODEL SS-1B \$99<sup>95</sup>**

### high fidelity speaker system kits

**MODEL SS-1 \$39<sup>95</sup>**

A truly outstanding performer for its size, the Heathkit model SS-1 provides you with an excellent basic high fidelity speaker system. The use of an 8" mid-range woofer and a high frequency speaker with flared horn enclosed in an especially designed cabinet allows you to enjoy a quality instrument at a very low cost. Can be used with the Heathkit "range extending" (SS-1B) speaker system. Easily assembled cabinet is made of veneer-surfaced furniture-grade 1/2" plywood. Impedance 16 ohms, Shpg. Wt. 25 lbs.

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

## Free Catalog!

Don't deprive yourself of the thrill of high fidelity or the pleasure of building your own equipment any longer. Our free catalog lists our entire line of kits with complete schematics and specifications. Send for it today!



### NEW! "DOWN-TO-EARTH" HIGH FIDELITY BOOK



THE HOW AND WHY OF HIGH FIDELITY, by Milton Sleeper, explains what high fidelity is, and how you can select and plan your own system. This liberally-illustrated, 48-page book tells you the HI-FI story without fancy technical jargon or high-sounding terminology. **25c**

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

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**ALSO SEND THE FOLLOWING KITS:**

QUANTITY	ITEM	MODEL NO.	PRICE

Enclosed find \$..... Please enclose postage for parcel post—express orders are shipped delivery charges collect. All prices F.O.B. Benton Harbor, Mich. NOTE: Prices subject to change without notice.

# AUDIO ETC.

Edward Tatnall Canby

## 1. SUM-AND-DIFFERENCE BROADCASTS

**W**ITH ALL DUE RESPECT to a number of worthy tuner manufacturers, I suggest, and am suggesting to all comers, that the stereo AM-FM tuner is not a very good permanent investment. Stereo sound via simultaneous FM and AM transmission seems to me to be the most obvious of temporary expedients, doomed to disappear along with the two-arm, two-cartridge "binaural" disc, as a useful and interesting transition device—but no more.

Economics work in odd ways in such matters. It isn't easy for anybody to know just when a new and superior way of doing things is likely to turn commercial in a respectable style. FM itself was a case in point and still is relatively in an unsettled state, after hanging on doggedly through the dark days of the postwar FM slump. (We all were expecting an FM boom; instead, the boom was in TV and FM came close to dying, superiority or no.) "Binaural broadcasts" have been with us now for a surprisingly long time and the practice continues to expand, or hold its own. WQXR in New York, one of the first in the U.S. (was it *the* first?) to broadcast AM-FM two-channel sound, is making hay with the new interest in stereo and the abundant material now available; WQXR even advertises its daily stereo schedule, live and recorded, in the newspapers.

Nevertheless, FM-AM stereo transmission is a makeshift and, for my money, an unfortunate one. If the lateral-vertical stereo disc was put aside because of inherent dissimilarities in the two channels, then FM and AM invite the same—and much more potently. I suppose that with a first-rate AM signal from a nearby station, a high-quality AM tuner, broad-band, and no inconvenient man-made static in the neighborhood, you can get an AM sound that is at least comparable in quality in a rough way to that of a companion FM signal. I have my strong doubts if there are many situations in which the two signals are really alike in quality. I've never heard such a set-up. Plain fact is that AM and FM are inherently different in sound, and that is that.

When will FM multiplex stereo come in? I have no present information, but have noticed a good deal of preliminary activity here and there. Economics, again, are the determinant, and stereo disc will be enough, thank you, for the immediate stereo future.

But when stereo disc has established it-

self, when the public jitters and distrust—which are going to be big jitters, I fear—have given way to appreciation of stereo's simplicity, ingenuity and effectiveness in the disc form (my feelings, anyhow), then there should be a fine demand for the related and easily tied-in feature of stereo broadcasting via FM multiplex. Personally, I'm going to wait for this. I feel no urge at all to equip myself with anybody's stereo AM-FM system. But a working multiplex system for an FM tuner would fine me immediately receptive. And since there are various negotiations now going on in respect to coming FM multiplex broadcasts, I suspect we'll have something to listen to in the reasonably near future.

The beauty of FM multiplex stereo, in respect to present disc stereo developments, is that the two are so intimately related in their use of stereo information. The 45/45 disc contains the sum of the two stereo channels in its lateral groove configuration—the element that conveys the essential monaural information; therefore a laterally played stereo disc gives you the full monaural musical sound of both tracks. The vertical disc component is the difference signal, which conveys the essential stereo information. Play your disc on a monaural system and you have the complete monaural effect, not just one channel.

FM multiplex will broadcast not the two channels, right and left—as in present AM-FM broadcasting—but these same sum and difference signals. That is enormously important, and is the key to future broadcast stereo compatibility. The sum signal will go out on the regular FM channel, and can be received in the standard manner, for full FM coverage. (As things are now, each channel in the stereo broadcast is one half of the music, a lopsided view, left-hand or right-hand.) The difference signal will be sent out via the second channel, courtesy of multiplex; the unscrambler in your FM tuner will extract it and send the two signals, sum and difference, through a phasing network, now called a matrix (see last month's issue), to give the right and left channels as in the original.

The idea of sum-and-difference broadcast via FM multiplex is such a "natural" that—barring economics—it just has to succeed. Just when the time of success is actually to come is another matter. The sooner the better, I say, and meanwhile, the preliminary steps are being taken, both in the broadcasting end, via permits granted by F.C.C. and assorted current experimental broadcasting, and in the

tuner end via such things as FM multiplex attachment connections—for the when and if—already present in some commercial hi-fi equipment. Frankly, I'll be looking forward to FM stereo broadcasting.

P.S. A radio man in Philadelphia, Ed Snipe, has mentioned to me an interesting and typical distortion of stereo that he has noticed via the present FM-AM stereo broadcasts—the effect of limiter action, on the AM channel but not the FM channel. Limiters can be pretty potent in their alteration of signal volume, yet ordinarily, on one channel only, we aren't too aware of it. But as soon as you combine a limited AM signal with an unlimited FM signal for stereo effect, you get a startling unbalance in the volume, which is constantly changing.

The results are not too hard to imagine, since volume balance between the two stereo channels is essential if the subtleties of phasing and signal-difference are to register intelligibly. When the FM channel fades to a whisper but the AM channel is boosted up, a musical soloist, to take an example, suddenly moves over to the AM side—but when the volume increases to maximum and the FM side is very loud but the AM is held down by the limiter, your soloist migrates over to the other side of the room, taking most of his orchestra along with him. The attendant change in the relative level of background hiss and interference on the AM side must be doubly distressing, I should guess.

In fact, I wince and shudder every time I think of these hideous annoyances, and others, in AM-FM stereo. Definitely, it is not for hi-fi performance.

## 2. PILE OF LPS

There's a mighty big Tenth Anniversary to celebrate this month, the decennial of the LP record, first announced in June, 1948, a year and a month after this magazine's debut under its original name, AUDIO ENGINEERING.

Most other columnists, following today's usual practice, have long since finished shouting about LP's Tenth. (They're probably doing advance research on the Twentieth by now.) Back in January, the other magazines were full of it. But now, at the actual moment, I seem to have the field to myself. I'm just old-fashioned.

Mr. Bill Schwann, who runs the little Schwann Long Playing Record Catalogue, has fortunately come up with his own celebration, the 100th mensiversary (you find a better name) of his own publication, which was last month's issue of the catalogue. In that connection, and as the man who knows most about LP statistics, he issued a compilation of numerical material on LP during these ten years that has both confirmed my worst fears and made me feel a bit better about the woes of record reviewing in the LP age. Lord! What a pile of records, over ten years!

So allow me to take a speculative spin with you into Mr. Schwann's incredible statistics, to put some perspective behind them in terms of the average man's home listening. Figures are figures, but to give them meaning we've got to translate them into man-hours of home listening, dollars and cents of cash buying and the like. If

(Continued on page 30)



the experts say... in High Fidelity the best buys are



EICO  
KITS and WIRED

**BETTER ENGINEERING** Since 1945 EICO has pioneered the concept of test instruments in easy-to-build kit form — has become world-famous for laboratory-precision instruments at low cost. Now EICO is applying its vast experience to the creative engineering of *high fidelity*. Result: high praise from such authorities as Canby of AUDIO, Marshall of AUDIOCRAFT, Holt of HIGH FIDELITY, Fantel of POPULAR ELECTRONICS, Stocklin of RADIO TV NEWS, etc. — as well as from the critical professional engineers in the field.

**SAVE 50%** Mass purchasing, and a price policy deliberately aimed to encourage mass sales, make this possible.

**EASY INSTRUCTIONS** You need no previous technical or assembly experience to build any EICO kit — the instructions are simple, step-by-step, "beginner-tested."

**DOUBLE 5-WAY GUARANTEE** Both EICO, and your neighborhood distributor, guarantee the parts, instructions, performance... as well as *lifetime* service and calibration at nominal cost... for any EICO kit or wired unit.

**BEFORE YOU BUY, COMPARE** At any of 1200 neighborhood EICO distributors coast to coast, you may examine and listen to any EICO component. Compare *critically* with equipment several times the EICO cost — then you judge. You'll see why the experts recommend EICO, kit or wired, as best buy.

† Thousands of unsolicited testimonials on file.



HF52 Speaker System



HF190 FM Tuner with "eye-tronic" tuning



HF61 Preamplifier



HF60, HF50 Power Amplifiers



**HF52 Speaker System:** Uniform loading & natural bass 30-200 cps achieved via slot-loaded split conical bass horn of 12-ft path. Middles & lower highs from front side of 8 1/2" cone, edge-damped & stiffened for smooth uncolored response. Suspensionless, distortionless spike-shaped super-tweeter radiates omni-directionally. Flat 45-20,000 cps, useful to 30 cps. 16 ohms. HWD: 36", 15 1/4", 11 1/2". "... rates as excellent... unusually musical... really non-directional!" — Canby, AUDIO. "Very impressive!" — Marshall (AUDIOCRAFT). Walnut or Mahogany, \$139.95. Blonde, \$144.95.

**HF190 FM Tuner** equals or surpasses wired tuners up to 3X its cost. New, pre-wired, pre-aligned, temperature-compensated "front end" — drift-free. Sensitivity, 1.5 uv for 20 db quieting, is 6X that of other kit tuners. DM-70 traveling tuning eye. Response 20-20,000 cps±1 db. Cathode follower & multiplex outputs. Kit \$39.95. Wired \$65.95. Cover \$3.95. \*Less cover, excise tax incl.

**HF61A Preamplifier**, providing the most complete control & switching facilities, and the finest design, offered in a kit preamplifier, "... rivals the most expensive preamps..." is an example of high engineering skill which achieves fine performance with simple means and low cost." — Joseph Marshall, AUDIOCRAFT. HF61A Kit \$24.95, Wired \$37.95, HF61 (with Power Supply) Kit \$29.95, Wired \$44.95.

**HF60 60-Watt Ultra Linear Power Amplifier**, with Acro T0-330 Output Transformer, provides wide bandwidth, virtually absolute stability and flawless transient response. "... is one of the best-performing amplifiers extant; It is obviously an excellent buy." — AUDIOCRAFT Kit Report. Kit \$72.95. Wired \$99.95. Matching Cover E-2 \$4.50.

**HF50 50-Watt Ultra-Linear Power Amplifier** with extremely high quality Chicago Standard Output Transformer. Identical in every other respect to HF60 and same specifications up to 50 watts. Kit \$57.95. Wired \$87.95. Matching Cover E-2 \$4.50.

**HF30 30-Watt Power Amplifier** employs 4-EL84 high power sensitivity output tubes in push-pull parallel, permits Williamson circuit with large feedback & high stability. 2-EZ81 full-wave rectifiers for highly reliable power supply. Unmatched value in medium-power professional amplifiers. Kit \$39.95. Wired \$62.95. Matching Cover E-4 \$3.95.

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# EDITOR'S REVIEW

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## STEREO CONVERSION

**W**ITH EVERYONE in the industry talking and thinking stereo, the one-channel listener seems to have been forgotten, at least temporarily. It must be admitted, however, that there are many music lovers who are not yet ready for the two-channel set-up, their reasons being anything from lack of space for two speakers, lack of space in the budget, or general lack of interest in stereo because they haven't yet either heard it, or at least not been convinced, clear up to a general dissatisfaction with the present state of development of the equipment necessary to provide the complete system. If we may be permitted a few words of unasked-for advice, we should like to sound off on the subject this month.

Not everyone has the space to accommodate two complete speaker systems in his living room—that's for sure. Many of us may have had to fight for space enough for one good system, and may be loath to reopen the discussion just to get another speaker in the room. Few of us have diggings which would accommodate a JBL Ranger-Paragon stereo speaker, although from our experience we feel that this unit is the *only* one we have seen that is suitable for reproducing a concert from the stage of an auditorium—far better than two conventional high-quality speaker systems spaced apart on the stage at a chosen distance.

The Electro-Voice Stereon speaker, which graced the cover of last month's issue, is a step in the direction of a two-speaker system. This arrangement employs a usual type of full-range speaker in which the low frequencies of both channels and the highs of one are fed to the main speaker, with the highs only of the second channel being fed to the Stereon. While the unit pictured last month was, in effect, the top end of the larger E-V systems, the same principle could be employed—either by combining the lows from both channels to a single woofer and using two separate tweeters, or by following the same arrangement as in the Stereon.

A corner speaker adapts itself readily to this arrangement, since the two tweeters could be mounted so as to project from the sides of the cabinet, and thus reflect off the adjacent walls to give a fairly wide spacing. Many similar arrangements are possible, and we would welcome details of any home constructed units that work out to the satisfaction of their builders.

We are sorry to say that we have not completed our study of simplex systems to provide two-channel operation with what is essentially a single amplifier, but hope to report further on this idea in the near future.

While many audiophiles have been holding back on equipment purchases to await "the last word" in stereo facilities, some may be doing themselves a disservice by so doing because they are missing many hours of pleasurable entertainment from good single-channel equipment—and remember that we have been fairly well pleased with monaural reproduction for several years, and there is still an enormous library of monaural records. One plan which gives the music lover an opportunity to buy what he needs now without the purchase being a total loss was recently introduced by Shure Brothers, Inc. Their plan permits you to buy either of their two high-quality monaural phono pickups *now* with the agreement by the company to credit you with 75 per cent of the purchase price on an equivalent type of stereo pickup anytime up until the end of 1959. That means that for one quarter of the price, you may "rent" one of these pickups for a year and a half—and by that time it is assumed that you will have decided what your final system might be. We believe this a fair offer, and it would seem possible that other companies might follow suit.

The audiophile who needs a new basic amplifier now has no problem—since he will need two for stereo use he will incur no loss by purchasing an amplifier now; when he does convert to stereo he simply buys another basic amplifier and, perhaps, a suitable preamp for stereo use. Even a complete amplifier—one which has controls—need not be junked at the conversion period. The existing "front end" can be used for one channel and another front end added for the second, perhaps for use with a basic amplifier. If the user wants a preamp designed for stereo use, he can readily tap into the complete unit and use only the power stages for one of the channels.

In other words, we feel that there is little need to "junk" any present equipment—although it might be more desirable to end up with a stereo preamp than with two single-channel units—the rest of the equipment still remains the same. There is no need to hold back in buying phonograph turntables or changers, since there will be no special requirement for stereo use, and even a stereo pickup may be used with a monaural system. Tape recorders are already available with stereo heads—and even those which are not so equipped can usually be converted to stereo use if desired.

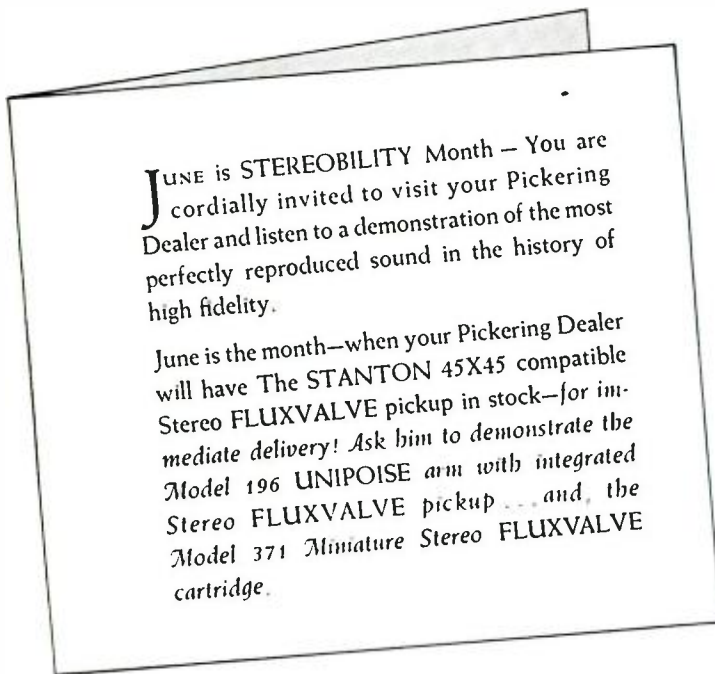
And so we say that the time to buy equipment is when you need it. No matter what one finally decides on as best suited to his requirements, there is likely to be something better introduced tomorrow. So why wait?

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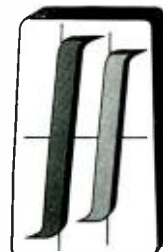
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1948—Early “point contact” transistor.

## The remarkable transistor observes its 10th birthday

In 1948, Bell Telephone Laboratories announced the invention of the transistor. In 1958, the transistor provided the radio voice for the first United States satellite.

To advance the transistor to its high level of usefulness, Bell Labs had solved problems which, in themselves, approached the invention of the transistor itself in scientific achievement.

First, there had to be germanium of flawless structure and unprecedented purity. This was obtained by growing large single crystals—and creating the “zone refining” technique to purify them to one harmful part in *ten billion*.

The “junction” transistor, another radical advance, spurred transistor use. Easier to design, lower

in noise, higher in gain and efficiency, it became the heart of the new electronics.

An ingenious technique for diffusing a microscopically thin layer on semiconductors was created. The resulting “diffused base” transistor, a versatile broadband amplifier, made possible the wide use of transistorized circuits in telephony, FM, TV, computers and missiles.

In telephony the transistor began its career in the Direct Distance Dialing system which sends called telephone numbers from one exchange to another.

For Bell System communications, the transistor has made possible advances which would have been impossible or impractical a brief decade ago.



1958—Satellite transistor, incorporating 10 years of Bell Labs research and development.



# BELL TELEPHONE LABORATORIES

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# Comb Filters, Anyone?

NORMAN H. CROWHURST\*

Various means have been proposed to provide a stereophonic effect from a single-channel source so that our old records and tapes and our radio reception will not need to sound so much different from stereo. The author points out some of the fallacies of one of these methods.

**W**HY WOULD I need a comb filter, what on earth is it, and what would I do with it?" you are probably asking. Well, maybe you could do some basic research with it—for example, prove the multiplication table. At some time in our youth most of us must have written down three figure 4's, added them up with the aid of our fingers, beads, or what-have-you, and found that the result was 12. From this one concludes presumably that the process called multiplication is an extension or simplified method of performing repeated addition. This would seem to be pretty basic. However, maybe someone *could* come along with a computer designed exclusively for the purpose of multiplication and, by a variety of "basic research," could "prove" that the process of multiplication has no connection whatever with the process of addition.

Would this be a useful thing to do, and what possible connection does it have with high fidelity reproduction or stereophonic sound? Quite frankly we don't see that either. We wouldn't even mention it if we hadn't attended a certain session at the Audio Engineering Society convention last fall where a paper was presented on the subject, "An Artificial Stereophonic Effect Obtained From Using a Single Signal."

This paper used the usual mathematical approach with a liberal sprinkling of E-to-the-jay-omega-t's and cos-omega-t-plus-jay-sine-omega-t's, to help enforce the impression that the author knew what he was talking about. It also introduced a series of what are called Comb Filter Experiments. We are sure that many of these experiments have never been conducted before. But the real question comes: what do they prove, and do they prove what the author of this paper contended?

One advantage of attending a convention such as this is that one learns what comb filters are. If we had not been present, we might have gone through the rest of our lives in ignorance of this enlightening information. Comb filters consist of a set of narrow band-pass filters, similar to those used for performing spectral analysis of sound, so that alternate groups of 200-cps frequencies are separated into two different channels.

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

The first 200 cps, for example, would go to channel 1, 200 to 400 cps would go to channel 2, 400 to 600 to channel 1 again, 600 to 800 to channel 2 again, and so on all the way up the audio spectrum. (These are not the actual frequencies used in the paper, but are used to make it easier to follow). The object of the experiment was to use these comb filters with different "intensity and phase variations," in each channel, playing single channel program into the system, and finally feeding the resultant to a pair of headphones for the listener to determine whether any "stereophonic effect" was produced.

## A Comparison

It does not take very much simple logic to work out the answer, without the cumbersome mathematics—or the need for a series of comb filter experiments. The experiment of taking a recording, either on disc or on tape, and using two pickups spaced apart a fraction of an inch, so the time difference in picking up the same sound information is just a matter of a few milliseconds, has been conducted many times. We did it at least 25 years ago, and we hesitate to claim any originality in this "experiment."

If these two pickups are connected so as to play through the same amplifier and loudspeaker, it does not require very much mathematical analysis to show that at certain frequencies the output from the two pickups will add together while at other frequencies they will be out of phase so one will subtract from the other. This will result in a frequency response for the combination very much like the comb filters of this "very advanced" paper. At all multiples of the frequency where the first cancellation takes place there will be another cancellation. And at intermediate frequencies the outputs will add.

This has been tried any number of times over the years. The effect is rather like added reverberation—and added "liveness" to the sound. If the timing between pickups is close enough, there is no distinct "echo," but it gives the same effect as playing the program in a room without any damping of any kind—furnishings and so on—or it sounds as if the room were larger than it really is. True it does not produce a

stereophonic effect. It gives no sense of perspective or direction to individual sounds.

## Effect in Auditorium

But now consider what happens when you are sitting in an auditorium where sound comes both directly from the orchestra to you and by reverberation paths which take a little longer. Each ear will be receiving two distinct patterns of sound with a certain time difference between them. The time differences will vary slightly for each ear because it is not located at the same point in the auditorium.

If we were to analyze the frequency response of the auditorium from a position in the orchestra to each ear we should find a response that looked very much like the comb filter, or the combination of two pickups being played a short time distance apart with their outputs combined. In fact it would look very much like a loudspeaker response, measured in a "live" room, because of "standing waves." Each ear location taken will show a similar response, but equivalent to a *different* "comb filter."

The direct sound from the orchestra will of course arrive, without benefit of such filtration, a small fraction of time before the reverberation gets there to produce the comb filter action. It seems the Bell Labs experiments that formed the basis for this paper really did exactly this same thing by electronic means.

The original experiment performed by Lauridsen in Denmark in 1954 was repeated at the end of the lecture about comb filters. It consisted of playing two pickups with time difference between them. The first pickup played through a channel that fed a loudspeaker directly facing the audience in a conventional type of enclosure. The second pickup went through a second channel that fed a loudspeaker mounted in an open baffle board crosswise on to the audience, so the sound from the back and the front of the cone radiated sideways and produced a cross pattern.

If you have ever done any experimenting with loudspeakers and mounting you may have noticed that a loudspeaker unit mounted on an open baffle board sounds quite good if you are

(Continued on page 61)

# A Complete Tone Compensator

ROBERT M. VOSS\*

If you aren't satisfied with already existing types of tone controls, you may find this combination of the two common circuits exactly to your liking. Such a unit is easy to construct because critical preamplifier circuits are not included.

**A** VOLUME POTENTIOMETER is probably the essential control in any audio system, and one hears some wonderful sound from setups in which a tuner equipped with one is directly connected to power-amplifier and speaker system.

Most high-fidelity systems, however, also include record players, and it is at this point that some additional control over the sound is desirable. Quite a few records, even when correctly equalized, need some other means of frequency correction in order to sound balanced. In addition, few preamplifiers provide the correct curves for every record, and even a modest record collection usually contains a few discs that sound excessively screechy even when played with a 16-db-at 10,000-cps rolloff. Since 16 db is the largest amount of pre-emphasis most equalizers can compensate for, it is obvious that we need some way of further reducing the treble. Similar situations, of course, arise in the low-frequency range, so the audiophile finds himself in need of variable tone control action at both ends of the sound spectrum.

Two types of tone controls are in general use. Of the two, the older is the variable-slope, fixed-crossover type. This type varies the boost or cut on either side of a frequency—usually in the vicinity of 1000 cps—which remains constant. Hence, only the slope varies, and it is impossible, for instance, to vary the response at 10,000 cps without causing

\* 697 West End Ave., New York 25, N.Y.

a change (although appreciably less) at 2500 cps, or to boost 100 cps without raising the 400-cps level. When properly designed, the bass and treble controls neither interact nor affect the midrange level, but furnish very useful frequency compensation. Figure 1 shows typical response curves.

Fairly recently, another type of action has come into wide use. Whereas the foregoing type varies only the slope, this type varies the turnover frequency, with typical curves like Fig. 2. Using this method, one can use a considerable amount of boost or cut below, for instance, 200 cps or above 5000 cps with little effect on the range in between. The variable-turnover design uses a large amount of negative feedback, and it is generally considered to be superior to the variable slope type. Its use of feedback is said to reduce distortion considerably, but even with conventional tone controls distortion does not enter into the picture (except for perhaps a slight deterioration of wave form) if driving levels are low.

Upon careful consideration, however, it is seen the neither type alone will take care of all conceivable adjustments. Consider, for example, a typical curve problem, that of an old NAB recording being played back through an RIAA equalizer. The first thing that the listener will notice is the lack of bass and the excessive treble. If he uses variable slope controls he will be successful in getting rid of the extra 2.25 db of treble at 10,-

000 cps. When he tries to lift up the bass, however, he will run into trouble, for both curves use 500-cps turnovers, and it is below 100 cps that the RIAA playback curve levels off while the NAB continues at a 6 db/octave rise. If he tries to boost the range below 100 cps he will also have to boost the range between 100 and 1000 cps, which will give him a broad upper-base peak giving the music a muffled character.

If, on the other hand, the listener attempts to correct the equalization using feedback tone controls, he will be able to touch up the bass very nicely, but he will not be able to effect a gradual treble rolloff from 1000 cps up. Instead, he will have to choose between a peak in the lower treble range or a loss of everything above 10,000 cps.

It is obvious, then, that only a combination of the two will take care of all problems, and will, in addition, enable the listener to produce some interesting side effects.

## Combination Unit

The unit described here includes both types of tone controls. Since it was used with associated equipment which included a gain control, its only means of level adjustment is a screwdriver shaft potentiometer located on the rear panel. If the builder desires, it can simply be moved to the front. This, however, necessitates the use of a larger chassis than the 5"×2"×7" model used by the author.

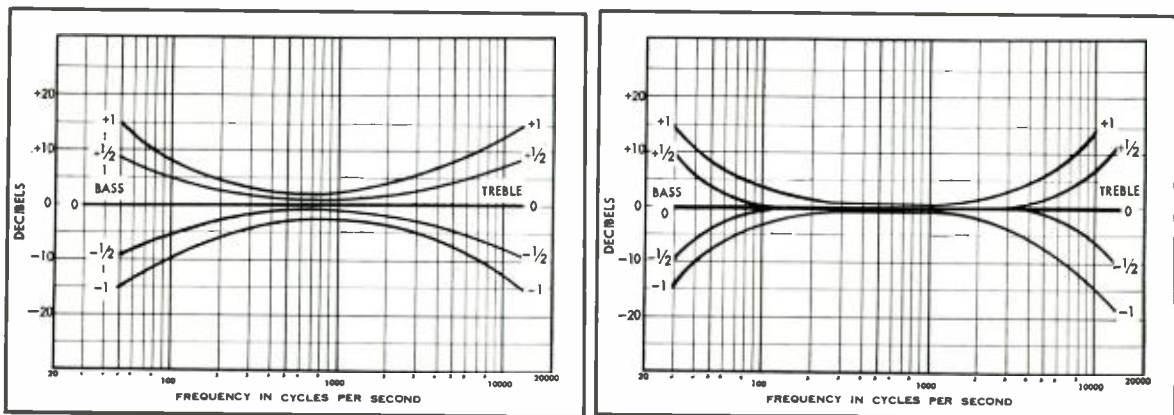


Fig. 1 (left). Typical curves obtained from fixed-turnover tone controls. Fig. 2 (right). Curves obtained from sliding-turnover or "Baxendall" type tone controls. These are measured curves from the unit described.

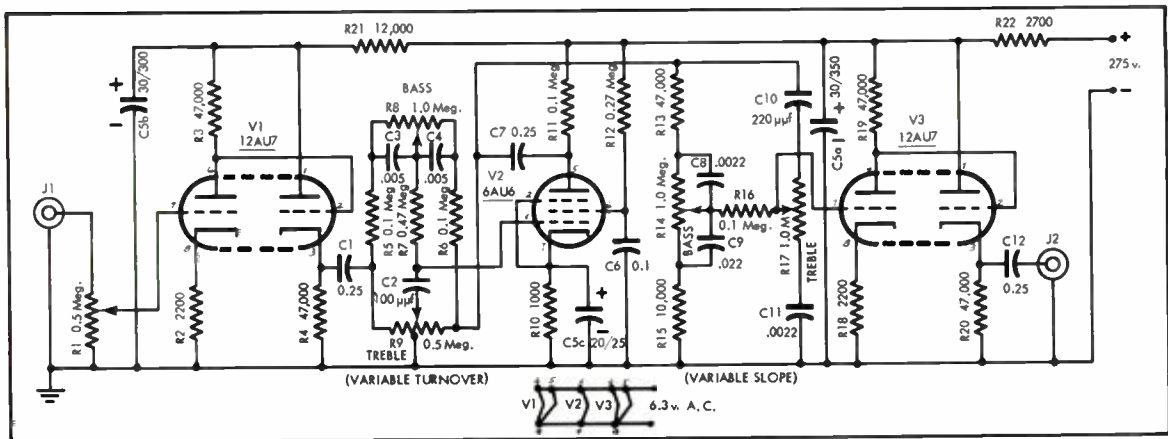


Fig. 3. Schematic of combination of tone-control types into one unit. Power may be obtained from main amplifier or from separate supply.

The operation of the tone compensator is simple. The signal first goes through a conventional voltage amplifier which is direct coupled to a cathode follower. The cathode follower, necessary because of the low input impedance of the next stage, then feeds the feedback tone control. The output of this stage (the mid-range gain of which is independent of the initial stage gain) then feeds directly to the conventional tone controls. After this comes another voltage amplifier direct coupled to the output cathode follower in the same manner as the first. Because of the low output impedance of the feedback control circuit, there is no interaction between any of the tone controls.

Inspection of the circuit, Fig. 3, will reveal feedback around every stage. The cathode resistors of the voltage-amplifier sections of the 12AU7's are left unby-passed more for the purpose of eliminating extra gain than of canceling the small amount of distortion produced.

If the builder already has a preamp with variable-slope tone controls, then he is advised to utilize only that portion

of the schematic up to the 6AU6. The output can then be taken from the "cold" side of the feedback capacitor at point A.

The compensator requires about 275 volts of well-filtered d.c. at about 10 ma, and 6.3 volts a.c. which has been balanced to ground to minimize hum.

In addition to touching up equalization, the tone compensator can be used to produce several interesting effects. If the variable-slope treble control be boosted about one quarter turn and the variable-turnover treble be cut by about the same amount, a smooth "presence" rise will be heard, as the feedback control will only cut those frequencies above about 4,000 cps. Figure 4 shows the resulting curve. Similarly, if a choral recording lacks volume in the tenor section, the variable slope and feedback bass controls should be boosted and cut, respectively, by about 90 degrees, giving a curve like Fig. 5. Many other possibilities will suggest themselves to the experimenter.

The tone compensator makes an interesting project, and, for about \$10 and

a couple of evenings of interesting construction, a very useful addition to any hi-fi system. **AE**

#### PARTS LIST

$C_{11}, C_{71}, C_{12}$	0.25 $\mu$ f, 400-volt, paper
$C_2$	100 $\mu$ f, mica
$C_3, C_4$	.005 $\mu$ f, 400-volt, paper
$C_{5a, b, c}$	30-30-20/350-300-25, electrolytic
$C_6$	0.1 $\mu$ f, 400-volt, paper
$C_8, C_{11}$	.0022 $\mu$ f, 400-volt, paper
$C_9$	.022 $\mu$ f, 400-volt, paper
$C_{10}$	220 $\mu$ f, mica
$J_1, J_2$	RCA phono jacks
$R_1$	0.5 megohms, audio taper potentiometer, serewdriver shaft
$R_2, R_{18}$	2200 ohms, 1/2-watt, carbon
$R_3, R_4, R_{19}, R_{20}$	47,000 ohms, 1-watt, carbon
$R_5, R_6, R_{16}$	0.1 megohms, 1/2-watt, carbon
$R_7$	0.47 megohms, 1/2-watt, carbon
$R_8$	1 megohm, linear taper potentiometer

(Continued on page 62)

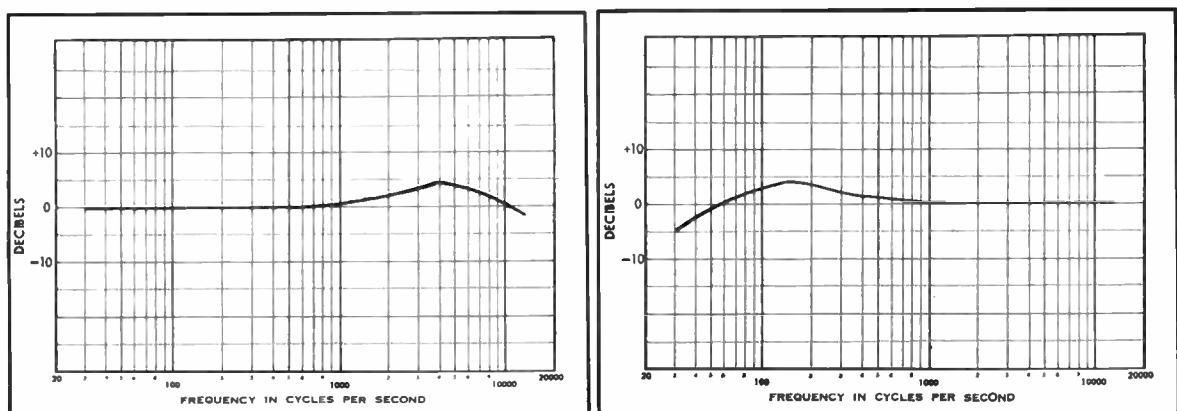


Fig. 4 (left). "Presence" rise obtainable from one setting of the two treble tone controls. Fig. 5 (right). "Tenor" rise which may be obtained by adjustments of the bass controls.

# Stabilized Variable-Sensitivity Tuning Meter

RONALD L. IVES\*

An instrument which will aid in tuning an AM receiver to the optimum setting and which is likely to find many uses around the audiofan's shop for various indicating chores.

**M**USICAL PROGRAMS of good tonal quality can be received on either one or two sidebands, using commercially-manufactured equipment of conventional design. Double-sideband transmission and reception are standard in the AM broadcast band. Tone quality of signals received on 1.77 sidebands, for example, is not likely to be good, when conventional equipment is used, yet this is exactly the type of reception that occurs when the received signal is not centered in the i.f. passband of the receiver.

Need for some sort of a tuning indicator has been recognized for several decades, yet few AM receivers are equipped with one, and many of those supplied are totally inadequate for the precise tuning needed to secure maximum tone quality.

Conventional designs which work well through a narrow range of signal strengths include the "Magic Eye" tube; a plate-current meter or plate-current bridge in one or more AVC-controlled stages; an AVC voltmeter, usually of the bridge type; a metered i.f. discriminator<sup>1</sup>; and a difference amplifier, consisting of two fixed resistors and two triodes, connected as a bridge, to measure AVC voltage. This is the most satisfactory type for most uses, as it is substantially immune to variations in line and battery voltages, and can be so arranged that a meter burnout by an extra-powerful signal is literally impossible. In its simplest form, this is the circuit of the most popular "S-Meter"

\* 2075 Harvard St., Palo Alto, Calif.

<sup>1</sup> Ronald L. Ives, "Hypersensitive resonance indicator." *Electronics*, August, 1950.

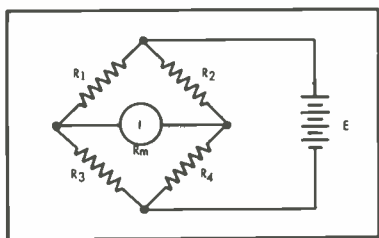


Fig. 1. Basic bridge circuit.

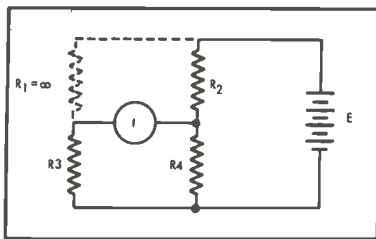


Fig. 2. Bridge circuit with one arm infinite.

used in amateur and commercial communications work. As slightly modified, to provide variable sensitivity, constant zero at all sensitivity settings, and separation of AVC and indicator functions, it becomes one of the most satisfactory tuning meters for all AM receivers, from high-fidelity music to high-intelligibility voice.

## Bridge Fundamentals

In any bridge circuit, such as that of Fig. 1, indicated current will be zero when  $R_1 = R_2$  and  $R_3 = R_4$ . Under these conditions, the bridge is said to be balanced. Likewise, maximum current will be indicated when three arms of the bridge are of finite value, and the fourth is infinite (open).

In this situation, when  $R_1$  is infinite (open)  $R_1 = R_2$ , and meter resistance is disregarded, the circuit of Fig. 1 reduces to that of Fig. 2, and indicated current is shown by:—

$$I = \frac{1}{2} \cdot \frac{E}{R_2 + \frac{R_3 + R_4}{2}} = \frac{E}{2R_2 + R_3 + R_4}$$

as computed from Ohm's and Kirchoff's Laws. More simply stated for this special case, indicated current will be one half of system current, which is that through  $R_2$ .

Meter resistance can be considered negligible, in this special application, when it is less than 1/10th of arm resistance. At this value, meter current is about 0.47 times the system current. As standard 0-1 mil d. c. meters, such as the Triplett 326-T, have resistance of about 55 ohms, meter resistance can be

disregarded if arm resistances ( $R_2$  and  $R_3$ ) exceed about 550 ohms.

## Difference Amplifiers

If either the upper or the lower pair of arms of Fig. 1 are replaced by similar triodes, we have what is commonly known as a difference amplifier. Four difference-amplifier circuits, all of which work, and work well, with a variety of dual triodes, or with two similar single triodes, are shown in Fig. 3. Under any operating conditions likely to be encountered, these difference amplifiers need neither a. f. nor r. f. isolation in their plate supplies, work well when the plate supply is poorly filtered, and are substantially immune to the drift problems and other gremlins that make most d. e. amplifiers so difficult to use effectively.

In all of these circuits, after initial balancing, if both grids are at the same potential, the bridge will remain balanced regardless of fluctuation in grid and plate potentials, and despite tube ageing, so long as both triodes age equally.

When the two grids are not at the same potential, the bridge is unbalanced, and current is indicated on the meter. Changes in plate and filament voltages will affect the amount of current indicated when the bridge is unbalanced, but this effect is usually small, and is partly compensated for by the cathode bias of the triodes.

Maximum meter deflection occurs when one triode (such as any  $V_1$  in Fig. 3) is cut off. Maximum meter current flows, under this condition, when load resistance  $R_{P1}$  in (B) of Fig. 3 is infinitely large with respect to meter resistance,  $R_m$ , at which time exactly half the current in the working triode,  $V_2$  flows through the meter. Actually, as already shown, little is gained by increasing the load resistance beyond ten times the meter resistance. This is most fortunate, as tube currents are zero with infinite load resistors.

From these considerations, which are helpful design guides, and not rigid Meadean laws, it appears that the circuit of



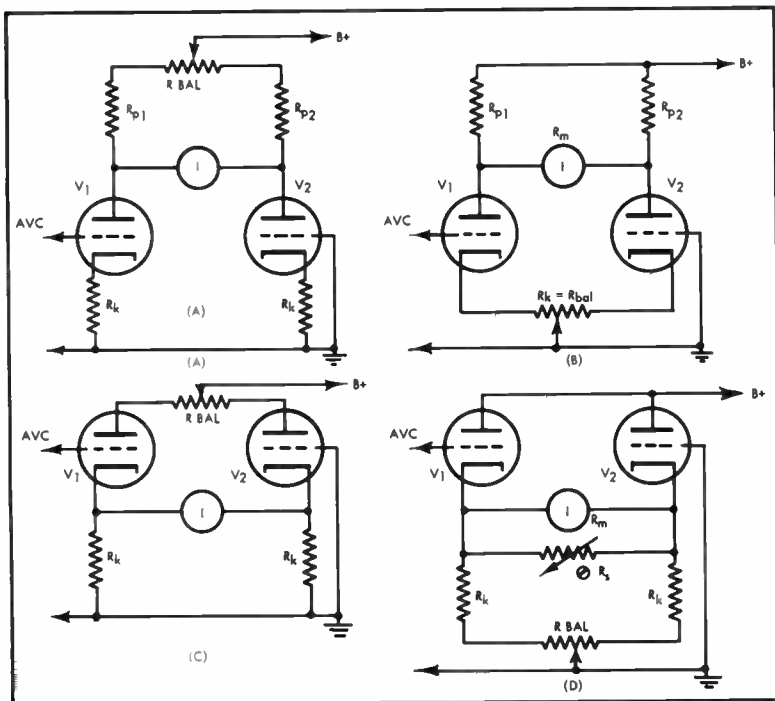


Fig. 3. Conventional difference-amplifier circuits.

(D) in Fig. 3 is electrically the best. Because it uses the fewest components, and operates with the control and indicator at the lowest potential with respect to ground, it is also the most practicable. All of the other circuits, however, as well as a large number of rather obvious modifications of them, work well, and have definite uses in other electronic metering applications.

In any of these circuits, with proper initial design and adjustment, it is impossible to damage the meter by applying too high a negative voltage to the input, and meter performance, in general, is stable, consistent, and trouble-free for the life of the tube.

#### Constants

The foregoing principles can be applied in a number of ways to make a tuning meter, using standard components, and needing no special test equipment or time-consuming adjustment to secure good operation. All circuit references will be to (D) of Fig. 3, although most of the discussion applies as well to the other difference amplifiers.

Because the resistance of a standard 0-1 d. c. milliammeter, such as a Triplett 327-T, is about 55 ohms, the cathode resistance should be not less than about 550 ohms, and the plate resistance of the tube used should exceed 5500 ohms. Tube current, per plate, when input voltage to grid 1 (AVC) is zero, should be about 2.5 milliamperes.

To permit the use of as many standard components as possible, without sacrificing meter range, a meter shunt, for

setting the range, is desirable. This should be about 250 ohms for the 55-ohm meter movement.

From the tube handbook, select a dual triode having a cutoff value, for the plate voltage to be used, equal to or less than the maximum AVC voltage produced by the receiver in normal operation. With many receivers, the AVC excursion exceeds the bias range of any conventional dual triode, and a variable input voltage divider, to be discussed later, is necessary.

From the characteristic curve of the tube chosen, determine the grid bias,  $E_g$ , for a plate current about 2.5 times the meter sensitivity. This will be 2.5 ma for a 0-1 ma meter. From this compute the cathode resistance,  $R_k$ , required, using the formula:—

$$R_k = \frac{1,000E_g}{I_p}$$

Where

$R_k$  = cathode resistance in ohms  
 $E_g$  = grid volts  
 $I_p$  = plate milliamperes

For the special case under consideration, in which  $I_p = 2.5$ , this reduces to:—

$$R_k = 400 E_g.$$

Now, select the balancing potentiometer,  $R_{bal}$ . This can be any convenient stock potentiometer, with a total resistance less than twice the  $R_k$  value computed above. The nearest size larger than one-fifth of  $R_k$  is usually quite satisfactory.

From the computed cathode resistance, subtract half of the balancing resistance. The result will be the theoretical value of the fixed cathode resistance,  $R_k$ . The practical value will be the nearest smaller 5-per-cent resistor. Two fixed cathode resistors are required, but exact matching is not necessary, as small unbalances in either the cathode resistors or the two halves of the dual triode can be corrected by adjustment of the balancing potentiometer.

Typical values of  $R_k$ ,  $R_{bal}$ , and  $R_s$ , for a variety of dual triodes operated with 250 volts on the plates, and using an 0-1 d. c. milliammeter in the circuit of (D) in Fig. 3 are given in Table I.

#### Variable Sensitivity

Because of the very wide range of signal strengths encountered today, accurate tuning with a single-range tuning meter is very difficult, and a variable sensitivity meter is most desirable. The simplest and most obvious method of attaining variable tuning meter sensitivity is to insert a high resistance potentiometer in the input, as in Fig. 4. This expedient works, and designs using it have recently been published by Amfahr<sup>2</sup> and Chambers.<sup>3</sup> Most unfortunately, this design does not work very well, and the meter has a balance point (zero) which shifts as the sensitivity is adjusted. Thus, when the meter is balanced at high sensitivity, it goes off scale backwards when the sensitivity is lowered. This makes comparison of signal strengths difficult, and leads to the neglect of weak signals between strong signals.

The shifting of the balance position

<sup>2</sup> W. U. Amfahr, "Unidirectional Loops for transmitter hunting," "Mobile Manual for Radio Amateurs," A.R.R.I., West Hartford, Conn., p. 298.

<sup>3</sup> C. V. Chambers, "The S-FS Indicator," QST, Sept. 1955.

TABLE I

Type	Cutoff	$E_g$ for 2.5 ma.	Cathode ckt. res.	$R_{bal}$	$R_k$	$R_s$
12AX7	— 4.0	— 1.3	540	250	220	250
6SL7	— 5.0	— 2	800	250	680	250
12AT7	— 12.0	— 4	1600	500	1300	250
6SN7	— 18.0	— 11	4400	1000	3900	250
12BH7	— 24.0	— 15	6000	1000	5600	250
12AU7	— 24.0	— 15	6000	1000	5600	250

Values of cathode, balancing, and shunt resistors for various dual triodes operated at 250 volts, and using a 1-ma. meter movement.

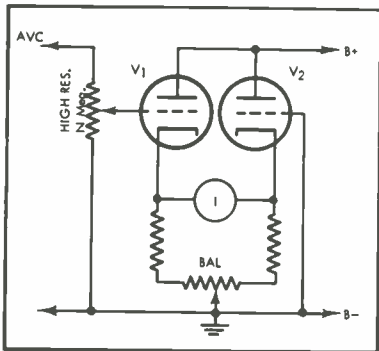


Fig. 4. Tuning meter input voltage divider.

of a difference amplifier as the input resistance is changed is due to contact potential, a fundamental property of vacuum tube circuits which is not very well described in most tube handbooks.

In any vacuum tube, the cathode emits a stream of electrons as long as it is hot. The grid projects into this stream of electrons, and intercepts some of them. If the grid return is of low resistance, as at (A) in Fig. 5, these electrons return to the cathode, and the grid acquires no (appreciable) charge as a result of this electron interception.

If, in contrast, the grid return is of high resistance (several megohms), as at (B) in Fig. 5, the electrons intercepted by the grid do not return easily to the cathode, but pile up on the grid, giving it a strong negative charge, amounting to several volts with some tubes when the grid resistance is about ten megohms. This produces partial cut-off of the tube, exactly as will a bias battery of equal voltage.

Contact potential is used by receiver

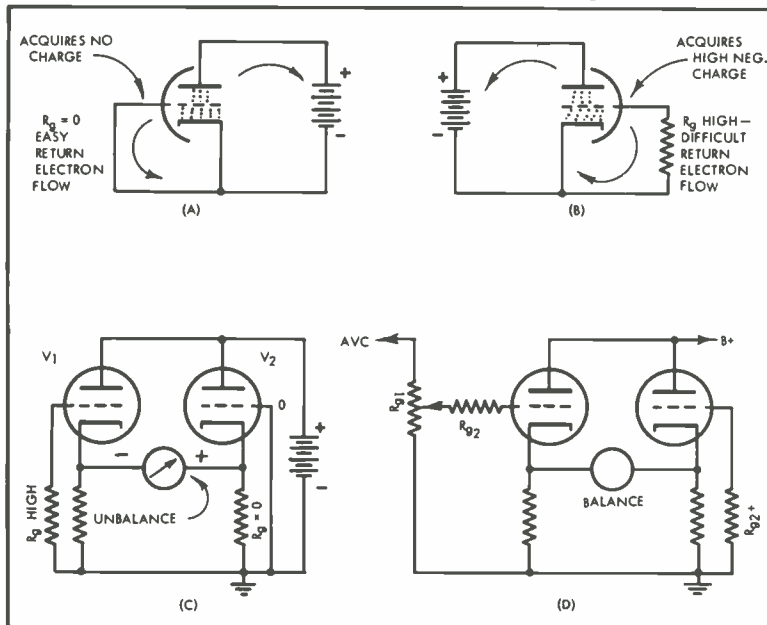


Fig. 5. Contact potential problems.

designers to bias single-cathode diode-triodes functioning as detector, AVC, and first audio stages in a variety of receivers.<sup>4</sup>

In the basic difference amplifier circuit, in which the grid of  $V_2$  is grounded, as in Fig. 4,  $V_1$  has contact potential, and the two halves of the triode are not in perfect balance until the balancing potentiometer is moved away from electrical center to compensate for the differing biases on the two halves of the dual triode. The initial unbalance condition is indicated in Fig. 5, C.

Theoretically, this contact potential effect can be reduced to a negligible value, but not to zero, by inserting a very high resistance in series with each grid lead. This is  $R_{g2}$  at (D) in Fig. 5. As the contact potential produced by the drop across  $R_{g2}$  far exceeds that produced in  $R_{g1}$ , adjustment of  $R_{g1}$  makes only a negligible change in the contact potential on the grid of  $V_1$ , and hence no visible effect on tube balance.

Unfortunately, the added resistance must be many times the original grid circuit resistance—ten or more times, in most instances. This calls for an added grid resistance of about 100 megohms, in tuning meter applications. With such high resistance, the tube cuts itself off, and will not function as a difference amplifier. If there is any gas in the tube, operation will be most nonstandard and unsatisfactory, due to gas conduction.

Practically, this contact potential effect can be reduced to a negligible value, and even to zero, by inserting a variable resistor, of suitable value, ganged with the grid potentiometer of  $V_1$ , in the grid

<sup>4</sup> "RCA Receiving Tube Manual," Technical Series RC-17, p. 272-274.

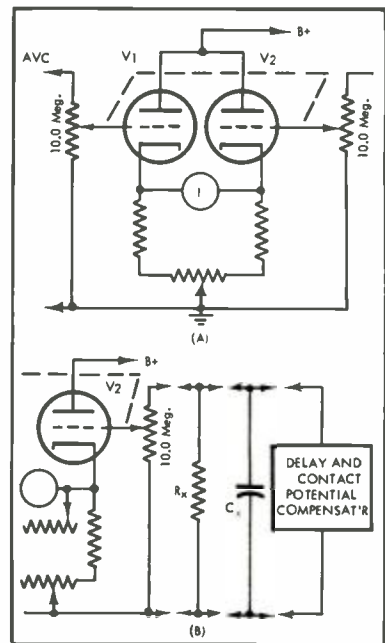


Fig. 6. Practical stabilization circuits.

circuit of  $V_2$ , as at (A) in Fig. 6. With this arrangement, the difference amplifier, used alone, will remain in balance regardless of the potentiometer setting.

When connected to a receiver, however, this balance is not so well maintained, as the metering circuit (such as the AVC circuit) contains resistance and capacitance which is shunted across the potentiometer of  $V_1$ . This resistance can be compensated for by inserting an equal resistance,  $R_c$ , in the grid circuit of  $V_2$ , as at (B) in Fig. 6. Capacitive compensation, provided by  $C_c$ , is usually necessary so that the instrument pointer will not "kick" as the sensitivity of the meter is changed by adjusting the dual grid potentiometer.

With these compensations, the tuning meter can be balanced at all sensitivity settings when the output of the metering circuit is zero at zero signal. As this is not the case with most AVC circuits, which have locally-produced contact potentials and usually some inserted delay bias, additional compensation or special connections, to be outlined under "Receiver Connections," will usually be needed.

#### Construction

Using the semi-theoretical material already discussed, it is possible to construct a tuning meter which will perform consistently, over a long period of time, with a minimum of adjustments while in use, even though the sensitivity can be varied at will over a wide range, such as ten to one.

Because many receivers are not equipped with an accessory socket; and because the accessory socket on most receivers so equipped is already over-

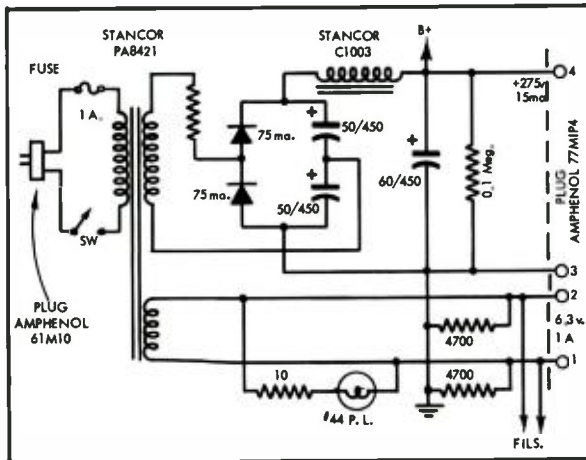


Fig. 7. Meter power supply circuit. Unmarked resistor from top of transformer secondary to junction of the rectifiers is 47 ohms.

loaded, this tuning meter is provided with an integral power supply, with enough surplus rating to operate one other accessory, such as a preamplifier or a Q multiplier. Circuit of the power supply comprises Fig. 7. This is a straightforward transformer-type voltage doubler which performs well under constant loads. The filter provided is more than adequate for meter operation, and is entirely satisfactory for supplying Q multiplier, but needs an additional section for operation of a preamplifier or similar device.

As should be obvious, all components were chosen with an ample margin of safety, to prevent in-service failures, even after several years of use.

Do not, in an effort to save approximately seventy five cents, make the plate supply "transformerless." Such connections will make the receiver chassis, and/or some part of the metering circuit, "hot," and may lead to a costly burnout of the receiver, as well as causing potential danger to anyone approaching either the receiver or the tuning meter.

Circuit of the complete difference am-

plifier is shown in Fig. 8. Connection of the plug to both the metering and compensating circuits makes possible the use of this meter with a wide variety of receivers, each containing the necessary components to compensate for delay voltages and contact potential internally produced.

Fig. 9. Panel view of variable sensitivity tuning meter.

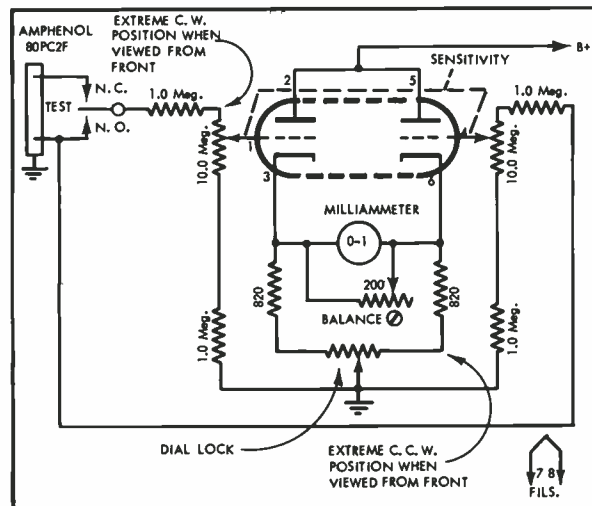


Fig. 8. Complete difference amplifier circuit.

is shown in Fig. 9, and the bottom view in Fig. 10.

The a. c. input, fuse, shunt adjustment, AVC input, and power output connections are mounted on the rear of the cabinet, which is pierced at the top (Continued on page 56)



Fig. 10. Bottom view of meter, showing ventilating grille and rubber feet.

# Three-Channel Remote Amplifier

ALBERT STRATMOEN\*

Simple and effective design results in remote amplifier which is compact and convenient. Circuitry is readily adaptable to other applications—with suitable equalization—such as preamplifiers for tape heads or phonograph pickups.

**T**HIS AMPLIFIER is designed for hard usage with small expense and high performance. The drain on its 9-volt battery is only 6.5 milliamperes, so battery cost should be less than a cent an hour. The noise level is 58 db below zero VU for maximum gain or -140 dbm referred to the input. Distortion averages about 0.75 per cent at zero VU and about 1.5 per cent at +4 VU. Frequency response is down 1.5 db at 50 cps and up 1 db at 7500 cps. Hum and microphonics are non-existent and temperature compensation is adequate for practical purposes. Its three inputs should take care of most remote set-ups even church pickups.

The chief problem in transistor amplifiers is, of course, noise. I have found that proper operating points and low-noise resistors are just as important as low-noise transistors. Ordinary carbon resistors can make enough noise to rival the most noisy transistors. The operating points in this circuit were determined experimentally by varying the resistors in collector, base, and emitter circuits while keeping a check on gain, noise, and distortion. I found that cheaper transistors could have been used in the first two stages without increasing noise by more than a few db.

The feature most responsible for the low battery drain is the grounded-col-

Fig. 1. Front view of remote amplifier. Note that phone jack is insulated from panel. Use of circuit-closing jack eliminates need for toggle switch shown.



lector output stage, as seen in the schematic, Fig. 2. I prefer to look at the output problem from a voltage standpoint when dealing with transistors. In a grounded emitter output stage, a step-down transformer must be used to match the output impedance of about 6000 ohms to the 600-ohm line. This means that in order to get a 2-volt signal in the line, at least 6 volts must be available at the transistor. This dictates a battery voltage of at least 15 volts for good linearity. A transformer like this

isn't easily available in a quality grade. However, by using a grounded collector circuit, a line-to-line transformer can be used and these transformers are standard items in all brands. Because the output impedance of the grounded collector stage is about 600 ohms, no step-down ratio is needed and 2 volts output is satisfactory. Under these conditions a 9-volt battery, or possibly less, would be sufficient. It is true that the grounded collector circuit has less than unity voltage gain but there is consid-

\* 225 Irvin St., Lock Haven, Pa.

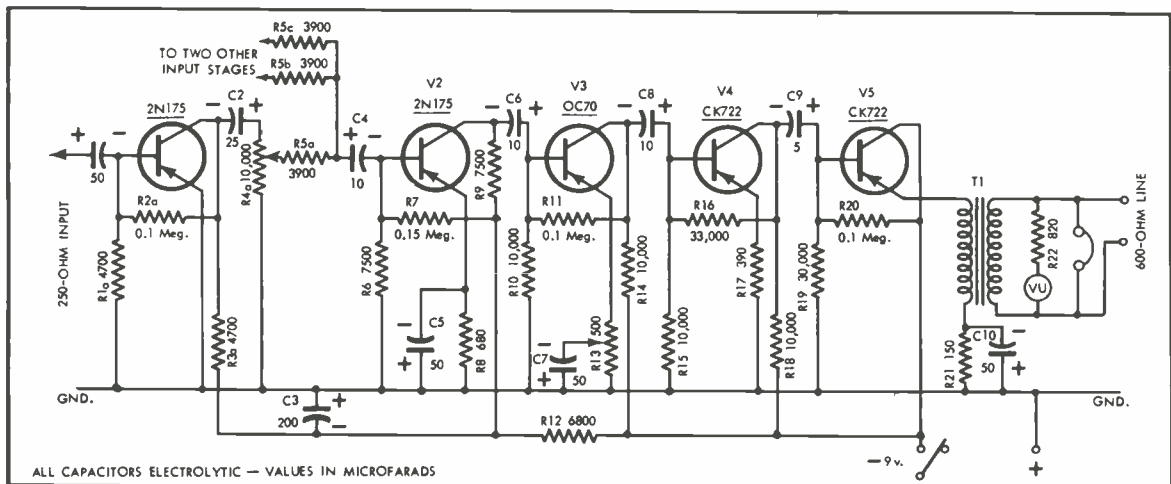


Fig. 2. Complete schematic of amplifier except for input stages #2 and #3. They are identical with the stage shown.

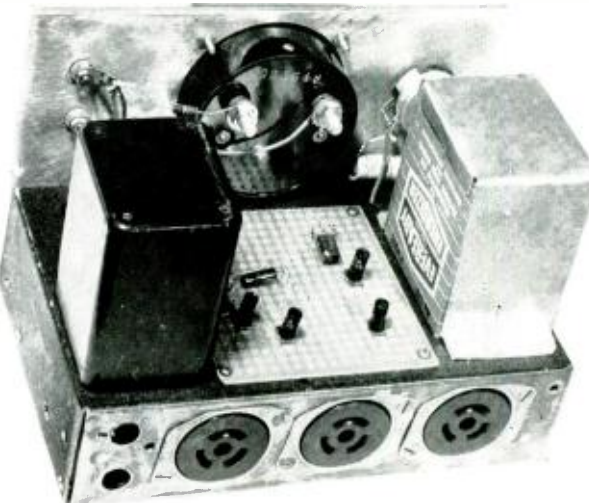
erable power gain and the input impedance is high, thus making an excellent match with the driver stage. I have used the cheap CK722 transistors here as they are perfectly satisfactory and their collector dissipation is higher than most transistors so they are less likely to be damaged by excessive current. The emitter resistance of 150 ohms plus the resistance of the transformer primary provides considerable protection and also helps to minimize the effects of changing transistors. Better than half of the battery drain goes into this stage. It is almost distortion-free because of the degeneration present and the light load it presents to the driver helps to cut distortion in that stage. I have used the smallest coupling capacitors possible consistent with good low-frequency response to keep noise down and to avoid interaction between stages which causes a period of surges when the amplifier is turned on. It is well-known that transistor noise is inversely proportional to frequency, so noise could be reduced by decreasing the value of the coupling capacitors still more. Some may prefer to do this and sacrifice the lowest frequencies. The bias was adjusted to cause a collector current of 4 ma. Greater power output could be obtained by biasing for more current and the transistor is capable of handling much more.

#### Driver Stage

The main source of distortion is the driver stage as it must supply more than the output voltage due to the less-than-unity voltage gain of the final stage. I found that distortion could easily go to 20 per cent if operating conditions are incorrect. By obtaining base bias voltage from the collector the values of resistors are not very critical, and temperature stabilization results because if the collector current goes up due to increasing temperature the collector voltage drops and so does the bias, so this counteracts the increase. The emitter resistor also provides temperature stabilization. Bypassing this resistor is a convenient way of boosting the gain by 10 db, but the absolute noise level also goes up 10 db, so unless this gain is needed it is better to leave it unbypassed. Also linearity will be better and this is important as this stage handles the greatest voltage swing.

The next stage uses an Amperex OC70 transistor but a CK722 could be used if desired. The main feature of this stage is the gain control in the emitter lead. This serves as a sort of master gain without the loss in signal caused by the additional resistor and capacitor usually used. A 10 db variation is obtained and it is advisable to keep the control at minimum gain in order to utilize the gain from the low-noise

Fig. 3. Top of amplifier chassis. Transistor  $V_4$  is not visible, but two of the flea clips holding it are. Transistors wired to flea clips are also taped to mounting board with cellophane tape.



stages and thus take advantage of gain early in the amplifier. Temperature stabilization results from the emitter resistor as well as from obtaining base bias from the collector.

Noise, rather than distortion, is the problem in the first two stages. Proceeding from output to input, the next stage uses a RCA 2N175 low-noise transistor. Noise is also minimized here by using a low supply voltage (2.5 volts) and by using either wire-wound or deposited carbon resistors. Temperature stabilization is obtained by a bypassed emitter resistor. By having the gain controls following a high-gain input stage, ordinary carbon volume controls may be used. Some interaction between the controls will be noticed because of the low value (3900 ohms) of the isolating resistors, but their use preserves as much as possible of the precious gain of the input stage. Gain of one channel increases by 2 db when another channel is turned to maximum gain. This effect could be eliminated by changing the isolating resistors to 4700 ohms, but I preferred to conserve input stage gain.

#### Input Stage

In the input stage, which consists of three identical channels, I have kept the resistances low because the microphone voltage will not be affected much by the 4700-ohm input resistor and noise would be higher if this value were increased. A large coupling capacitor between microphone and base is desirable as the 250-ohm microphone will tend to keep the effective input impedance down. One could well use even larger capacitors here. All resistors in these channels must be either wire-wound or deposited carbon—preferably the former. Temperature stabilization results from obtaining bias from the collector.

As seen from Figs. 1, 3, and 4, no attempt was made to use miniature parts with the exception of the capacitors. Reduction in the size of the unit would be of little value and the larger parts are more rugged and the transformer has better frequency response, lower distortion, and greater power capability. The carbon battery is cheaper than mercury types and while it may not last quite as long, its voltage will fall more gradually thus making it less necessary to have a spare or a means for checking it frequently. I have left the unit on (unintentionally) for several days without noticeable drop in battery voltage. However, some means should be provided to prevent this from happening again, and I have since installed a circuit closing phone jack in place of a toggle switch.

The case was painted with aluminum paint to minimize temperature rise when exposed to sunlight. A sponge rubber pad, as seen in Fig. 1, was used on the bottom of the case to prevent scratching finished surfaces with the sharp corners of the case. It was not needed to prevent microphonics because there are none.

#### Performance

The test set-up consisted of a Barker-Williamson audio oscillator followed by a Gates Gain Set having three fixed pads. The first two were 600-to-600 ohms of 40 and 20 db loss respectively. The third was an impedance-matching pad of 20 db loss for a 600-ohm input and 250-ohm output. Therefore, assuming an amplifier gain of 80 db, which was the target set, the voltage input to the gain set would be equal to the amplifier output if the amplifier gain were 80 db. Any difference, if not too great could be read on the VU meter.

The amplifier was loaded with a 680-

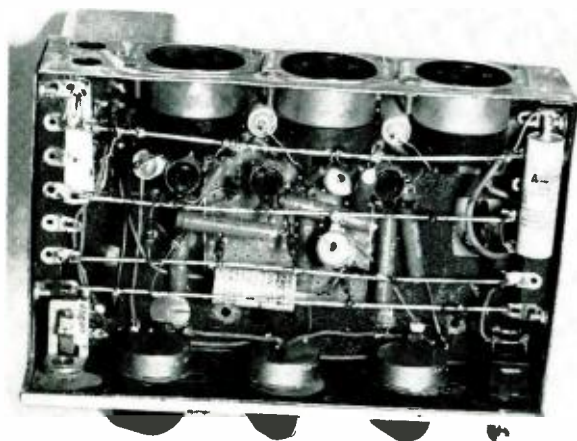


Fig. 4. Bottom of chassis. Holes in chassis for battery terminals are lined with friction tape to prevent shorting. Busses, counting from rear, are: 1, ground; 2, -2.5 volts; 3, -9 volts; 4, ground.

ohm carbon resistor and the output was connected to the input of a Barker-Williamson distortion meter which was used to measure distortion and noise.

The gain at 1000 cps was 82 db with one channel and the degeneration control at maximum gain. This could be increased to 86 db by turning up the other channels but the noise would increase unless they were loaded with microphones. Under these conditions, noise was 58 db below zero VU for one channel. With 82 db gain, this adds up to 140 db absolute noise level below zero VU or -140 dbm. Decreasing the gain would, of course, result in less noise, so under ordinary conditions with a gain of 65 db which is about average for sports reporting, the noise level is about 70 db below the program, which is very good.

The amplifier is comparatively insensitive to variations in load impedance as the following figures show:

Load Impedance ohms	Output Level db
2000 ohms	+2
1500 ohms	+1.5
1000 ohms	+1.1
750 ohms	+0.5
600 ohms	0
500 ohms	-0.5
400 ohms	-1.3
300 ohms	-2.8

Distortion increases slowly with output up to +4 VU as shown below:

Output VU	Distortion per cent
0	0.52
-1	0.55
-2	0.60
+3	0.70
-4	1.1
+5	2.1

Frequency response is within the FCC limits for AM broadcasting:

Frequency cps	Output Level db
50	-1.5
100	-0.8
400	0
1000	0
5000	+ .5
7500	+1.0
10,000	+1.0
20,000	+2.8

Distortion vs. frequency is also within FCC limits when oscillator distortion is taken into consideration. At 50 cps the reading was 2.7 per cent but the oscillator alone gave a reading of 0.85 per cent. Taking the liberty of subtracting this (which may not be strictly accurate) the figure becomes 1.85 per cent. Except for this reading, all others include oscillator distortion:

Frequency cps	Distortion per cent
50	1.85
100	1.1
400	0.72
1000	0.52
5000	0.36
7500	0.34
10,000	0.34



Fig. 5. Rear view of unit. Entire chassis may be taken out of the case by removing two round-head screws. Hubbell twistlock connectors—for microphones—are flush with surface of cabinet.

Incidentally, oscillator distortion averaged about 0.15 per cent over the range.

These figures prove the amplifier is good enough for all remote programs except possibly those at a considerable distance from the studio where the output of +4 VU may be a little low. It could be increased by biasing the output stage for more current. Temperature compensation could be increased by bypassing the emitter resistor of  $V_4$  to increase gain and using up this gain by increasing emitter resistors in all stages. Other changes that some may consider advantageous would be smaller input connectors, such as Cannon XL types or a larger chassis. The design is not critical so these changes aren't very difficult to make.

#### PARTS LIST

$B_1$	9-volt battery, Eveready #276
$(C_1), C_2, C_3, C_4$	50 $\mu$ f, 6-volt, electrolytic
$(C_5)$	25 $\mu$ f, 15-volt, electrolytic
$C_6$	200 $\mu$ f, 12-volt, electrolytic
$C_7, C_8, C_9$	10 $\mu$ f, 15-volt, electrolytic
$C_{10}$	5 $\mu$ f, 15-volt, electrolytic
$M_1$	VU meter, Triplett 327T or equivalent
$(R_1), (R_2)$	4700 ohms, wirewound or deposited carbon
$(R_3)$	0.1 megohms, wirewound or deposited
$(R_4)$	10,000-ohm potentiometer
$(R_5)$	3900 ohms, 1/2-watt, carbon
$R_6, R_7$	7500 ohms, wirewound or deposited carbon
$R_8$	0.15 megohms, wirewound or deposited carbon
$R_9$	680 ohms, 1/2-watt, carbon
$R_{10}, R_{11}, R_{12}, R_{13}$	10,000 ohms, 1/2-watt, carbon
$R_{14}, R_{15}$	0.1 megohms, 1/2-watt, carbon
$R_{16}$	6800 ohms, 1/2-watt, carbon
$R_{17}$	500 ohm potentiometer
$R_{18}$	33,000 ohms, 1/2-watt, carbon
$R_{19}$	390 ohms, 1/2-watt, carbon
$R_{20}$	30,000 ohms, 1/2-watt, carbon
$R_{21}$	150 ohms, 1/2-watt, carbon
$R_{22}$	820 ohms, 1/2-watt, carbon
$T_1$	600-600 ohm, line-to-line transformer, UTC HA108 or equivalent
$(V_1), V_2$	2N175 transistors
$V_3$	OC70 transistor
$V_4, V_5$	CK722 transistors
	5" x 8" x 2" chassis
	5 1/4" x 8 1/4" panel
	5 1/2" x 8 1/4" x 5 1/2" cabinet
	punched Bakelite circuit board, 4" x 4"
4	Transistor sockets
9	"Flea" clips, for circuit board
3	Hubbell Twistlock 3-wire polarized receptacles, 15-amp., chassis mount tie point strips, 7-terminal circuit-closing phone jack, Mallory 704A or equivalent
2	
1	

NOTE: Parts listed in parentheses are for input stages, and three of each are required. E

*the*

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AE-6-58

# New Approach to Stereo Records

MAXIMILIAN WEIL\*

A pioneer in matters pertaining to phonograph pickups—both acoustic and electromagnetic—takes issue with the presently accepted 45/45 monogroove stereo system, and proposes what might be described as a deluxe stereo phonograph.

**W**HY THE STAMPEDE? Where's the fire? Why the panic about LP discs having to face up to stereo tape? Surely the leading record manufacturers have no reason to become alarmed—for they are the only ones in a position to offer a complete library of stereo tapes equal to the existing gigantic library of LP discs. They have the artists, they have the master tapes. In fact, they have everything it takes to "face up" effectively.

There are those in the industry who are showing impatience with the deliberate and cautious procedure by the record manufacturers, in the matter of stereo records. The fact is that this is a very serious matter and caution *should* be exercised. If the industry rushes into the market with a half-baked or pseudo-stereo record—one that is at best a poor compromise—it is sure to kill stereo discs on short order.

In the present state of the Art, the performance of an orchestra cannot be reproduced—certainly not as a facsimile of the original. At the 1953 New York Audio Fair, the writer had a well known cellist play in person, then stop while an electronic reproduction took over and continued the performance. The audience could not detect any difference. This demonstration proved that the Art has now advanced sufficiently to make possible a facsimile reproduction of the performance of single instruments. Since then, others have tried a similar performance but with a full symphony orchestra in a concert hall. The report as given out stated that the audience "could not tell the difference." I am sure the comparison must have been 100 per cent perfect for the simple reason that the reproduction was not compared with the actual performance of the orchestra but only with "itself." To be sure, the orchestra was on the stage but only made believe it was playing. Obviously, then, when the players put down their instruments there could be no difference in musical performance. With publicity of this kind,

While we cannot say that we agree whole heartedly with the statements of the author regarding the lack of quality in present stereo records, it must be admitted that not all of them are of quality comparable with the better LP's. We feel, however, that they are likely to get better as time goes on. After all, some of the first LP's were somewhat lacking in perfection, but they have come a long ways in the past ten years. However, there is food for thought in Mr. Weil's suggestion, and it is quite possible that there may be a "super stereo" disc sometime in the not-too-distant future.

it is only normal for Hi Fi enthusiasts to ask, "If, with present Hi Fi equipment the listeners cannot hear any difference between the actual orchestra and an electronic reproduction of it, why go to all the trouble and expense of stereo?"

It took 75 years to achieve the clarity, the cleanness, the refinement of today's LP discs. At this juncture, the question is then, "Is the music lover willing to sacrifice all that for a measure of spatial effect (stereo)?" I, for one, do not believe he is. He will be, however, more than receptive if in addition to the superb quality of today's LP discs he can also obtain some stereo effects. This is accomplished readily with magnetic tape, on which two or more channels can be recorded and reproduced independently, reproduced without any cross-channel distortion.

### Complexity of Waves

In a concert hall the stage is about 75 feet wide and, say, some 40 feet deep. This means that the players are spread out over an area of about 3000 square feet. Here we have a condition of the extremely complex waveforms produced by a symphony orchestra being impressed upon the microphone diaphragm which has an area of less than half a square inch. This is then amplified and the output is impressed on the speaker which, in the present state of the Art, is utterly incapable of responding to such a complex waveform.

In a multichannel system, the wave-

form picked up by each microphone is much less complex than with a single channel. In turn, each speaker is subjected to a waveform of less complexity. This makes it possible to have better definition and "cleaner" sound, and this is actually what is gained in present stereo.

Stereo records presented so far are a retrogression when compared to high-quality LP's. At best they deliver only a spasmodic stereo effect together with a high amount of distortion which would not be tolerated in today's best records. However, stereo on disc *can* be had with the high quality of the best long playing records of today.

### The Weil Stereophonic System

The writer proposes a system in which the two channels are recorded on opposite sides of a single disc—thus providing quality equal to the best LP's of today on both channels without any compromise whatever. Channel A is recorded normally, as shown in *Fig. 1*, with the turntable rotating clockwise and the groove spirals as on a standard LP disc. Channel B is recorded in reverse, so to speak, with the turntable rotating coun-

(Continued on page 59)

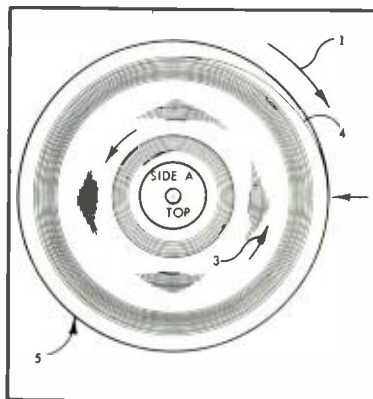
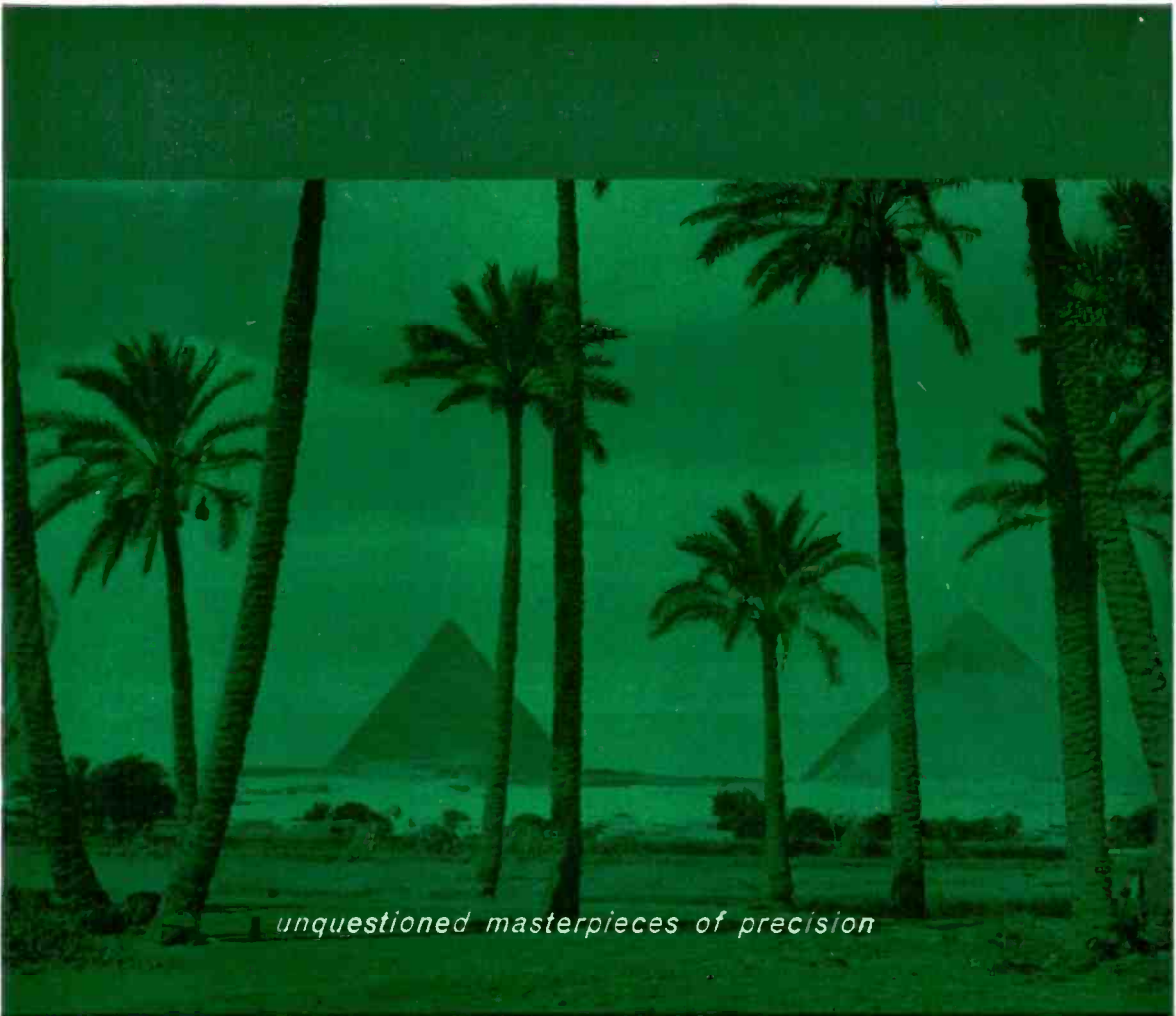



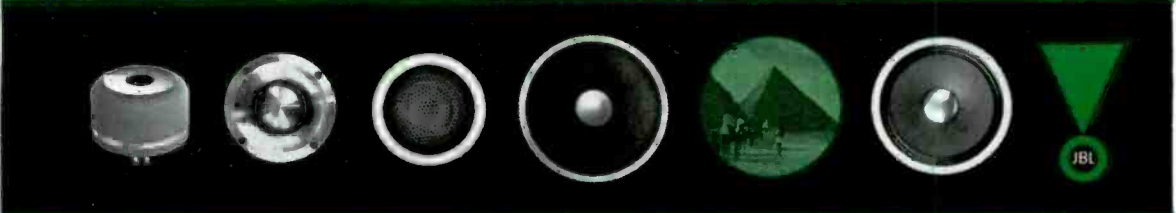
Fig. 1. Recording and rotation of the "A" channel disc is in the normal manner, just as in the usual LP record.

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## AUDIO ETC

(from page 12)

you collect records, in an average sort of hi-fi way, if you are a reader of our record review columns, and others too, how does the great LP library that now exists stack up (to put it graphically) against your own possible record consumption and needs?

Well, according to *Schwann* it stacks up mile-high. The output of LP titles over these ten years or so is just about beyond belief. The expansion, from zero in June, 1948, is something to goggle at, the more so because it has taken place in a competitive commercial market.

With the exception of a few foundations, nobody deliberately makes records not for money. The present LP catalogue is enormous thanks to that fine combination of high hopes and ideals, plus considerable hard-boiled cash receipts, that marks any commercial development. Not all records succeed—but virtually all of them are *intended* to succeed.

We, the great "Ammurician" people (as Wendell Willkie used to say) have called forth this torrent of plastic discs over the last decade; we, the people, have supported it, in detail and in the mass. You can't call the LP record either esoteric or precious—there's too much of it. You can't even say that the classics have been carried along by the pop hits. To some extent, yes; but the classics have managed to swim for themselves, as you shall see by example, in a moment.

### Listings

Mr. Schwann has rounded up his figures since the first *Schwann* catalogue appeared according to a convenient unit which he calls a listing—an entry in the catalogue. Some listings are for single records; many, however, represent albums with from two to as many as a dozen discs in them. On the other hand, *Schwann* does a great deal of cross referencing. A given title often appears in several places, notably when there are two or more composers represented or works included. *Schwann's* statistics are simply based on the number of listings, over the years.

Now with all these multiple listings of the same disc and these albums with numerous records in them, can we trust the *Schwann* figures? Not exactly. They are rough averages—since the multiple listings of a single title tend to balance out those albums with more than one record in them. Mr. Schwann himself suggests that, averaging things out, the listings are fairly indicative of the actual number of LP's issued and withdrawn since the great LP inception in 1948. Being a sober soul, he merely says, "The two may balance off to some extent." And I'm more than willing to go along, in the utter absence of any further statistics on LP—for who but *Schwann* would ever know how many LP's had been put out? (Maybe the Library of Congress, but I'll bet they haven't bothered to count their card entries.)

This being the great age of the statistical average, we can take a bit of inaccuracy. We love to swallow without a blush such monstrosities as (to make one up)

for every two-and-a-fifth childreun born in each city-and-a-half, seventy nine hundredths of a male will reach the age of 50.9 without having two-thirds of an appendectomy. So—the number of *Schwann* listings equals the number of LP's issued, then.

(Mind you, this isn't the number actually sold—the LP listings are the separate, individual record titles, released and catalogued. Any one of them *might* have sold a million copies and probably did sell a couple of hundred at least.)

### 30 to 30,000

Let me begin hindside foremost, with our own record review coverage. In our *RECORD REVIEW*, not including the Robertson jazz reviews, we cover in a good month maybe as many as thirty records and albums, in reviews that go into a good deal of detail, both historical and interpretive. (I counted them in one recent issue, to find out.)

Now that's a solid dose, if you ask me. If you were so ardent a collector as to believe in Canby to the point of buying piecemeal every record recommended, you'd be running a steady record bill of about a hundred bucks a month, just to keep up with me. (You'd soon double the sum in cost of storage shelves, catalogue systems and—if you played the records—diamond styli.) And in terms of listening hours, you'd have something like twenty five hours of playing time, unbroken, on your monthly agenda. Nobody in his right senses (nobody but me, maybe), would want to buy *that* many records.

But listen to Mr. Schwann, about monthly new LP releases. He has a special section for them, each month. How many? "*Sometimes . . . as many as 500*" in a single month! That includes pops, folk and jazz, of course. But don't underestimate the classics. If they were to reach even half of that figure—which they do, easily—their total would be darned close to ten times the monthly budget of \$100 worth of new discs I mentioned above. Want to shell out \$1000 each month? If you do, you can keep up with *all* the new classical releases, more or less.

How many "listings" have been listed in Schwann in the eight years and some months since the catalogue started (Oct. 1949) through March of the present year? The April, 1958, issue lists 19,830 entries, and they appear on 303 different record labels. But since 1949 there have been large numbers of withdrawals, of course. Records removed from the catalogue account for roughly a third of the total number of items launched in ten years of LP history—just about 10,000.

(Side remark: If you are a record collector, take note that with ten thousand LP items already withdrawn, the "collector's item" area of high-priced older LP's is obviously going to grow fast in the coming years. So far, collector's items have been mainly older 78's, both acoustic and electric. Now—the LP collector's item is coming to the fore.)

If you will now add the present 19,830

available record listings to the ten thousand that have been withdrawn, you come up with a grand total of just under *thirty thousand LP listings*, for a mere ten years of LP record history!

Turning back to October, 1949, Mr. Schwann notes the material that he had for cataloguing in the beginning of LP's second year. This, you'll remember, was the season of the big LP-45 Record War. From June, 1948, when Columbia first launched the LP, until well along into the next season, there were no LP's except Columbia's, and a few tentative LP beginnings from small companies. (As I remember, my first non-Columbia LP was a Concert Hall Society item, pressed on red vinyl.) A *Schwann* catalogue for October, 1948, if there had been such a thing, would have had small pickings. One label. A handful of records. It's understandable that no LP general catalogue appeared during the first LP year.

But in October, 1949, a year and four months after LP began, Mr. Schwann's first issue already listed eleven record labels and 96 composers. There was a grand total of 674 listings.

I suspect—knowing the way in which early catalogues of new offerings are made up—that this one was somewhat padded by luxuriant multiple listings. There was plenty of room, after all, and the catalogue's aim was to be useful. So maybe there weren't quite as many as six hundred honest-to-goodness LP items ready for our inspection, in that month.

But if you've looked at recent *Schwann* catalogues, you'll know that space today is at a minimum and not a bit of it gets wasted. The big problem is—how to get 20,000 records into one small hand catalogue that must be reissued in revised form every thirty days! So (if you follow me) the actual increase in the LP library was faster and greater, probably, than Mr. Schwann's listing figures show. And it happened not in ten years but in eight and a half.

### Beethoven

Perhaps you have followed the implied advice of our *RECORD REVIEW* and have given up any idea of building an "average" collection of records. I have never said so out loud, but a few references here and there (like the recent article of the Record Clubs) but I have always felt that a man's record collection is his own business and doesn't need to be one bit more "average" than he wants it to be. If you are the type who collects nothing but Mighty Wurlitzer organ records—more power to you (*And you'll need more power.* Ed.) If you prefer to build a fabulous record collection of harpsichord music—or Spanish Zarzuelas (popular operettas), or New Orleans jazz, you have every right to, and you should be encouraged to buy whatever you want, to experiment, to explore. So you don't like Beethoven? Well, then there's no reason at all why you should buy a single Beethoven LP record for your collection. (No reason except one—you might give him a whirl now and

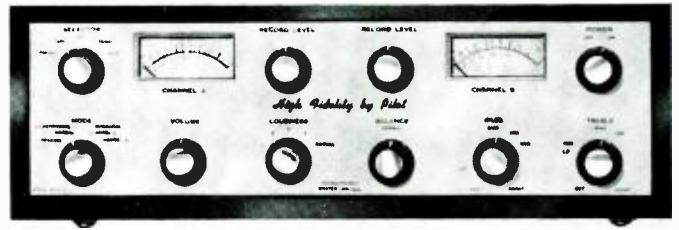
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by **Pilot**

SP-215 STEREO PREAMPLIFIER



SM-244 STEREO PREAMP AND AMPLIFIER



### **Pilot** *SP-215 and SM-244 Stereo Components*

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The SP-215 is a complete stereo preamp and audio control system. It is in effect, two matched control-preamps housed in one enclosure. Versatile beyond anything known today, the SP-215 may be used with any stereo signal source: FM-AM stereo broadcasts, stereo tapes and stereo discs. A separate output is provided for making stereo tape recordings from any of these program sources as well as with microphones. Two panel-mounted VU meters permit each channel to be precisely monitored for the recording. And there are independent controls for adjusting the reference and peak recording levels on each channel. The SP-215 may also be used for conventional, non-stereo high fidelity.

Features of the SP-215 include bass and treble controls, volume and loudness controls, as well as a balance control for equalizing the level between the two channels. The SP-215 outputs may

be fed into any two basic power amplifiers, such as the Pilot AA-908 or Pilot AA-410A. Both power amplifiers are operative, and the available power output is the sum of both. Pilot SP-215 Stereo Control-Preamp System complete in enclosure \$189.50.

The SM-244 is a complete stereo control-preamp and amplifier system, all housed in one enclosure. The two built-in power amplifiers are rated at 14 watts each (28 watts peak each) at less than 1% distortion. Inputs are provided for FM-AM stereo, stereo tape and stereo discs, microphones, auxiliary, and a separate output for making stereo tape recordings. There are bass and treble controls, volume and loudness controls, plus a balance control as on the SP-215. Whether used as a stereo or non-stereo system, the SM-244 provides an available peak power of 56 watts. Pilot SM-244 Stereo Control-Preamp-Amplifier System, complete in enclosure \$189.50—prices slightly higher in west.

Hear these new Pilot stereo components at your hi-fi dealer today! For complete specifications, write to:  
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then just to be sure that your taste doesn't suddenly change. You might get to like him, some day. The way you got to like coffee when you were a kid, and maybe beer too, after those awful first tastes of the bitter stuff.)

But—to get back on the track—suppose, for argument, you are of a mind to buy nothing but Beethoven. Suppose that only Beethoven interested you in the LP catalogue and you were to buy nothing else, see nothing else, hear nothing else. A relatively limited area for record collecting, you'll think, and in a way it would be rather obstinate of you to stick so avidly to one composer alone—but again, it is certainly your right and privilege.

Beethoven only, then. Let's go back and take up the figures I began with. We review roughly thirty classical records (speaking very loosely as to what classical means, since it often includes things like railroad trains in my somewhat zany department), thirty separate items in a good month. Take the hundred bucks you might spend on those thirty records and throw the whole thing into Beethoven. By golly, you're going to be a real fanatic; you're out to acquire a hundred dollars' worth of sheer Beethoven *every single month*, in "new" records—that is, records that are new to you and can be bought out of present LP catalogue listings.

If you are a solid record fanatic, you're likely to spend a couple of hours a day with your hobby and you'll want to play those records over a good many times. Let's settle on a hypothetical average of three times per disc. In that case, counting pauses for thought, chatter, and refreshment of a liquid sort, you're likely to get through about two records a day, one playing each. (Maybe, like me, you'll play one record straight through twice, in the same time.) In thirty days, then, you'll cover sixty complete playings, roughly speaking, if you take no days off and stick religiously to that two-hour session with the discs, day after day, weekends included, work-days included.

So, you see, if you want to keep up with that \$100 monthly budget (based on the number of records we review here in a month) you'll have to increase your record playing time by half again. Sixty playings? If you want to cover your new records for at least three playings each, you'll have to raise it to *ninety*. That adds another hour to the daily record budget of time. Three hours a day, my friend, not merely two. (This begins to sound like advanced piano training practice, or singing lessons.)

But we were speaking of Beethoven. You are the fanatic who is going to do all his record collecting in Beethoven alone, plunking down that \$100 each month for all-new Beethoven, listening to Beethoven three hours a day, seven days a week, with never a day's respite year in and year out.

*Year in and year out?* What? Enough Beethoven for that? According to Mr. Schwann's figures on present LP availabilities (not including the large number of items already deleted from the LP catalogue) if you started in right now buying only Beethoven, you could keep up that three-hours-a-day routine on Beethoven

alone for two years and five months without running out of presently listed records—at thirty a month! And if you felt that three playings isn't really enough, considering the cost of LP records, you could start in and play the whole batch over again, once each, and keep busy for another nine months. But by that time you'd want to go over your favorites in the huge collection and you could keep busy for the rest of that year selecting special items out of the mass of records.

And don't forget that you'd have to put aside an extra hour a week just to keep the records in condition and in the right places. A catalogue would be unthinkable—that would add another hour a day, at the minimum.

Ah—but we forget one thing. Beethoven is still coming out, faster than ever. You'd have to do more than merely cope with the Beethoven now in the catalogue; you'd want the new stuff too.

So, at ten or twelve *new* Beethovens a month, you'd have to shell out another thirty dollars or so just to keep up to date, and you'd be adding still another hour a day of listening (for the new stuff) on top of the three hours budgeted for the Beethoven already in the catalogue. That'd raise your monthly Beethoven bill to \$130 and your daily playing time to *four* hours.

Whoa—why not take things a bit more slowly? You'd probably prefer to spend not more than two hours a day listening to your collection; you'd rather *buy* fewer records, take a longer time to get through Beethoven. Spread the operation out. Reasonable enough except that you've forgotten one thing—the new releases. They just keep on coming out, and you can't stop them. If you didn't buy Beethoven fast enough, pretty soon you'd find you were losing ground instead of gaining. The longer you went on collecting Beethoven (ignoring all other records), the more records there would be that you didn't own, hadn't heard.

The moral of this Schwann-inspired tale is thus clear: the answer to the question "how long would it take me to collect all the Beethoven records on LP?" is—*forever*.

How many Beethoven listings *are* there in the present Schwann catalogue? To tell you would be pointless, since I have just shown the number to be in effect  $\infty$ . I'll only point out that Schwann lists as many Mozart discs as Beethoven. (There are just three less.) So if you'd like to switch specialties from the infinite Beethoven to the infinite Mozart, you can start in on a lifetime of Mozart collecting any day you want to. You'll never run all of *him* down on records if you grow as old as Methuselah, or Senator Green of Rhode Island.

If you pick on Brahms you can collect hundreds of LP discs—the same with Tchaikowsky and dozens of other composers. Old man Bach, the one who used to be thought of as so very mathematical, has no less than 650 listings right now, which isn't anywhere near the number for Beethoven and Mozart.

Now perhaps you know what it is like to be a record reviewer. And—after reading this—perhaps you're beginning to wonder how I manage to pick thirty-odd

records an issue out of that semi-infinity of new releases each month? That, my friends, is a professional trade secret. But I've been falling behind, losing ground for years, I'll admit. I play leapfrog, keep jumping forward to the latest stuff—otherwise I'd be back somewhere around 1951 at this point.

\* \* \*

Schwann is definitely one of my bibles, but to be entirely honest, I find that its rival publication, the *Long Player*, is my bible too. I recommend both of them to all systematic collectors and to the curious in general. They cover about the same material but—being human products—they do not always exactly agree. There are inevitable omissions, mistakes, minor confusions of listing. The two systems for listing the 20,000 or so entries are not always the same. If you can't find what you want in one of them, look in the other. If it appears in both, you've had yourself an excellent double-check. The *Long Player* is a newer sheet and isn't yet in a position to fork out long-time statistics—hence my present emphasis on Schwann.

Both Schwann and the *Long Player* have so far studiously avoided tapes, which is getting to be mildly annoying, what with so many tapes hanging around. (Harrison has a tape catalogue.) But when the stereo disc gets going these publications are logically bound to take notice, since their avowed stamping ground is the LP disc record in whatever form it may appear. Stereo or just plain ordinary, the LP disc will go marching on and the LP listings will continue to mount into the superastronomical infinity.

Did I hear somebody say in a wee small voice—but we thought tape was going to take over from the disc record? No—thirty thousand times no! That would seem to be the present answer.

### 3. Bu naB

Have you got your Bu naB yet? I borrowed one a month or so ago and it has been sitting around on my desk, waiting to be written up. I'd better tell you about it, in case you hadn't heard.

This is the #7 Bu naB, improved. It comes in a small plastic box, a bit thinner than a pickup cartridge box, and is accompanied by complete descriptive material and instructions, from which I hereby quote, in paraphrase. With reasonable care, the instruction sheet says, this model will give years of trouble-free service; it has been scientifically checked and inspected, it will meet or exceed specifications set up by the industry for accuracy, durability, and simplicity of operation.

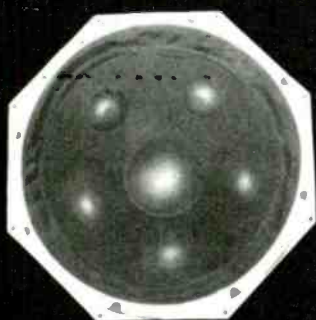
The simplicity of the design, the makers say, assures perfect results, even in the hands of the average housewife or small child; with a minimum of practice, results equalling those of a skilled technician using the conventional instrument may be expected. No moving parts—insures constant stability. Elimination of springs, cams, splines, etc., ensures against all variations due to changes in temperature and humidity. Non-fading colors make the Bu naB practical for use in bright sunlight for long periods.

(Continued on page 62)

the most nearly perfect reproduction of bass

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low frequency loudspeaker



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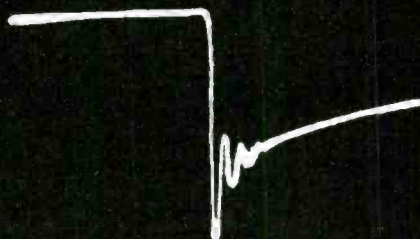
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When a transient square wave goes in  
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ABOVE: NORMAL SPEAKER BEHAVIOR  
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# Equipment Review

New Miracord XS-200 record changer—Bakers Ultra 12" loudspeaker—EICO HFT-90 FM tuner kit—Pentron "building block" recording equipment—Pilot SP-215 stereo preamp and SM-244 stereo amplifier

THE ADVENT of stereo has naturally brought with it a whole new complement of amplifiers, pickups, speakers, and other devices made necessary by the additional channel. Such items as might be considered equally usable with both monaural and stereo systems have not made any great changes—with the possible exception of adding the word "compatible" to the original description to try to get over the idea that they would work equally well with both.

And while the record changer is one item which should work just as well with either system, it just happens that one of them is the first "dual service" component to show an improved design which is intended to give better performance on stereo, but which at the same time will give improved performance on monaural systems.

The new XS-200 Miracord combines the thoroughly proven qualities of the original XA-100 with some new features which practically put it into the "turntable" category, yet it retains all of the automatic features. Now, instead of a changer which may be used manually at will—thus simulating the professional-type turntable—the new model is described best as "a turntable with record changing facilities." Actually, this is what many people have wanted for years.

Foremost in the modifications is the use of a four-and-a-half pound platter, with the diameter increased to 10 inches. The outer rim of the table is polished and with the almost perfectly true motion it looks—when running—just like the more expensive professional-type single-play turntables. Since the platter is made of cast iron, hum pick-up is reduced considerably with those pickups which are susceptible to external fields. The measured reduction with one of the more popular pickups was approximately 7 db.

The external appearance of the new model, *Fig. 1*, has been made more attractive by the change in color to a two-tone blend of walnut shades, which will go well with most wood finishes. All who have seen the new color scheme have agreed on this point.

While all previous Miracords have been all ready for stereo as regards wiring from the pickup to the terminal strip, (two wires and shield have been standard since the introduction of the XA-100 in this country) a second output lead has been added to the latest version to accommodate stereo cartridges. Thus one has only to plug the two leads into two amplifiers and he is ready to play stereo records—as soon as he has them. If the user wishes to operate the changer with a monaural pickup and amplifier system, he inserts one of the pin plugs into a shorting cap which is furnished, thus connecting one of the "hot" leads to ground. The two small pins on the inside of the head are the "hot" leads, and the large pin is the grounded common, connected to the shield.

The changer operates at four speeds, of course, and the motor has been "beefed up" so that even the heavier turntable attains full speed (at 33½ rpm) in less than half a revolution, and rumble is some 4 to 6 db less than heretofore because of the greater turntable mass. Wow and flutter measure between 0.15 and 0.2 per cent, which makes a piano record sound practically perfect.

Center-drop changer spindles are used for all record types—the "Magic Wand" for those with the small center hole and the conventional 45 spindle for those with the 45-type holes. A short spindle is used for manual operation, simplifying the placing and removal of records. In all, this new model is attractive, both in appearance and in performance. **F-21**

Fig. 1 (below). The new Miracord XS-200, with cast iron turntable for minimum rumble, less hum. Fig. 2 (right). Bakers Ultra 12" loudspeaker, which was tested in a Bradford Baffle.



## BAKERS ULTRA 12" LOUDSPEAKER

The performance of this 12-inch speaker is rather exceptional, from its low resonance to its high usable frequency of output. Free-air resonance of the one sample we measured was at 28 cps, with the resonance peak measuring only 32 ohms for a nominal impedance of 15 ohms at 400 cps—due, we imagine, to the use of a high-strength magnet and a voice coil wound on an aluminum former. The cone surround is a thin membrane of plastic foam, which permits large cone excursions, and the voice coil is sufficiently long so that it extends more than ¼ in. on each side of the magnetic gap, thus ensuring the gap being filled with the same number of turns at all times, even at high excursions of the cone. This is claimed to account for the low distortion of the speaker, which seems to be reasonable.

The frame of the unit, *Fig. 2* is cast aluminum, and is sufficiently rigid that it is not likely to be deformed by unequal tightening of the mounting screws. Flux density is said to be 18,000 gauss, which is high for a 12-inch speaker. Efficiency is somewhat less than average, but that is noticeable only in direct A-B testing.

This unit was checked in a Bradford Baffle—only slightly larger internally than the speaker itself. This enclosure features an opening in the rear which is kept closed by a swinging plate. Mounted on ball bearings, this plate can accommodate internal pressures so that no padding is required in the enclosure itself, and no special adjusting of port area is required for different speakers. Having no previous experience with this baffle, we measured the voice-coil impedance in the box as well as in open air. While the open-air curve showed about a 2 to 1 variation in impedance over the resonance peak area, the impedance variation of the speaker in the Bradford Baffle was something less than 10 per cent. We consider this to be rather remarkable, since most enclosures tend to raise the resonance frequency as well as boost the amplitude of the peak. While the theory of this type of enclosure may be beyond most of us, it must be said that the Bradford Baffle—at least with this speaker—does what enclosures are supposed to do.





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# GLASER-STEERS GS-77

With the availability of stereophonic records, the requirements for turntable and record changer quality become more critical than ever before. Yesterday's 'bests' may no longer be good enough. All previously acceptable units must now be re-examined in the light of the new quality demands imposed by stereo.

That the Glaser-Steers GS-77 should be ideally suited for stereo is no mystery. It is simply the result of strict adherence to rigid precision standards, and permitting no compromise in quality. This is evident in every feature of the GS-77.

The Tone Arm, by reason of optimum mass distribution and free pivot suspensions, exhibits no resonance in the audible spectrum. And tracking error is virtually eliminated. In addition, the arm counterbalance is so designed that the stylus pressure between the first and tenth record in a stack does not vary beyond 0.9 gram. These characteristics virtually eliminate vertical rumble (to which stereo is sensitive).

Turntable Pause is an ingenious GS-77 innovation designed for added record protection. During the record-change cycle, the GS-77 turntable comes to a complete halt, and doesn't resume motion until the stylus has come to rest in the lead-groove of the next record. This completely eliminates the grinding action which takes place where records are dropped onto a moving turntable or disc — more important than ever because of the delicate grooves of stereo records.

The GS-77 is the perfect record changer for stereo as it is for conventional monaural high fidelity. It brings with it traditional turntable quality — at its very best — plus the most modern automatic conveniences. And does it all with incredible mechanical simplicity. \$59.50 less cartridge and base.

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Fig 3. EICO FM tuner—kit or factory built—works right off.

In a nutshell, then, the Baker Ultra 12 in the Bradford Baffle makes an impressive performance, and one need not apologize for its size.

F-22

### EICO HFT-90 FM TUNER KIT

If we had been told five years ago that it would be possible to construct an FM tuner from a kit and have it work from the first time it was turned on, we would have been properly doubtful, but we now know that it is possible. Not only is it possible, but the performance compares well with factory-built sets in many respects, and after giving the completed kit a check-up with an FM sweep generator, only a very minor improvement was obtained.

Since we insist on actually building any kit equipment we review—so as to be able to assess the clarity and completeness of the instructions—we assembled the EICO HFT-90 entirely from the manual and without attempting to analyze each step as we went along. This is what the inexperienced builder would do, and if instructions are not adequate, he should be so advised. The EICO manual is simple and complete, and the finished set is neat in appearance and excellent in performance.

The specifications claim 1.5  $\mu$ v for 20 db quieting, full limiting from 25  $\mu$ v, frequency response uniform from 20 to 20,000 cps within  $\pm 1$  db, an i.f. bandwidth of 260 kc, and a peak separation of 600 kc at the detector, a broadband ratio-detector type. In comparison to other sets of known sensitivity, the EICO appears to meet its specifications; the alignment generator provides the bandwidths. So it must be conceded that factory alignment of kit parts does work.

The circuit employs an ECC85 in the front end—one half acting as a grounded-grid r.f. amplifier and the other half as a reflex converter. There are three i.f. stages, the ratio detector, and a cathode-follower output tube, together with a unique tuning indicator which is also the dial "pointer." This subminiature tube has a blue glow pattern which is in the shape of an exclamation point (we wondered if this was intended to indicate surprise that the

home-built kit worked) in which the top portion grows smaller as a station is tuned in. This tube is carried on the dial indicator and so serves to indicate where the set is tuned. Adequate r.f. bypassing is provided in the heater circuits, and a 6X4 serves as the power rectifier. The completed tuner, in its ornamental perforated cover, is 3 $\frac{3}{4}$  in. high, 12 in. wide, and 8 $\frac{1}{4}$  in. deep. Two outputs are provided—the normal audio output from the cathode follower and controlled by a volume control, and a multiplex output ahead of the de-emphasis network.

Following instructions explicitly, it took about six hours to complete the tuner, including mounting the enclosure. After completion, and with no checks whatever, the set was connected to an amplifier and turned on. It worked from the start, giving excellent reception. To determine how well factory alignment worked, the set was checked with a sweep generator and oscilloscope and only the tiniest improvement could be noted. Over-all impression—extremely good in both audio quality and appearance. Construction—simple and straightforward. Instruction manual—very thorough and accurate.

On the whole, an excellent kit for anyone needing a compact tuner of good performance—and at a very attractive price.

F-23

### PENTRON TAPE EQUIPMENT

Using the "building block" form of construction, the current Pentron semi-professional line of tape equipment provides a great amount of flexibility to the experimentally inclined, and makes it possible for anyone to start out simply and later build up to as complete a tape recording system as he desires.

Starting with the TM-4 tape deck it is possible to add separate amplifier units so as to accommodate eight different requirements:

1. Monaural playback only
2. Monaural recording and playback
3. Staggered stereo play plus monaural recording and playback
4. Staggered stereo play only
5. Staggered stereo play/record plus monaural play/record
6. Stacked and staggered play plus monaural play/record
7. Stacked and staggered stereo play/record plus monaural play/record
8. Stacked and staggered stereo play and monaural play.

Not all of these combinations require the TM-4 deck, as will be noted, but this model can be used for any one of the set-ups, and conversion can be made to step up the over-all flexibility. For these eight combinations, the following equipment will suffice:

1. TM-1 and CA-11
2. TM-1 and CA-13
3. TM-3, CA-11, and CA-13
4. TM-3, CA-15
5. TM-3, two CA-13
6. TM-4, CA-11, CA-13
7. TM-4, two CA-13
8. TM-4, CA-15

### TM-4 Tape Deck

This deck, shown in Fig. 4, mounts vertically, horizontally, or at any angle, and records stereo or monaural when used with the required amplifier units. It operates at 7 $\frac{1}{2}$  and 3 $\frac{3}{4}$  ips, and has single-knob control. A quarter turn to either right or left gives rewind or fast forward, respectively. Depress the knob and turn a quarter turn to the right and it records and plays. It is equipped with two heads—one a combination record/play head for a half track, and the other a stacked stereo head. For stereo recording—bulk erased or fresh tape is required.

The machine handles tape easily and smoothly, with reasonably light but effective braking. It mounts in a cutout 10-3/32 by 13 in., and requires a depth of 7 in. for clearance. Flutter and wow are claimed to be under 0.4 per cent at 7 $\frac{1}{2}$  ips, and under 1 per cent at 3 $\frac{3}{4}$  ips. All heads have removable pole pieces so they may be changed readily after wearing. The unit rewinds 1200 feet of tape in a measured 98 seconds, with fast forward being somewhat faster—of the order of 80 sec.

### Amplifier Units

The CA-11 preamplifier, shown in Fig. 5 is a 3-tube, self-powered tape playback amplifier which is equipped with a single gain control and a pilot light. It is 11-5/16 in. wide by 5 in. high and 8 in. deep (all amplifier units are the same size) and may be removed from its cage and mounted in a panel if desired. The equalization is modified NARTB, and the output is 1 volt from normal tape recording level.



Fig. 5. Pentron CA-11 preamplifier—a single-channel playback unit.

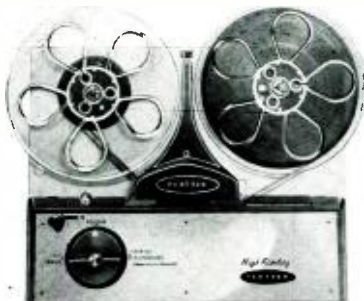


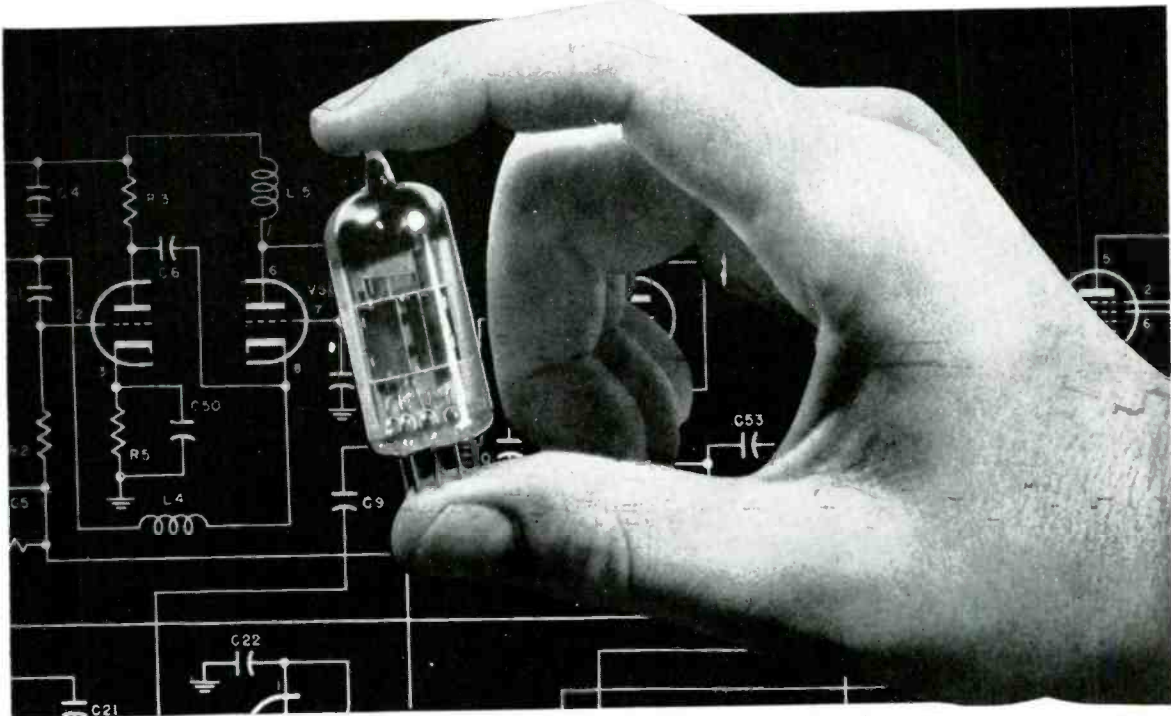
Fig. 4. Pentron TM-4 tape deck, one of the components of a complete system.



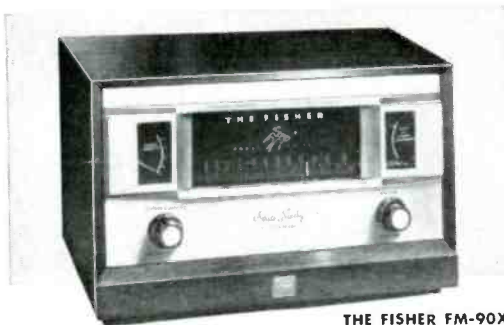
Fig. 6. Pentron CA-13 preamplifier—providing both recording and playback for one channel.



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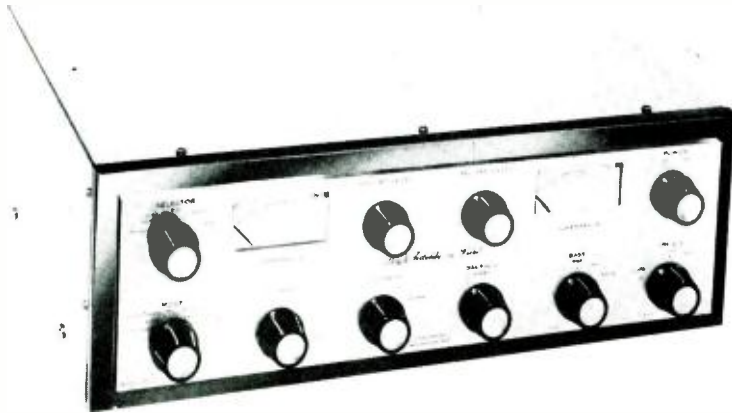


Fig. 7. Pilot SP-215 stereo preamplifier is a top-quality unit flexible enough for normal preamp use as well as for various recording applications.

The CA-13 preamplifier, shown in Fig. 6, is a record/play unit, with self-powered, and volume indicator and erase/bias oscillator. It will accommodate microphone or a high-level input such as radio tuner or phono preamp, and also serves for playback. An interlock switch prevents accidental erasing of desired material, and output level of the playback circuit is 1 volt at an impedance of 10,000 ohms.

The CA-15 preamplifier is used only for playback, and is essentially two CA-11's in the same cabinet. Separate level and equalization controls are provided for each channel, as well as a master gain control which changes gain simultaneously in both channels. This unit has five control knobs.

One other unit, the CA-14, completes the lineup. This is a microphone or phono mixer with four channels—two at high gain and two at either high or low gain as desired. This unit has a gain of only 8 db in the microphone channels, but it permits the use of as many as four mikes to feed into a single record amplifier with suitable mixing facility and no loss in over-all gain.

Taken together or in parts, this is a flexible line of equipment suitable for the experimenter who (1) needs the various services available, or (2) wishes to build up to a complete system with a step-by-step approach. The convenience of mounting provides for a wide latitude in housing the units, or they may be used in their separate cases and plugged together as required.

F-24

## PILOT STEREO AMPLIFIERS— SP-215 AND SM-244

One of the first of the stereo amplifiers to appear on the market was the Pilot SM-244, and along with it came the preamplifier, SP-215. Both offer good performance, and the preamp may be used as the nucleus of a complete high-fidelity record and playback system.

The SP-215, shown in Fig. 7, is extremely flexible, well engineered, and carefully built. Briefly, the circuit consists of two separate sections, both alike, and serving as the two channels of a stereo system. As to the circuit, there are five inputs to each channel—phono, tape head, microphone, radio, and auxiliary. The first three are preamplified, with suitable equalization for phono (RIAA) and tape head (NARTB). The selector switch connects

the desired input to the following circuitry, which is split into the recording section and the audio section. The former has a separate gain control feeding an amplifier stage, which in turn feeds a cathode follower for the recording output and a VT meter amplifier stage. The audio section begins with one section of a dual volume control, (a four-section potentiometer with two sections in each channel), followed by a loudness contour switch with five positions, a balance control, voltage amplifier stage, tone controls, another voltage amplifier stage, the second section of the dual volume control, and a cathode follower for audio output.

In addition, there is a function switch which provides for normal stereo operation, reversed stereo in which Channel A input is fed to Channel B output and *vice versa*, and two monaural positions in which both outputs are fed from either Channel A or Channel B inputs. Furthermore, a socket is provided for powering an external record amplifier which would provide the necessary equalization for recording with the specific heads employed.

With the audio circuits being gauged together, stereo operation is permitted with a minimum of controls. And with completely separate controls of the two recording outputs, flexibility of operation is assured in this circuit as well.

Circuit engineering is to be commended in this unit, with all heaters in the audio

channels operating from a d.c. supply. The recording channels—which operate at a higher level—employ a.c. on the filaments. The gauged controls have been held to close tolerances, with variation in gain not exceeding 1 db between channels.

Gain in the preamp stages is altered so that in the phono position a 7.5 millivolt signal is required for normal output, while only 2.5 mv is required for normal output on tape-head and microphone inputs. Separate level adjusting controls are provided for the two high-level inputs of each channel, and another dual control permits setting the record output signal to a value which will give an adequate indication on the VU meters.

Distortion is less than 0.25 per cent for a 1-volt output, and hum and noise measured 78 db below 1 volt. The normal output for the audio channel is 1 volt, while the recording output may be set anywhere from 0 to 1.3 volts. The tone controls—which affect the audio channel only—are marked with calibration points which correct for I.P., NAB, and AES curves without complicating the input switching for the lesser used equalizations.

This is a unit which will delight the eye of anyone who admires a good instrument, and its many uses should make it an extremely popular amplifier.

### The SM-244 Amplifier

Similar in appearance, except for the VU meters and the recording controls, the SM-244, shown in Fig. 8, combines the preamplifier equipment, tone controls, and the balance and contour controls of the SP-215 with two 14-watt power amplifiers to serve as a complete stereo system. The circuits are identical except for the output circuitry—the SM-244 has no meters, but does provide cathode follower outputs for both channels to feed a recorder, and the audio sections terminate in the power amplifier consisting of a 12AX7 and two 6L84's in each channel, with output impedances of 4, 8, and 16 ohms. There would never be any need for the use of an SM-244 with an SP-215, since the latter could feed two basic amplifiers to provide a complete system. But for anyone who did not require the flexibility of the recording channels, the SM-244 would serve admirably.

Distortion—1M—measured 2 per cent at 16 watts in one channel and at 17 in the other in the model tested. Hum and noise was measured at 66 db below 1 volt, which is quite satisfactory. While we prefer the SP-215 with two higher-power amplifiers for a complete system, the SM-244 should be perfectly adequate for any average installation where only a single pair of speakers was to be used.

F-25







Fig. 8. Pilot SM-244 offers both preamplifier and power output for stereo use.

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 <p><b>How is P·S·E easy on my budget?</b></p>	 <p><b>Why is P·S·E the only <u>genuine</u> plan?</b></p>
<p><b>A:</b> With P·S·E you can start as modestly as you like—with one extended range speaker, for example—and save part of your speaker budget until you've had more listening experience in your own home. Then, as your tastes develop and your budget allows, you can build up in successive, relatively inexpensive steps to a great variety of magnificent speaker systems. You are thus able to devote most of your initial budget to the selection of quality amplifying and program source equipment which cannot be economically altered or substituted later on.</p>	<p><b>A:</b> Because <i>all</i> University speaker components are <i>especially matched</i> and designed with <i>exclusive</i> built-in features that provide the versatility essential to such a plan. Because University makes the <i>world's widest range</i> of quality speaker components—woofers, mid-range, extended range, 2- and 3-way Diffaxials, tweeters, networks—that give you an almost <i>unlimited selection</i> of superb speaker systems to start or develop until you gratify your ultimate aspirations!</p>

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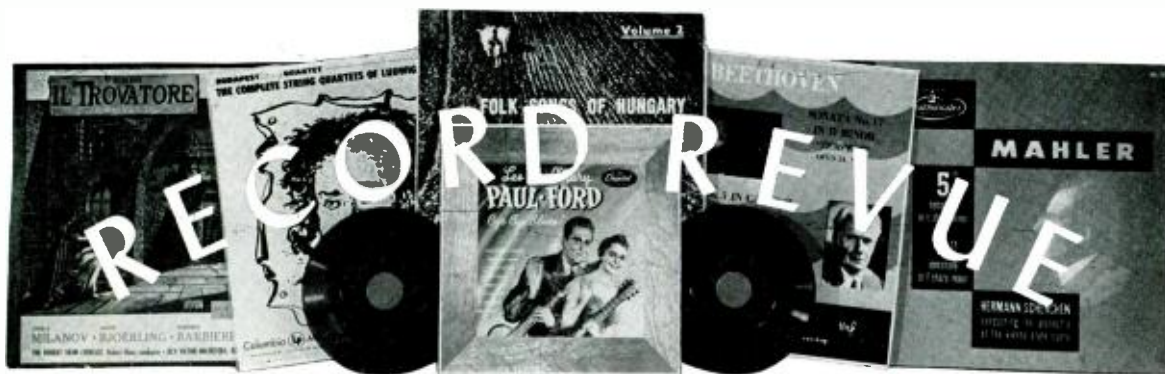


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## EDWARD TATNALL CANBY\*

### 1. FROM RUSSIA

**Shostakovich: The Festive Overture (1954); Memorabilia Year 1919 (1951); Symphony #9 (1945). State Radio Orch. of USSR, Gauk. Monitor MC 2015**

An interesting record, this, of recent Shostakovich. The two sides are astonishingly unlike but for legitimate reasons, when you come down to it. The Overture and "Memorabilia Year" are public, strictly practical works, the latter a film score (excepts). According to present day Russian thinking, they are accordingly written in a thoroughly "old-fashioned" idiom; most of the music might be a cross between "Annenk" (but not as strong) and, maybe, "William Tell." If I don't like it much, it's because of Shostakovich, not politics. Prokofiev wrote the same sort of music and made fifty times as much of it.

The Ninth Symphony is appealing, short—after the two utterly bloated and huge wartime symphonies, now happily forgotten—and musically meaningful, if on the dry side. But there is so much of earlier stuff in it, notably from his long-ago First Symphony, that the net effect is a bit tired, though pleasing. These are remarkably well and accurately played performances. Over there, they really respect this man—you can hear it in the playing.

**Shostakovich: Violin Concerto. David Oistrakh: Leningrad Philh., Mavrin. Monitor MC 2014**

This recent concerto is surely Shostakovich at his present best, displaying his highest virtues musically, as well as long-familiar traits, such as lengthiness. The music is wonderfully suited to the pure, Romantic techniques of Oistrakh and he, in turn, worships it both in the playing and in a set of very interesting notes on the record jacket, written by himself.

The piece is big, thick, but it is cast on a reserved, Romantic-dissident plane of expression, Shostakovich's best. The long, lyric, drawn-out first movement is superb for the violin, almost bleak in its sound, yet deeply expressive in a vast, distant, awesome way. It's been a long time since I've been so moved by a Shostakovich piece. The whirlwind scherzo that follows is the usual one of a hundred other Russian works, driving, scaterly, demonic, persistent, unrelenting. . . .

No point in going further in verbal description. A solid and impressive piece, played fervently and beautifully by some of the best musical technicians in the world. And the recording is as good as anything you'll find anywhere, too.

As usual, don't underestimate the Russians!

**Prokofiev: Cinderella (ballet). Royal Philharmonic, Irving. Angel 35529**

Modern? I honestly wonder how anyone can listen to this recording of about half of the long Prokofiev ballet on the familiar and

ever-romantic theme of Cinderella, and come away less than pleased. It is not pretentious music, and never shows off its modernness, though at appropriate times it is dissonant. (As if anybody minded mere dissonance these days!) It isn't earth-shaking, nor heroic—but then, neither is the sweet old tale itself. Just a fairy-tale version of the age-old progression: from rags to riches and back or love until midnight, most lyrically expressed.

You don't really need to follow the "plot" in detail, here. You'll find the music straight out of the unbroken Russian ballet tradition that goes back to the universally admired Tchaikovsky ballets, a seemingly endless series of "numbers," one after the other, all danceable, contrasted and ever fresh, a few familiar themes reappearing now and then to tie the whole together. This ballet, from 1941, was dedicated to Tchaikovsky and if you listen, you can tell why.

Out of fifty sections in the original three-hour span (roughly speaking), 24 are here recorded, as they were used for the famous English production of the music of about 1948. The playing is lovely and so is the recording.

**Tchaikovsky: Romeo and Juliet. Prokofiev: Romeo and Juliet (ballet suite). Berlin Philharmonic, Lorin Maazel. Decca DL 9967**

This is an extraordinary record and nobody could have been more surprised than myself—for I expected it just to be another publicity stunt. Far from it.

First, the little-known conductor with the funny name is a young American, under thirty, one of the many young Americans doing musical barnstorming in Europe—but this one is astonishing. In both these works, there is a discipline and cohesiveness in the playing of this world-famous orchestra, a strength of purpose and a solid viewpoint, that could come only from a respected conductor. Orchestras, even the best, don't play like this for just any old strapping who conducts them.

Second, the lining-up of these two different approaches to the great Shakespearean theme turns out to be remarkably effective, in Maazel's playing. As one of the younger generation, his Tchaikovsky is honestly modern, clean, sharp, strict in tempo, high-tension. It is one of the best realizations of the music I've heard within this modern approach, which sometimes leaves Tchaikovsky as mechanized as a player piano. Not here—though there is none of the sobbing and sighing of the old days. And again, as a youngster, Maazel has a feeling for Prokofiev, a respect for him, that lifts this performance a good way above several I've heard lately under more grown-up auspices. (The Boston Symphony recording seemed to me cold and bored; the Concert Hall recording of the work was mauled in the playing itself.)

The Tchaikovsky, a species of tone poem, is of course complete; the Prokofiev is a suite, a small portion of the whole ballet score, which runs to no less than four hours! This version is a combination of two of the three suites Prokofiev derived from the music.

**Prokofiev: Piano Concerto #3; Symphony #1 ("Classical"). Gary Graffman; San Francisco Symphony, Jorda. RCA Victor LM 2138**

As the critic Alfred Frankenstein points out in the jacket notes for this recording, Prokofiev was one of the creators—in his own piano playing—of the hard, steady piano style that now is taken for granted among hundreds and hundreds of highly trained younger concert pianists. This music, from 1921, first played by young Prokofiev himself in Chicago, was one of the definitive piano works that established that style. No wonder it is a favorite with budding pianists of the new generation!

Well . . . Gary Graffman is decidedly a man with steel fingers. No doubt about that. His piano fairly crackles with digital power. But Prokofiev, even in his salad days, was a man of warm heart, beneath the fury of his then-modern style. I wasn't on hand, as Mr. Frankenstein was, to hear Prokofiev play this music, but I must say that Graffman does a creditable job; the sheer static charge of this dry stuff of the Twenties is as high here as you could wish. The orchestra plays with equal dryness—even the acoustic situation is abnormally dry, for these big-liveness days.

Not bad . . . not bad. Refreshing. And there's a lovely, wry, sentimental slow movement between the outer pyrotechnics, played with all the feeling it deserves. I was prepared to dislike this record—I take it all back.

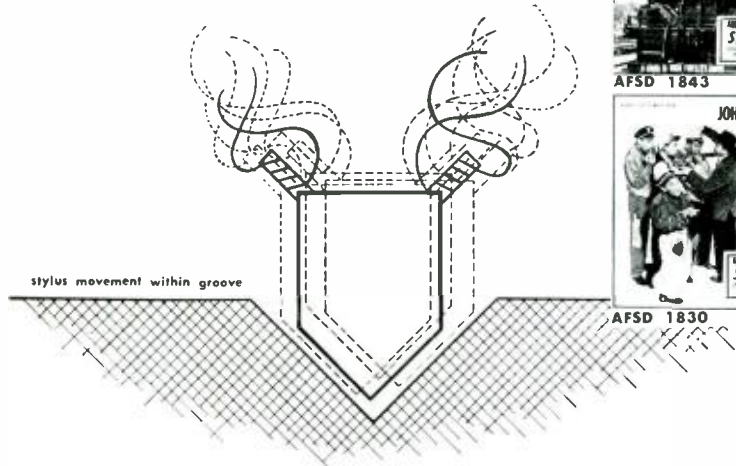
This "Classical" Symphony is one of the best versions yet. I object to two types of "Classical"—and this is neither: (a) played at whirlwind speed, cutely, like a bit of musical froth and (b) played solemnly, as though it were the one sober product of an otherwise drunken modernist! This version is rightly sold, not too fast, yet snazzy and just a bit modern and satirical. And I have never heard the myriad inner details so well brought out, by players and by recording engineers. Excellent, especially the last movement.

**Prokofiev: Symphony #5 (1944). Philadelphia Orch., Ormandy. Columbia ML 5260**

It's hard to believe that this big symphony dates from as recently as the end of the war (it was first played in 1945)—the music has become fairly familiar repertory fare in many symphonic programs and in numerous recordings in addition to this one. The piece is out of Prokofiev's late and Romantic period—a large work, full of melody and catchy theme material, on a broad, massive scale, a kind of big brother to the little "Classical" Symphony, Number One.

Ormandy and the Philadelphia have built up an immense Columbia catalogue of highly competent and very professional jobs, covering much of the symphonic repertory. Many of these recordings are superb—brilliant, polished where brilliance and polish make the music sing. Others, unfortunately, tend to sound routine, if highly polished. The fine line that divides a competent and routine performance from a broad and inspired one isn't always easy to draw—sometimes it's a matter

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of opinion, among reviewers as well as record buyers.

This music can hardly be a sort that has been too often played by the musicians—it isn't that well known. And yet some aspects of it hit me as on the languid, expertly routine side. Not much—generally it scintillates. But I can't really say that the warmth of Prokofiev's spirit is fully present. Expert playing does a lot to make up for it.

**Brahms: Piano Concerto #2. Gilels; Chicago Symphony, Reiner.**

**RCA Victor LM 2219**

If you have enjoyed RCA's powerhouse first-line recordings of the big concertos in the past, you'll fall right in line to buy this one, in hi-fi style. I don't know how it happens, but here we have a performance by the newly-emerged great Russian pianist teamed with old "Razor-Edge" Reiner, that follows precisely and astonishingly in the virtuoso tradition of such high-powered teamwork as that of Vladimir Horowitz and Toscanini on earlier RCA discs. The music thunders and roars, rises to white-hot intensity; the virtuoso pianism is dazzling, the orchestral playing the same.

Personally, I prefer a less flamboyant, more easy-going style for this Brahms. The Second Concerto isn't one of Brahms' tortured works—it is relatively on the placid side, for him. It can take a white-hot performance such as this, admittedly, and the neophyte listener is bound to be bowled over by its very intensity. But a few of us jundiced old hands, I think, would like to hear our Brahms more quietly. Matter of taste, and Gilels is undoubtedly a master pianist and a fine musician. In fact, his Russian warmth and Romanticism (they play Romantically over there) tends to balance the well-known razor-sharp chilliness of Reiner's extraordinary conducting.

**David and Igor Oistrakh Play Bach Concerto for Two Violins, etc.**

**Monitor MC 2009**

This is one of those records of tidbits—or leftovers, if you look at it another way—that leaves me cold. I suppose if you gotta have everything ever played by the Oistrakhs you'll grab this. But the Bach is a so-so performance with a lumpy orchestra; the trifling "Navarra" by Sarasate that follows it is out of place and an annoyance to anybody who wants to hear the Bach, anyhow. On the other side is a Bach sonata, played lumpily on the piano with papa Oistrakh on fiddle, followed by the only good item on the disc from my viewpoint, a little Hindemith Violin Sonata, Opus 11, #1, that is quite lovely. I'd buy it if they'd put it on a separate 45 rpm record for me. P.S. you won't find much fl. either, if that's what you're looking for.

**Pops Caviar. (Prince Igor Overture, Polovetzian Dances, Russian Easter Overture, On the Steppes of Central Asia.) Boston Pops, Fiedler.**

**RCA Victor LM 2202**

Each time I hear a new offering from the famed and original Boston Pops I marvel at the way in which Arthur Fiedler can pep up the old Boston Symphony, in its Pops guise! Amazing. Always, he plays a list of real corny (but never too corny) items; always, they have a freshness and glitter that makes you forget they're corny. Always, too, Fiedler manages to get into the deeper waters of really serious musical expression, wholly unselfish. In spite of the outward Pops mood. That is something no other pops orchestra has ever done as well. Fiedler is a fine musician and a man with a hair-trigger sense of style.

There are lovely lyric parts in the well known overtures here, as sweetly played as you can imagine. The noisy parts are full of kick—they pop and crackle. The pompous stuff, miraculously, keeps within the sprightly, light mood of the Pops style, too. The pompous Russian Easter Overture zips along, bells and all, at such a merry pace that I laughed to think what some of the more hi-fi-conscious maestri might have done with it here. "1812," only more so.

**Moiseyev Russian Folk Ballet Company—Great Russian Folk Dances.**

**Hungarian States Folk Ensemble—Hungarian Folk Songs and Dances.**

**Epic LC 3459**

Epic stole a march on competition here and rushed this disc out only days after the Moiseyev dance troupe had knocked New York for a loop. But on the record the Hungarians have it all over the Russians.

The Moiseyev dancers may be sensational but their music isn't. Just a lot of very old-fashioned semi-symphonic arrangements of supposedly authentic tunes, done up in the style of, say, 1880, full of sentimental harmonies. I got tired of it after a few bands.

On the other side, the Hungarians tear into wild, joyous Hungarian music that is a million times more "authentic" (though still arranged) than the Russian stuff and much more exciting. The orchestra plays barbaric, high-powered dance music with sharp, modern, yet highly folkish harmonizations; there are voices, all sorts, with yips and yells interspersed—so enthusiastically that I can't imagine how such a program could have been worked up as a prepared show.

I'd suggest that this record side is a marvellous illustration of how a group of gifted "classical" composers can create a national language for their country in terms of style and harmony—for this wild, powerful style comes right out of the famous work of Bela Bartok and Zoltan Kodaly. Their modern idiom, applied to real Hungarian folk music, has now become a national style—and it is far, far superior to the sentimental claptrap turned out by the Russian group's orchestra.

**Soviet Army Chorus and Band In A Program of Favorites. Monitor MP 520**

This is reported upon for those who remember the famous album of 10-inch 78's of the Red Army Chorus that still sits in many a front parlor today after many long years of use. Politics or no, it was a standout favorite, the old album, and for good musical reasons.

I can't even tell you whether this is the same old stuff—I don't have the old album on hand; but it is definitely of the familiar type and excellent of its sort; a big, puffy band, large, high-powered soldiers' chorus, numerous authentic Russian solos, tenor, baritone and basso profundo, two Czech items are included.

Nothing much on fl, though OK for all sorts of listening. The record is "processed from the original master tapes" according to the label: I wonder if maybe they were master discs?

**2. MOMMY, GIMME A RECORD**

**Franck: Symphonic Variations.**

**Rachmaninoff: Piano Concerto #2. Philippe Entremont; Netherlands Philh., Bamberger, Goehr.**

**Concert Hall CHS 1501**

Youth is conquering the piano, the world over. Entremont, in his early twenties, is a French entrant into the international competition, and he's a good one, if (perhaps unavoidably) a bit youthful in his playing.

Entremont plays César Franck's lovely and once-familiar work (we don't hear it quite so often nowadays) with a good deal more than a routine Romantic feeling. Where many a performance serves only to make the music the more dated and out of fashion, this version is earnest, fresh and respectful of the composer. Some of this has to do, surely, with the fact that in France old César Franck is an imperishably great Frenchman—like Wagner or Goethe to the Germans. Surely does no harm, if you can play as Entremont does. At least half of the credit, incidentally, goes to Carl Bamberger, who is turning out all sorts of highly excellent music these days, in Europe and in New York. He furnishes the rough, masculine orchestral element that so pointedly contrasts with the lyric, pathetic piano sound in the Franck.

The ultra-familiar Rachmaninoff (with another conductor) isn't as good. Though every budding pianist lives and breathes Rachmaninoff, most of them, including Entremont, waste their time; they aren't either old enough or massive enough. Somehow, Rachmaninoff's music, to sound its best, needs a genuinely older, bigger player. Entremont has the strength of wrist and hand—but not the weight, to speak figuratively. Nor the emotional sense of drama and long line.

**Organ Music by Liszt. Vol. 1: Vars. on "Weinen, Klagen, Sorgen, Zagen" (Bach): Evocation a la Chapelle Sixtine. Vol. 2: Fantasy and Fugue on "Ad Nos. Ad Salutarem Undam" (Meyerbeer): Prelude and Fugue on B.A.C.H.? Richard Elsasser, organ of John Hays Hammond Museum, Gloucester.**

**M-G-M E3576/77**

(See also Vols. 3, 4, 5.)

The bigger the recording prospects, these days, the better its chances of success—an old American business principle that seems to do very well in the recording field. Not a one of these giant Liszt works would seem to have a chance with modern listening audiences—too long, too old-fashioned, too leisurely—but here they are en masse on no less than five LP records: willy-nilly, I played them, and found myself thoroughly engrossed. They're an interesting and marvelous evocation of another era, once you adjust your inner time-sense to their enormous lengths.

Richard Elsasser is a remarkably fine Romantic organist, taking the music at its face value without compromise or apology. (His César Franck, on an earlier M-G-M disc, was also unusually expressive, I thought.) The fact that this peculiar organ makes use of an electronic "accentor" for an extra-Romantic roar, *via* loudspeakers, is beside the point—you can't tell the difference *via* a recording. What counts is the big recorded sound, as well as Mr. Elsasser's excellent period-sense for the enormous climaxes (the caged lion roaring) and the long, thinly held stretches of near-silence that were the essence of dramatic expression in Liszt's day.

Old-fashioned it surely is, and in extreme contrast to the now popular baroque organ and its literature. But Liszt, after all, was a great and powerful musical figure whose work is not likely to be kept down simply because it is out of style. Given a sympathetic performer, and the time to get used to the Liszt feeling, these big pieces are impressive. For that matter, you will probably be struck by their extraordinary chromaticism, that almost atonal sort of high-tension, nervous harmony that, I think, will be increasingly Liszt's hall mark as a very early forerunner of Schoenberg himself.

**A Dog's Life. An Actual Story in Sound. Conceived and recorded by Tony Schwartz. Ralph Bell, narr.**

**Folkways FD 5580**

This is the first record of Tony Schwartz I've heard—Folkways doesn't send review copies to us folks. This came from Tony himself, along with another one, and I'm enthusiastic. It's nothing more than the day-to-day life of Tony's dog, Tina, from the moment Tony walks into the ASPCA or the pound or something and signs her out as a puppy, to the grown-up stage when she comes down with a false pregnancy.

What can you record out of a dog's life? Well, you hear Tina herself (yap yap) but mostly, you hear Tony and Tina together, encountering neighbors, dog doctors, officials and what-not. Amazing what can be done with a midget tape recorder—given a guy who has the uncanny ability to put people at ease so they forget the infernal machine he carries around with him.

Schwartz is in his way a genius at this and it is his main occupation, most hours of the day and night. The dog documentation is put together from fragments made over a long stretch of months, with a script narrated (for radio purposes) by a sympathetic professional voice. Tony himself is heard most of the time, as he records in the field—or, should I say, on the street, on the town. The locale is New York and, incidentally, if out-of-towners would like to hear what we dizzy New Yorkers sound like in the flesh, on location, this'll give a marvelous picture of the local accents!

The sound quality is excellent. Hi enough in the fi so that you will forget very quickly that the material is "portable."

A required record for (a) recording experts (b) people who like people and (c) dog lovers. Also (d) dogs.

**Mommy, Gimme A Drinka Water.** Danny Kaye. Lyrics, music by Milton Schaefer, orch. G. Jenkins. **Capitol T937**

This one was sent to me in the normal manner for such things—air mail special, rush, Western Union, important information enclosed, do not delay contains NEWS. So I let it collect a bit of dust, just to get back. A heartfelt carbon-copy letter from Danny inside said Dear \_\_\_\_\_ and he forgot to sign it.

Just played it and must report that, like the rare whiskies of the ads, this one contains a certain proportion of genuine Kaye. I'd say about eight percent. The rest is neutral spirits and pretty dispirited at that. Mr. Kaye has been persuaded to get like a mean l'il old kiddie, taking over some of Red Skelton's ancient role.

The thing is, Danny Kaye is genuinely a hugely talented and very musical individual who is high-powered when he gets a chance. But this watered-down children's stuff hardly lets him get started. After the title piece, with Danny whining against an Impressionistic Hollywood-French huge-orchestra background, the thing just gets tiresome, the laughs dismally far apart. I only mention it at all because the germ of something awfully funny, in the line of the well known Steinberg Small Fry or maybe Dennis the Menace, is definitely in this piece. Sweet little unholy devils, small kids!

**Swingin' Pipe Organ.** Billy Nalle; Ray Mosca at the drums.

**RCA Victor LPM 1521**

The title of this is slightly misleading, considering the seriousness with which Mr. Nalle approaches the playing of modern-type jazz arrangements on the "Mighty Wurlitzer" type of organ. (A little birdie tells me this is the famous Paramount Theatre organ.)

Actually, it isn't at all highbrow jazz in the sound—what with "On the Sunny Side of the Street," "Song of India," "Summertime," and more Dorsey-associated titles. But Mr. Nalle himself is quite astonishing in his explanation—via a correspondence with me—of some of the effects I'd noticed here.

For instance, I said I thought that, in comparison with other "Mighty Wurlitzer" recordings, his registration was somewhat monotonous, unchanging; his answer was that this was a deliberate effect, an approach to the more classic feeling of Bach and Handel and the like, as opposed to the "Romantic" registration of other organists, who throw on the color, change every phrase to a new stop, in the style of the Nineteenth century. (That, too, is what old Stokowski used to do in his famous Bach-Stokowski arrangements.)

Nope, this music doesn't sound like Bach and you'll recognize every Tommy Dorsey tune right off—but it's worth keeping in mind that even the swiftest pops men these days are talking in terms of real gone classical theory. If you're a Mighty Wurlitzer man, you'd better get this one as an interesting contrast to others in the category. If you're a Bach-Handel man, you'll find the application of Eighteenth century principles of tone color to this music an interesting idea. (On the Paramount Theatre organ, too!)

**September Song.** (American Theatre Songs of Kurt Weill.) Lotte Lenya, orch. & chorus, Levine. **Columbia KL 5229**

Here is the thin little voice of the great Lotte Lenya in a collection of her husband's songs, excerpted from their various stage works. The Lenya magic is all there and, I suppose, the Weill too. I find, as an interested outsider, that Weill and Lenya make a superb combination when the dramatic action is complete, in a whole show (as in numerous recordings now available)—but that when the songs are excerpted, out of context, the banalities of the Weill style show up at their worst, the dramatic power at its least effective. So, too, with the little Lenya voice, which really isn't anything physically. It's all in her personal magic—when she has a chance to get it across. She really doesn't, here. Unless, of course, you know all these Weill scores by heart. Plenty of people do. **Æ**

# AR-1

three reports on

## SPEAKER DISTORTION

We believe that Acoustic Research speaker systems, by virtue of their patented **acoustic suspension** design, establish new industry standards in low distortion. This is a technical characteristic that can be directly interpreted in terms of musically natural reproduction.

Our opinion on the matter is shared by others:

**A** recent Master's thesis written at a leading engineering university (by George D. Ramig) involved distortion measurements on fifteen 12-in. and 15-in. loudspeakers,\* including the AR-1. Here are some of the results:

### PERCENT HARMONIC DISTORTION

	AR-1	Spkr 2	Spkr 3	Spkr 4	Spkr 5	Spkr 6	Spkr 7	Spkr 8	Spkr 9	Spkr 10	Spkr 11	Spkr 12	Spkr 13	Spkr 14	Spkr 15
50 cps (lowest used)	2.1	4.4	8.8	10.0	11.2	12.8	15.0	17.8	18.5	18.5	23.2	31.0	31.0	43.0	
55 cps	2.1	1.8	5.6	7.4	8.8	13.0	11.8	7.6	8.7	8.7	7.3	18.3	12.8	17.5	11.0
70 cps	1.9	1.9	2.7	4.4	5.3	5.9	7.1	2.2	5.4	5.4	9.6	7.2	3.0	4.4	6.3
80 cps	1.0	2.1	2.1	3.4	3.9	3.2	3.9	2.6	3.8	3.8	6.6	4.0	2.1	2.3	3.1

Measurements taken at 3 ft., 102 db on-axis signal level. Amplifier damping factor control "off", giving DF of 30. Data published with Mr. Ramig's permission.

\*All speakers were directly baffled, a less than optimum mounting for some.

1

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2

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3

**The Audio League Report, in adopting the AR-1W as its bass reference standard, wrote:**

"At 30 cycles, only 5% total harmonic distortion was measured, as compared to values of 30% to 100% of other speaker systems we have tested . . . we do not specifically know of any other speaker system which is truly comparable to it from the standpoint of extended low frequency response, flatness of response, and most of all, low distortion."

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# ABOUT MUSIC

HAROLD LAWRENCE\*

## The Folk-Song Composer

**T**HE MEASURE of a countryside's richness in living folk song," wrote Percy Grainger, "is the measure of its illiteracy." This may seem paradoxical in the face of the outpouring of folk music recordings and the popularity of multitudes of folk singers and dance troupes in nations with high literacy rates. The key to Grainger's statement lies in the word, "living." For the folk music that lives is the kind sung by villagers, peasants, desert nomads, and others whose contact with the civilization of the cities, mass media, and the modern world is as remote as possible.

Geography plays an important role in the preservation of so-called authentic folk songs; swamplands, inaccessible mountain towns, mud huts in parched terrains, jungle depths, and even Arctic floes are targets of the folk song archaeologist, provided that radio, records, and TV have not gotten there first. The intrusion of "arranged" music into a community which had heretofore made its own music has the same effect as bad money on gold: it tends to drive the latter into extinction.

The general conception of folk music is derived from "popularized" sources almost entirely. In its raw, unadulterated state, the folk song is a far cry from the usual sentimental setting, polite harmonization, and orchestral transcription. The "uneducated" folk tune recorded in the field would probably repel the listener who associates the words, "folk music," with the past-toned English countryside in one case, or the bubbling mountain streams and tinkling bells of Auvergne in another. Indeed he would be amazed to discover the lack of obvious resemblance between an original melody sung by a nonegenarian Somerset farmer in a cracked, raucous voice, and its graceful lyrical counterpart in an orchestral setting, such as Vaughan Williams's *English Folk Song Suite*.

The use of folk songs in concert music began in earnest with the Napoleonic Era and the rise of nationalism. The folk tunes which 18th century composers employed in their sonatas, symphonies and concertos had been thoroughly cast in the classical mold. Notwithstanding the authenticity of the Russian melodies used by Beethoven in his *Rasoumovsky* Quartets, or the Croatian tune which became the principal theme of the slow movement of Haydn's "Drum Roll" Symphony, there were no conscious attempts here, or in the music of other classical composers, to seriously exploit local color. Once the business of quoting the song was disposed of, full attention was focused on the work's formal development. In the romantic era, these national melodies (symbols of political and musical independence) held the stage in their own right, dictating the layout and spirit of

each composition. The harmonic and orchestral trappings of the period, however, often smoothed the rough edges of the original tunes. Thus, MacDowell's heartfelt tribute to the American Indian, in the Suite No. 2 in E Minor, while containing thematic material collected from various North American tribes, is no more than a picture-book representation of actual Indian music, irrespective of the work's intrinsic merit as a whole. Liszt's *Hungarian Rhapsodies*, Brahms' *Hungarian Dances*, Granados's *Spanish Dances*, and other similar works composed in the 19th century were idealizations of the folk idiom.

Most of the folk songs utilized by the romantics were acquired through such secondhand sources as published collections, gypsy improvisations, and café ensembles. During the first decade of the next century, serious composers refused to accept the conventional treatment of folk material and began a historic series of investigations into the hinterlands. With notebook and Edison cylinder machine, they trekked off to places no conservatory musician had ever dreamed of visiting. From the throats of Norfolk farmers, Carpathian peasants, and Andalusian gypsies, thousands of tunes were collected, recorded, and codified. The results of this musical birdwatching profoundly influenced the creative development of some of the greatest contemporary composers.

This influence was most strongly felt in countries with little or no formal musical tradition (Russia, Norway and Hungary quickly come to mind), as well as in nations beyond the orbits of Germany, Austria, and France. To the early 20th-century composer stifling in the restrictive atmosphere of post-romanticism, folk music offered an immense creative stimulus. No longer content with the mere transplanting of folk motifs into established forms, he developed a spanning new musical grammar. In Hungary, Béla Bartók collected no less than 2721 Hungarian melodies, all of which pointed toward a harmonic path far removed from major-minor patterns. "These primitive melodies," wrote the composer, "show no trace of the stereotyped joining of triads. That . . . means greater freedom for us in the treatment of the melody. It allows us to bring out the melody most clearly by building round it harmonies of the widest range varying along different keynotes."

At about the same time Bartók and Kodály were exploring remote regions of their native land in search of the old musical language of the Hungarian peasant, an Australian composer and pianist was conducting a similar investigation in Lincolnshire, England. The musical work that grew out of his expedition was some 22 years in the making (1905-1937). For

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



the fact that *Lincolnshire Posy* is virtually unknown to the general public, Percy Grainger has partly himself to blame. The tremendous popularity of *Molly on the Shore*, *Country Gardens*, and other light pieces which Grainger himself described as "half-breed" tunes, placed in the shadow some of his more original creative efforts.

"Original," though, is too weak a term to employ in describing *Lincolnshire Posy*. "Unique" would suit it better. Grainger has done more than make the folk music of England his artistic mother tongue, adopting its modes, melodic contours and rhythmic character. While Bartók, Falla and Vaughan Williams apotheosized the folk idiom, Grainger went a step farther. His astonishing work is a series of musical portraits of the actual singers who performed for him during his excursion through the English countryside. Each of the six movements depicts the singer's personality no less than his habits of song. These include, as Grainger wrote in his preface to the score, "his regular or irregular wondrous of rhythm, his preference for gaunt or ornately arabesqued delivery, his contrasts of *legato* and *staccato*, his tendency towards breadth or delicacy of tone."

Like Bartók, Grainger meticulously noted down every nuance, change of rhythm, and phrasing detail in the singers' styles. But where the former applied his research to pure abstract forms, Grainger created some of the most powerful tonal characterizations in modern music, from that of Mr. George Gouldthorpe who, "though his face and figure were gaunt and sharp-cornered . . . and his singing voice somewhat grating . . . yet contrived to breathe a spirit of almost caressing tenderness into all he sang, said and did—though a hint of the tragic was ever-present also," to Mr. George Wray, who "never failed to invest [his tunes] with a unique quaintness—by means of swift touches of swagger, heaps of added 'nonsense syllables,' queer hollow vowel-sounds (doubtless due to his lack of teeth) and a jovial, jogging stick-to-it-iveness in performance."

These and three other characters are evoked by Grainger with an unerring sense of musical portraiture. The work, scored for winds, brass and percussion, represents a vanishing race of old folk singers who will take their part in musical history along with the troubadours of medieval times. Æ

## Coming HI-FI Shows

According to our latest information, the following is a list of the high fidelity shows presently scheduled for the next few months:

June 6-8—Houston, Texas; Shamrock Hilton Hotel. (*Independent*)

Sept. 19-21—Chicago, Ill.; Palmer House Hotel. (*International Sight & Sound Exposition, Inc.*)

Sept. 30-Oct. 4—New York; Trade Show Bldg. (*IIIFM*)

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12-17A



## CHARLES A. ROBERTSON\*

Juanita Hall: Sings The Blues  
Counterpoint CPST 556

COUNTERPOINT, the second label to release a stereo disc, also enjoys the distinction of being the first to present a product balanced in the studio with full consideration of the problems of compatibility introduced by the Westrex 45/45 system last Fall. Recorded the first week in February, the result is the equal monaurally of the majority of non-classical items on the market, taking a place only slightly below the best in single-channel sound. The stereophonic effect is excellent, with good separation of instruments and living presence, due in part to the majesty of the rich voice of Juanita Hall. It would be hard to put a hole in the middle of her big, full tones.

"There is every indication that stereo on discs is going to find a ready audience and most of my future releases will be compatible," stated Bill Fox, president of Esoteric Records, when interviewed regarding his new venture at the offices of the company at 333 Sixth Avenue. "I feel that stereo has something to add even to an instrumental solo, most certainly to the piano. As I see it, the word *compatible* has to cover the whole field, including the selling price. Ours remains the same for the first releases and I hope no rise is forced by increased costs.

"Like everyone else I am waiting impatiently for more stereo equipment to be made available, particularly cartridges. One of mine is out on loan right now to a friend who missed out on two shipments to his retailer, once because he stopped for lunch on his way to the shop. I intend to give each one a listening test as it becomes available. Until I hear a few more, it will be difficult to judge the best way to balance a session, especially with regard to the bass."

Records are auditioned in an alcove about the size of the average living room by means of a pair of Acoustic Research AR-1's. "These speakers might have been designed with stereo in mind," Fox said, "and I am glad I already had one. So far I have made only a temporary addition to my monaural equipment. I will need meters to check the gain on each channel, not only to approve test pressings, but because they will give me more accurate reference points to use in the studio than just preamplifiers. There are so many new factors to consider that I like to have the instruments to back up my ears. When I find time to complete it, my permanent installation will provide a great deal of flexibility.

"B & C Recording handles our pressing and I am fortunate to be able to work

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

with them. Johnny Quinn did the mastering and had the Juanita Hall record ready for the Baltimore high fidelity show the last week in March. I had hoped our classical release, which was recorded under the 60-foot dome of the Peabody Auditorium, and features Aldo Parisot with the Baltimore Conservatory Orchestra, would be ready at the same time. However, it required more preparation and should be out in a week or so."

The Hall session was held at the Beltone Studios on West 31st Street, and engineered by Les Cahan. In mentioning the studio, Fox said, "I like it because it has just the right amount of liveness and the musicians can be set up in normal playing position without too much moving around. As to mike placement, a Telefunken U-47 carries the voice on the right channel, along with a Western Electric for the piano and RCA's 77-D for the drums. On the left channel, the three horns are carried by another U-47, with an Altec Lipstick for the bass viol. It is necessary to set two peaks for stereo and in this case the voice was set a little over the horns. As Miss Hall knows how to use a mike, I was able to leave the controls alone after that, except to touch up the piano solos slightly."

Partnership in a Greenwich Village music store brought Fox into the record business shortly after World War II. His associate, Jerry Newman, is known for the sessions he made as an amateur enthusiast in Harlem at Minton's and Clark Monroe's in 1941. Using the Esoteric label, they began to dub 78's and make air checks as a sideline to fill the requests of their customers. When May Higgins, manager of Claudio Muzio, on her first American tour, permitted them to dub her collection of Muzio's acoustical discs, they issued their first LP. They produced their first live record in 1949, when Seymour Barab told them that Dimitri Mitropoulos was looking for a company willing to issue Schoenberg's *Serenade* in time for a tribute to him by the International Society of Contemporary Music on his 75th birthday. Their activities broadened with the acquisition of a former stable, especially adapted to chamber music, on East 26th Street, which was the scene of dates by many of the smaller companies. An amicable parting of the ways came last year, with Newman retaining the studio, while Fox turned his attention exclusively to promoting the discs and recorded tapes in his wide-ranging catalogue.

Recent jazz releases feature Al Haig and Rusty Dedrick, and test pressings of a compatible stereo session headed by Peeewe Russell, in the company of Ruby Braff, Vic Dickenson, and Bud Freeman, stand approved. "Stereo has dimmed my affection

for pickup groups," said Fox. "There is too much going on in the studio to waste time on unrehearsed dates. My interest is now in men who have played together and understand each other, as on these first two discs, or have worked out something new to say under a leader such as Charlie Mingus. As it was, I inadvertently switched the channels on one of Miss Hall's tracks. It's not too important at this stage of the game and could even have a little curiosity value, but I don't want it to happen again.

"My first effort more than satisfies me, though I have a few theories I want to try out in the future. The demonstration by Columbia of its use of an electronic computer in its system indicates that others are working on their own theories. How many of them will gain acceptance throughout the industry remains to be seen. Personally, I think there is still much that should be done in the studio to ensure compatibility. I visited the new Regent Sound Studios, especially designed for the needs of stereo, before it opened this week and intend to make use of it."

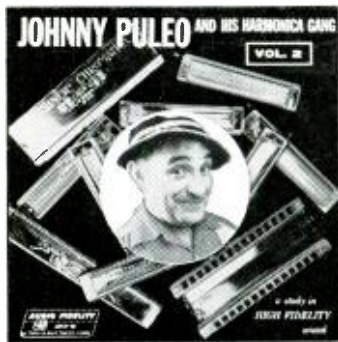
When questioned about the durability of the new discs and the advisability of playing them with a monaural pickup, Fox replied, "Using a cartridge with good vertical compliance, B & C Recording tested an Audio Fidelity release by playing it 300 times. Though the noise level increased in proportion, the stereo effect was still present. Another factor regarding wear is that most monaural styli are 1 mil and are tangent to the groove at a point slightly higher than the smaller stereo stylus. In normal use, the two points would not coincide in a majority of cases. Those persons doubtful about the suitability of their cartridge should consult their dealer."

"Stereo means the engineer will be working with quite a few new tools," he concluded, "but good ears and taste will still regulate their use to obtain realism. Even as today in the case of the echo chamber and vocalist's booth, they must be employed so their mechanics are not noticeable. I am depending upon the experience gained during my years with Jerry Newman to transcend these problems. There is no other way, except to always record the voice of a Maria Callas—or a Juanita Hall."

Under the guidance of Perry Bradford, a blues composer since the turn of the century, the Bloody Mary of the Broadway production of "South Pacific" sings a few of his numbers and some others mainly associated with Bessie Smith, whose message first reached her at the age of eleven. However belated, the entry of her magnificent voice into the blues field is an event worthy of rejoicing. Here is one Juilliard alumnus who will not be accused of lacking the right expression and feeling for *Downhearted Blues*, *Second Fiddle*, and *I Don't Want It Second Hand*.

Two of her companions, Coleman Hawkins on tenor sax and Buster Bailey on clarinet, were standard fixtures at Bessie's sessions and trumpeter Doc Cheatham is secure in his knowledge of the tradition of Joe Smith, the cornetist who accompanied her so ably. An indication of the good balance achieved is in the way the horns blend with the voice, instead of being relegated to the background. But the best proof of compatibility comes from Bailey, who has been treated shamefully on some recent discs. Finally given the recording it deserves, his tone emerges warm and brilliant. He has seldom played better in his long career.

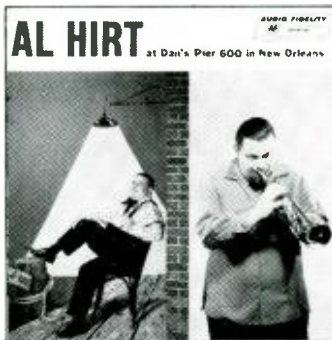
Pianist Claude Hopkins heads the rhythm section and is credited with the arrangements. Though its cohesion varies according to the equipment used and the method of playback, this is an area which



AFLP 1859



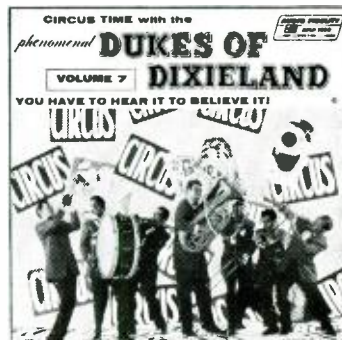
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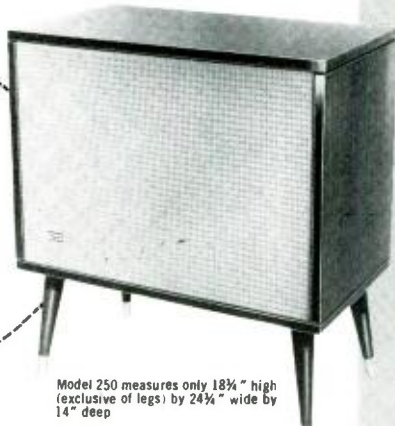
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allows considerable leeway. Besides, the talented Jimmy Crawford is on hand to hold things together, aided by George Duivier on bass, and his drums are skillfully recorded. The compatible disc takes another definite step forward in this recording. To convince your ears that a stereo disc can be made which will play back well monaurally, you need only compare it to recent single-channel efforts by some of the same personnel.

When stereo was introduced, techniques borrowed from the movies had value for demonstration purposes. But the cinerama effect of too great a separation of sections has no place in the living room, besides being out of balance on a compatible disc. As many tapes were made by this method, there is a backlog to be exhausted and many stereo discs will not be compatible. Before you believe statements that a compatible stereo disc is not practicable, listen to this recording and judge for yourself.

**Cat-Iron: Sings Blues and Hymns**  
**Folkways FA2389**  
**Harold Arlen: Blues Opera Suite**  
**Columbia CL1099**

Once again the travels of Frederic Ramsey Jr. along the byways of the South have brought him to the door of an undiscovered folk artist. In this instance on the outskirts of Natchez, where his portable equipment was unpacked to record Cat-Iron, a singer whose original blues hark back to the days when it was a flourishing port. Though bits of his melodies and lyrics are familiar from the pieces of other minstrels, he uses his virile voice to weave them into themes relating to his experiences among the rivertowns. There is the tale of *Jimmy Bell*, a gambling man of many parts, as well as *Got a Girl In Ferriday*, *Long Way From Home*, and *Don't Your House Look Lonesome*.

That he presents them with undiminished veracity is partly explained in the notes. Since his conversion to the church, Cat-Iron only plays the blues after some persuasion, and then on a borrowed guitar. He prefers the hymns which fill one side of the LP and serve as a powerful preface to a deeper expedition into blues territory. A strong conviction fills *When I Lay My Burden Down*, *I'm In Your Hand*, and *Fix Me Right*.

The suite extracted from Harold Arlen's "Blues Opera" is tired Tin Pan Alley claptrap of pre-Gershwin vintage. It is about as far from the blues as Cat-Iron will be from the premiere of the larger work at the Brussels Fair this summer. Not only are the orchestrations of Samuel Matlowsky, conducted by Andre Kostelanetz, no closer to jazz than the mood music of Jackie Gleason, but they are less original. Scattered throughout are quotes from such standards as *Free and Easy* and *Come Rain or Come Shine*. Unless the full-scale performance clothes it with more substance, the informed European critic will find it thin in American folk elements even in comparison to works by such non-natives as Stravinsky, Milhaud, and Weill.

**Dinah Washington: Dinah Sings Bessie Smith**  
**EmArcy MG36130**  
**Eddie Chamblee: Chamblee Music**  
**EmArcy MG36124**

Because so many writers dwell at length on her tragic death and blighted career when recounting her legend, the immense recorded legacy of Bessie Smith has become colored by a sense of bitterness and defeat. It should not be forgotten that she was a brilliant entertainer at the height of her career, capable of bringing a heartwarming emotional release to her understanding audiences. Dinah Washington, in retelling stories made famous by the greatest of the blues singers, emphasizes this most winning side of her personality. Like Juanita Hall in her album, only two numbers of which are repeated here, she refrains from copying records for the original inflections and wisely retains her own style to capture the spirit of the monumental Bessie on *Send Me to the 'lectric Chair* and *Backwater Blues*.

*You're Been a Good Old Wagon*, with characteristic answers trumpeted by Fortunatus Richards, and *Trombone Butter*, with Quentin Jackson filling the role of Charlie Green, are invested in a friendly humor. Clark Terry grows a muted-trumpet obbligato on *Carless Love*, and pianist Jack Wilson sets a reckless mood on *Me and My Gin*.

The accompanying group is directed by her husband, Eddie Chamblee, whose relaxed staccato attack on tenor sax has enlivened her appearances since their marriage. After leaving Lionel Hampton, he and trombonist Julian Priester took the style of that riotous organization and hammered it into a shape which makes their septet the most musical of the rhythm and blues bands. With Joe Newman sitting in occasionally on trumpet, *Whisper Not*, *And the Angels Sing*, and *Without a Song* become wholly appealing.

**Clark Terry: Duke With A Difference**  
Riverside RLP12-246

If there is anything an Ellington fan would rather hear than the band itself, it is one of the Duke's men at the head of a unit drawn from its sidemen. As extensions of his sound and style, they form an important part of his discography. But of late, the practice has been to team one of his soloists with musicians not associated with the orchestra. In this renewal of some of his best compositions, it is heartening to know that all concerned served lengthy spells under his direction and have considered statements to give body to the arrangements of Mercer Ellington and Clark Terry. All give form to choruses they could not use in the regular format of the band.

Numbers like *Mood Indigo*, *C-Jam Blues*, and *Take the A Train* have become so familiar in the original versions that it is hard to imagine them with altered meter and fresh accents. In the jazz world they are treated with more respect than any standard, and it takes veteran altoist Johnny Hodges, Britt Woodman on trombone, and Terry on trumpet to fool around with them. Paul Gonsalves gives handclapping impact to his tenor-sax solos on *Cottontail* and *In a Mellotone*. Tyree Glenn returns to the fold for melodic fill-ins on the vibes. The setting of Marlon Bruce's vocal on *In a Sentimental Mood* is by Mercer Ellington, with Quentin Jackson taking the trombone chair on this and *Come Sunday*. Jimmy Woode plays bass and the bass drum pedal is still part of Sam Woodyard's equipment.

**For Basie Prestige 7127**

For years the team of Walter Page on bass, Freddie Greene on guitar, and drummer Jo Jones made the Basie rhythm section the most persuasive thing to jazz. The death of Page last December brought an end to the triumvirate and to a career which began with Bennie Moten in 1918. He contributed immeasurably to the birth and flowering of the Kansas City style, leaving in trust a long recorded legacy which is increased in sum by this last reunion of the trio. With Nat Pierce filling the Count's post at the piano, they rework five tunes of the creative period from 1937 to 1941.

For a musician who has never made a mediocre appearance on discs, Shad Collins is the most unrecorded of trumpet men. This omission was partly rectified on a few Vanguard dates, but here he is rewarded with unrestricted playing space on his original *Rock-a-bye Basie*, *Live at Five*, and *Diggin' For Hex*. This freedom permits Paul Quinichette, known for his allegiance to the tenor-sax style of Lester Young, to try his luck with the Hershel Evans parts on *Out The Window* and *Texas Shuffle*. If you find the solos in the present Basie arrangements too short, or merely want to revisit some old friends, this effort is highly recommended.

**Johnny Griffin: The Congregation**  
Blue Note 1580

This is the most fortunate of the sessions by Johnny Griffin, a tenor saxist recently imported from Chicago, due to the irresistible theme of the title tune. Cast in the same lusty mold as Horace Silver's *The Preacher*, it is one of the happiest jazz originals since that sermonizing classic. Full of a spiritual shout, it is carefully shepherded by the commanding



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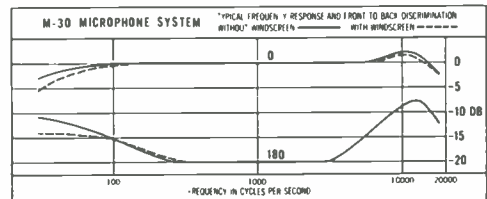
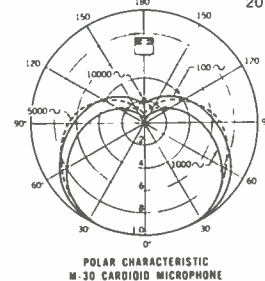
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timbres of the composer. It sets the scene for the rest of the date as, supported only by a rhythm section, he stretches out on *I'm Glad There Is You and It's You Or No One*. He toys with the melody line of *Tangerine* on *Latin Quarter*, and relaxes on a basic blues. The shadow of Silver also reaches pianist Sonny Clark, who is playing more in the same vein since his arrival from California. Paul Chambers is on bass and an able drummer from Philadelphia, Kenny Dennis, makes his recording debut.

#### Miles Davis: Relaxin' Prestige 7129

By now it is fairly evident that the two sessions at which the Miles Davis Quintet reeled off twenty-four numbers in quick succession were something special. The five unveiled on the previous album, titled *Cookin'*, combined with the current six, are sufficient proof of the need future historians will have to consider the complete set in any study of the trumpeter during his most productive period. When a major portion of its repertoire was recorded, under studio conditions approximating a club performance, his group had worked its way to a level of expression which was at a height last spring just before it disbanded. It is time for Ira Gitler, on his next liner note, to provide a box-score listing the sequence of numbers and other trivia, delving perhaps into the contractual reasons for the inception of the date. Also cardiograms on producer Bob Weinstock and engineer Rudy Van Gelder after the event.

There were no retakes, but one false start and the spoken exchanges before and after a take are included. The singling out of any specific item as the best of the lot is precluded at this time by its piecemeal release, but it is hard to believe the present one will be surpassed. At least, no investment in an expensive album is needed for a sampling. There is nothing studied about *If I Were A Bell*, or the light airiness of *I Could Write A Book*. And any "man walking on eggshells" quality is soon dissipated by the intense drive of the rhythm section on *Olea* and *Woody'n You*. Drummer Philly Joe Jones is in excellent form, and bassist Paul Chambers outdoes himself. Pianist Red Garland's solos sparkle, and John Coltrane on tenor sax is vital and compelling. Miles is beautifully lyric on *You're My Everything* and *It Could Happen To You*. This sort of performance occurs only once in a while. When it does, it has universal appeal and even traditionalists will find themselves liking it.

#### Here Comes Louis Smith Blue Note 1584

A high school teacher from Atlanta who majored in music at Tennessee State University and went to the University of Michigan for postgraduate studies, is the latest trumpet discovery to be placed under contract by the label which introduced Clifford Brown and Lee Morgan. At the age of thirteen, Louis Smith began to play his horn in a Memphis high school, but it was some years later that he formed a personal style, influenced by Fats Navarro and the man he salutes in a gripping solo on *Tribute to Brownie*. Two of his originals show his blues strength, and on *Ande*, he creates lines on the changes of *Indiana*. The lone ballad, an impassioned *Stardust* formed with a full tone and skyrocketing phrases, passes all too quickly.

His choice of a teammate also involves, under a pseudonym, a former member of the teaching profession and the alto saxist in the Adlerly family, who is suitably explosive on *South Side*. Tommy Flanagan alternates on piano with Duke Jordan. Bassist Doug Watkins and Art Taylor on drums fill out the rhythm section. Tom Wilson supervised the date for Transition, a label now unfortunately in state of suspension.

#### Dick Johnson: Most Likely . . . Riverside RLP12-253

When the swing bands reigned supreme, their featured soloists acquired reputations and soon attracted groups of ardent followers. Because such musicians prefer studio work today, name leaders frequently check them out on loan to make recordings and substitute players of lesser renown for road tours. Before the big bands can regain their former eminence, there must be quite a few

young men willing and able to follow a career like that of Dick Johnson, a personable alto saxophonist who joined Charlie Spivak in 1952. Three years later he went to Buddy Morrow, who encouraged him to form a jazz quartet within the band and featured it at college concerts.

Firmly supported by pianist Dave McKenna, a fellow New Englander and companion from the Morrow unit, he spells out on a set of ballads and five originals the benefits of his experience and his worth to a big band. His *Lee-Antics* points up his debt to Lee Konitz, but his style takes its shape from a steady development and an awareness of the need to please an audience. With the inventive rhythm team of bassist Wilbur Ware and drummer Philly Joe Jones adding sparkle to *It's So Peaceful in the Country* and *It's Bad for Me*, this LP will spread the news of Johnson and his talents more widely.

#### Jimmy Smith At The Organ Blue Note 1551

Usually an organist of driving intensity, Jimmy Smith recorded a set of prettily-played ballads a while back with his trio. It was somewhat of a novelty, but he must have liked the idea as he begins his eighth album in the same way. It is his most successful effort, taken as a whole, and starts to build from a sweetly nostalgic *Summertime*, a duet with the expressive Lou Donaldson on alto sax. On *There's A Small Hotel*, he is joined by the melodic young guitarist Kenny Burrell, and drummer Art Blakey. An immediate rapport is established and continues to grow as all four examine the blues on Burrell's *All Day Long*.

By keeping the proceedings simple and unpretentious, though Blakey seems to strain at the leash a bit, they are thoroughly relaxed for *Yardbird Suite*, which moves on firmly chiseled lines. Donaldson's tone acquires a mellow patina from the organ and Smith, benefiting from restraint, carries out the conception of the date in a manner that is completely satisfying.

#### Red Rodney: 1957 Signal 51206

When musicians were scarce during the war years, Red Rodney was drafted to go on the road at the age of fifteen to play the Harry James trumpet choruses in the bands of Jerry Wald and Jimmy Dorsey. Since then he became a disciple of Dizzy Gillespie and assimilated the doctrines of Miles Davis, but still retains the characteristic Celtic wit and rich emotional sense of James, and even of that soulful Irishman Bunny Berigan. Something in his makeup prevents Rodney from exploiting these elements commercially, and they crop up only occasionally to pleasantly underline his solos on *You Better Go Now*, *Star Eyes*, and *Stella By Starlight*.

In his return to recording, after a lapse of six years, he is joined by the Chicago tenor Ira Sullivan, who also plays trumpet in a duet on Rodney's *Red Arroyo*. Pianist Tommy Flanagan, on the blues theme *Box 2000*, engages in exchanges with bassist Oscar Pettiford, who is credited with the Latin-tinged *Ubas*. Elvin Jones is drummer on the originals and is spelled by Philly Joe Jones. Still only thirty, Rodney has his best playing days ahead and, if given the chance, can make an important contribution to jazz.

#### Pepper Adams: Critics' Choice World Pacific PJM407 Zounds! The Lennie Niehaus Octet Contemporary C3540

Early in 1957 Pepper Adams left the confines of the Stan Kenton orchestra, where he first drew the attention of the jazz public, taking along the drummer Mel Lewis to form the nucleus of a short-lived small group. Before a career of free lancing and a poll victory brought him to his current engagement in New York, this session last July reunited him with Lewis and Lee Katzman, a Kenton trumpet man, and has the spirit and feel of a unit within the band. It shows clearly that Adams has as much to offer a large organization as Ellington's Harry Carney, his main influence on baritone sax.

An outpouring of angry emotion and a cutting attack as a soloist, resulting in the neck-

name of "The Knife," are moderated by the sympathy of his backgrounds on a slow blues and Thad Jones' *Zoo* and *5021*. Bassist Doug Watkins gives telling support and pianist Jimmy Rowles realizes the theme of *Alone Together*. Kenton might well consider making a similar tight-knit group of soloists an extra attraction in his caravan.

Its logical mentor would be Lennie Niehaus, leader of his sax section and arranger, who seems more able than Adams to resolve the conflicting demands forced on an improviser in the post of sideman. On a series for Contemporary with an octet, he has established himself as a writer of discrimination and a leading exponent of the alto sax. The present release is an expansion of a 1954 date, adding four numbers recorded after a two year interval. In addition to the presence of Adams, changes in personnel substitute a French horn and tuba for the piano and trumpet. The shading is more varied and Niehaus gives evidence of a steady development on *With the Wind and the Rain*, *Blues for Susie*, *The Sermon*, and Miles Davis' *Four*.

**Chico Hamilton: South Pacific in Hi-Fi**  
**World Pacific PJ1238**  
**Australian Jazz Quintet: Rodgers & Hammerstein Selections** **Bethlehem BCP6022**

Simply because they are such downright good show tunes, the works of Rodgers and Hammerstein present a challenge to any group trying to remove them from their original context. By stripping eleven songs from "South Pacific" of their usual trapping, the Chico Hamilton Quintet slips around this hurdle and plays them with regard for the creative impulse of the writers when they first conceived them. The effective use of cross-rhythms by the leader and an uncontrived oriental flavor serve to renew the Broadway score. As he remarks on the liner, Chico believes, "one of the hardest things in music is to retain simplicity."

But the tunes gain variety from the jazz sense of his drumming on *Some Enchanted Evening*, from his diverse sense of tempo on *Bali Ha'i*, and from his tonal sense on *Happy Talk*. Fred Katz plays *A Cockeyed Optimist* as a cello solo, accompanied by John Pisano on guitar. Paul Horn proves again that a flute chorus can be amusing, and bassist Hal Gaylor's arrangement of *Honey Bun* is bouncy and swinging. One of the most happy marriages of jazz and show music, the recording is further enhanced by the tonal depth of the Forum Theater in Los Angeles.

In its survey of Rodgers and Hammerstein, the Australian Jazz Quintet offers only two duplicate selections and maintains its standing as one of the coolest of the small groups. Actually a sextet, it is expanded by the doubling of the reed men and the addition of a drummer for recordings. The three Australian members have classical backgrounds and are tonal colorists, balancing the flute against a bassoon or the piano against the vibes, in carefully painted chamber music.

**Leon Berry: Giant Wurlitzer Pipe Organ, Vol. 3**  
**Audio Fidelity AFLP1844**

This giant is not the instrument at the Hub Rink in Chicago, played by Leon Berry while earning his livelihood and presented on his two previous albums, but a theater Wurlitzer which he adopted and installed in the basement of his home. For months he spent the early morning hours arraying six ranks of pipes behind expression shutters along one wall, and arranging the usual assortment of percussion. Finally, with the console refinished and polished, it was ready for him to while away his spare moments embellishing a melody or toying with the special effects, which include a mechanical canary bird waiting in its gilded cage to lend voice to a melody from "The Student Prince."

In these surroundings the organ has a pleasant, domesticated sound, somewhere between the mammoth pipes at work in a theater and an electronic organ. Its contented tone is just right for the mood music interludes of *Sari Waltz*, *This Can't Be Love*, and *Falling in Love with Love*. Such pieces as *Washington Post*, *Tavern in the Town*, and *Dirie* are decorated with a well-balanced frosting of glockenspiel, cymbals, snare and bass drum, in all their crystal clarity. **AE**

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low speed stereo quality cuts tape costs in half Unique design creates a performance quality at 1 7/8 ips and 3 3/4 ips so far only achieved at 7 1/2 ips. You have more listening time — more listening pleasure — and you pay less for pre-recorded tape.

**3-speed versatility covers any application** Records half-track . . . plays back half-track, full-track and stereophonic tapes. Can be used for public address or as power amplifier for any sound source.

**lowest tape tension and smoothest tape motion** Low wow and flutter assures perfect tonal pitch — 10 gram operating pull reduces head wear to a minimum and tape stretch and breakage becomes practically non-existent.

**compact and portable in luxury-styled carrying case** Can be console mounted on a slide drawer assembly — or easily removed and used as a portable recorder.

**simplicity of design makes it so easy to operate** Minimum of controls assures freedom from common servicing problems of intricate push-button mechanisms.

For the most advanced in recording equipment, look to

# RE **Tandberg** of AMERICA inc.

10 E. 52nd Street  
New York 22, New York

The Tandberg incorporates Electronic Automatic Shutoff that works through metalized strip on Tape Leader and Bass Boost Switch that imparts greater fullness to the Low End.

adds up to a **TANDBERG**  
with better value than ever!

\*Tandberg four track conversion kit will be available for Model 3-Stereo.

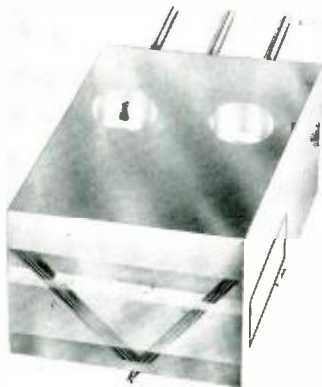
# NEW PRODUCTS

● **Improved Starlight Turntable.** The new Model 60A Starlight turntable is an improved version of the original Model 60. The new instrument plays recordings at all four standard speeds and can be adjusted to any speed between 16 and 84 rpm. Wow and flutter are stated to be



less than 0.18 per cent, with rumble down more than 52 db. Other features of the 60A include an illuminated stroboscope for exact speed settings, automatic retracting 45-rpm center hub, four-pole shaded-pole motor, and a new rotary power switch with built-in click filter. The unit is furnished in decorator black. Complete technical information is available from Metzner Engineering Corporation, Hollywood, Calif. **F-1**

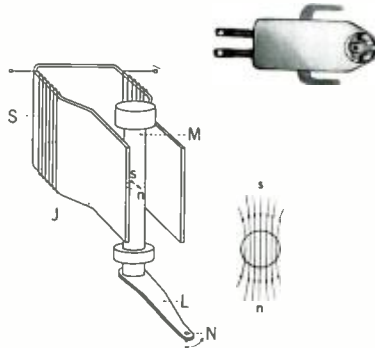
● **Electro-Sonic Stereo Cartridge.** Designed from the ground up to meet the reproduction requirements of 45-45 stereophonics, this new cartridge comprises a pair of ESL patented D'Arsonval movements, essentially similar to the single D'Arsonval movement of the well-known ESL C-60 Series cartridge. The two rotating coils form a V-shape, with the apex at



the specially-designed stylus shoe. The exceptionally wide range of this new ESL stereo cartridge extends from 20 to 18,000 cps, with excellent transient response. Output impedance is only 20 ohms at 1000 kc, and channel-to-channel crosstalk ratio is 20 db. Compliance is  $3 \times 10^{-6}$  cm/dyne and voltage output is 2 mv at 10 cm/sec. Radius of the stylus is 0.7 mil. The cartridge fits all standard arms. Electro-Sonic Laboratories, Inc., 35-54 36th St., Long Island City 6, N. Y. **F-2**

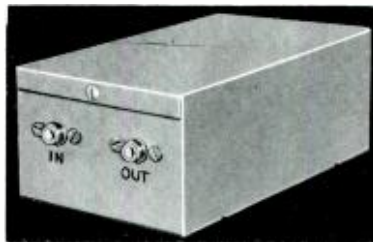
● **Norelco Pickup Cartridge.** This new cartridge operates on the magneto-dynamic principle of transducer design, with the magnet in motion and the coil stationary. Heart of the principle is the armature, a thin cylindrical rod 1/32 in. in diameter and 1/2 in. long, made of "Ferroxdure," a special high-coercivity hard ferrite material developed by Philips of the Netherlands. Frequency response of the cartridge is 10 to 20,000 cps  $\pm 2$  db. This extremely wide and linear response is attributable to high compliance, which lowers the low-frequency response to well below 10 cps with most pickup arms, and to low mov-

ing mass, which puts the high-frequency resonance point well above the audible range. At the typical reference level of 10 cm/sec. velocity, output voltage is 35 mv.



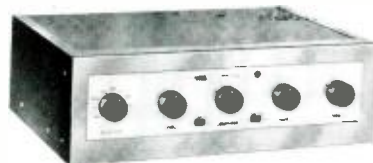
Tracking force is five grams. The Norelco "Magneto-Dynamic" cartridge comes complete with 1-mil diamond stylus and all necessary hardware for installation in any standard arm. Further information can be obtained from High Fidelity Products Division of the North American Philips Company, Inc., Hicksville, N. Y. **F-3**

● **Reverberation Unit.** This device makes possible an illusion of "presence" in high-fidelity music systems without the necessity of two sources of program material. The U-2 Reverberation Unit is employed as a link between the basic amplifier out-



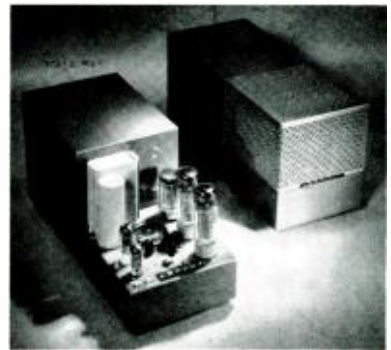
put and the input of any auxiliary amplifier-and-speaker combination. Application of natural reverberation principles simulates the effect of true stereo installations. Hook-up is a simple matter covered in full by installations instructions supplied with each unit. Manufactured by Ultron Company, 7943 Haskell Ave., Van Nuys, Calif. **F-4**

● **EICO 30-Watt Amplifier.** Available in both kit and factory-wired form, the new HF-32 is an excellent example of low-silhouette design in which compactness and attractive appearance are obtained without compromising sound engineering practice. Power tubes are well-separated from each other and from heat-sensitive components, undesirable couplings are avoided, and a single horizontal chassis is used which greatly simplifies kit construction. The HF-32 combines the EICO Williamson-type power amplifier which uses four EL84's in push-pull parallel, with a versatile preamplifier-control section featuring inputs for tape head and



microphone as well as for phono and tuner. Front panel controls include scratch and rumble filters. Bass and treble controls are peaked at 50 cps and 10 kc, respectively, and range from 14 db boost to 15 db cut. Full information may be obtained by writing EICO, 33-00 Northern Blvd., Long Island City 1, N. Y. **F-5**

● **Marantz 30-Watt Amplifier.** This addition to the Marantz group of high fidelity audio products fills a need for a compact, medium-power basic amplifier of better-than-average quality. Based on the circuitry of the well-known Marantz 40-watt amplifier, the 30-watt power capacity of the new unit results in considerable re-



duction in cost even though it fully retains the superior construction techniques and performance characteristics for which Marantz is known. Exceptionally compact, the new amplifier measures only 6" x 15" d x 7 1/2" h and is appropriately shaped for multiple amplifier installations. Specifications are essentially similar to those of the Marantz 40-watt amplifier. Marantz Company, 25-11 Broadway, Long Island City 6, N. Y. **F-6**

● **Multi-Use Microphone.** Engineered to function as a hand, stand, desk or neck-lace-type microphone, the 200 series is a new addition to the line of microphones manufactured by The Turner Company, 903 17th St., N.E., Cedar Rapids, Iowa. Available as a crystal, dynamic or ceramic



unit, the 200 series is well suited for almost any type of recording or communication application. As a crystal it has a frequency range of 60 to 10,000 cps and output of -53 db; as a ceramic, frequency range is 60 to 10,000 cps with output of -60 db; the dynamic unit has a frequency range of 60 to 13,000 cps with output of -53 db. The microphone is housed in die-cast zinc alloy with satin-chrome finish. **F-7**



This  
is where  
the music  
begins

Furniture By JENS RISOON DESIGN INC., N. Y.



*The Collaro* CONTINENTAL, TC-540

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

Selecting your own high fidelity record playing system can be an exciting and rewarding experience. You look for an amplifier with low distortion and low noise level. You want a speaker capable of reproducing the entire audible range. And you want to make certain you pick the right record player to go with your system—because that's where **the music begins**.

The *right* record player for today's fine high fidelity systems is the all new Collaro—the turntable that changes records—featuring the revolutionary transcription-type tone arm.

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

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

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

Four speeds, manual switch that permits playing single record or portion of a record; jam proof mechanism, hold the arm in

mid-cycle and it won't jam; automatic intermix, plays 7", 10" or 12" records in any order; automatic shut-off after last record has been played; wow and flutter specifications, 1/4 (0.25%) RMS at 33 1/3 RPM, superior to any changer in the world; muting switch and pop filter to eliminate extraneous noises; extra heavy duty 4-pole induction motor; heavy rim-weighted, balanced turntable for fly wheel action; removable heavy rubber turntable mat; pre-wiring for easy installation; attractive two tone color scheme to fit any decor; factory custom-testing for wow, flutter, stylus pressure and correct set-down position. Reflecting their custom English craftsmanship Collaro changers are tropicalized to operate under adverse weather and humidity conditions. The base, in blond or mahogany, is optional at slightly extra cost and the Collaro mounts easily and quickly on a pre-cut mounting board or base.

When you buy your Collaro, you're buying professional quality equipment at a record changer price. Collaro prices start at \$37.50. The Continental, featured above, is \$16.50. (Prices are slightly higher west of the Mississippi.)



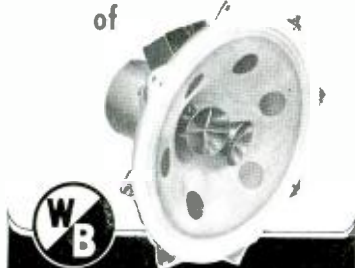
FREE: Colorful new catalog, containing guide on building record library plus complete Collaro line.

WRITE TO DEPT A-013  
ROCKBAR CORPORATION  
MAMARONECK, N. Y.

Rockbar is the American sales representative for Collaro Ltd. and other fine companies.

# Low-Cost Hi-Fi with the SOUND ECONOMY

of



## STENTORIAN\* LOUDSPEAKERS

THE SOUND THAT STANDS ALONE . . .

Now, with W/B Stentorians, you can enjoy high-quality high fidelity at unbelievably low, low cost!

Manufactured in England by world-renowned Whiteley Electrical Radio Company — originators of the first commercial permanent magnet loudspeakers in 1927 — Stentorians provide a beauty and realism that has won the unqualified praise of nearly every leading audio critic and user, both here and abroad.

But hearing is believing! Hear the W/B Stentorians at your very first opportunity . . . and discover for yourself why these distinguished units are the leading low-cost speakers in the world today.

STENTORIAN EXTENDED RANGE SPEAKERS	SPECIAL AUDIOPHILE NET
15" STENTORIAN WOOFER Model HF 1514 Response, 25 — 4,000 cps.; bass resonance, 35 cps.; power rating, 25 watts; 10 lb. Alcomax Magnet System List \$149.50	\$89.50
12" STENTORIAN EXTENDED RANGE LOUDSPEAKER Model HF 1214 Response, 25 — 14,000 cps.; bass resonance, 39 cps.; power rating, 15 watts; 5½ lb. Alcomax Magnet System List \$87.50	\$52.50
Model HF 810 (8") Response, 50 — 12,000 cps.; bass resonance, 65 cps. . . . . List \$18.25	\$10.95
Model HF 610 (6") Response, 60 — 12,000 cps.; bass resonance, 70 cps. . . . . List \$14.95	\$ 8.95
STENTORIAN TWEETER Model T-10 Response, 2,000 — 16,000 cps.; power rating, 5 watts; 2½ lb. Alcomax Magnet System . . . . . List \$35.00	\$20.95
UNIVERSAL IMPEDANCE LOUDSPEAKERS WITH 4, 8 & 16 OHM VOICE COILS	
Model HF 1012-U (10") Response, 30 — 14,000 cps.; bass resonance, 35 cps.; power rating, 10 watts; 12,000 gauss; 2 lb. Alcomax Magnet System . . . . . List \$31.60	\$18.95
Model 812-U (8") Response, 50 — 12,000 cps.; bass resonance, 65 cps.; power rating, 10 watts; 12,000 gauss; 2 lb. Alcomax Magnet System . . . . . List \$25.00	\$14.95
Model HF 816-U as above but with 16,000 gauss; 3½ lb. Alcomax Magnet System List \$49.95	\$29.50
STENTORIAN CROSSOVER UNITS Input and output impedance, 15 ohms. Individual units for crossover at 500, 1,500 cps. . . . . List \$23.25	\$13.95
or 3,000 cps. . . . . List \$16.60	\$ 9.95
STENTORIAN CONSTANT IMPEDANCE BALANCE OR VOLUME CONTROLS For mid-range, high frequency system balance, or control of remote loudspeakers. Individual units for 4, 8, or 16 ohm impedance. List \$11.75 ea.	\$ 6.95 ea.

For complete literature on these and many other famous Stentorian loudspeakers and audio accessories, see your dealer or write:

### Barker Sales Company

339 South Broad Avenue, Ridgefield, N. J. U. S. A.

Exclusive Sales Agents for the U. S. A. and South America  
Charter Member Inst. of High Fidelity Mfrs., Inc.

\* T. M. Whiteley Electrical Radio Company

• **Fairchild Cartridge.** Designated as the Model 230 "Micro-7" this cartridge is a production version of the Fairchild Model XP-3 which has been on the market for the past several months on an experimental basis. The 230 contains many of the basic features of the XP-3 with several new design elements. These include the use of a 0.7-mil diamond stylus, air damp-



ing, higher vertical and lateral compliance and lower tracking force—as low as 1 gram in arms capable of this adjustment. Output of 5 mv permits use of the 230 without a transformer to feed most any preamplifier. Manufactured by Fairchild Recording Equipment Company, 10-40 45th Ave., Long Island City 1, N. Y. F-8

• **Bogen 4-Speed Manual Player.** A new lower-priced 4-speed record player, superior in many respects to its predecessor model, is the newest addition to the line of high-fidelity equipment marketed by David Bogen Company, Paramus, N. J. The B-21 turntable plays all discs up to



12 in. at all four standard speeds, and permits variation of each speed within a range of 5.0 per cent. The motor is of the 4-pole type, and the turntable is covered with serrated rubber to protect records. A plug-in head supplied with the B-21 accommodates all popular cartridges. Mounting space required is 13x10x2½ ins. above and 2½ ins. below motor board. F-9

• **Tapak Tape Recorders.** Engineered for recording serious music outdoors and away from power lines, the Tapak Duplex



Musicale and Triplex Musicale models incorporate a new development known as "Gyro Drive." Consisting of a tape-driven flywheel and ball-bearing idler, Gyro Drive acts as a mechanical wow and flutter filter. Both Musicale models record at 7.5 ips, feature fast power rewind and immediate reproduction through built-in 4x6-in. speakers. The Triplex also features in addition a VU meter and 600-ohm-output. Gyro Drive is also offered in kit form for installation on earlier Tapaks. For illustrated literature, write Broadcast Equipment Specialties Corp., P. O. Box 119, Beacon, N. Y. F-10

• **Roberts Recorder.** Providing a high quality monaural recorder and playback unit self contained in one carrying case, the Roberts Model 90-S unit incorporates a three-position power switch which allows the use of the tape deck alone to feed two external amplifiers for stereo playback. In addition, by using a second



record amplifier and previously erased tape the machine will make stereo recordings, thus supplying the occasional need for the stereo function without increasing the bulk of the recorder for most applications. A hysteresis-synchronous motor is used, holding wow and flutter to professional standards, and the frequency range of the stacked stereo head permits playback flat within ±2 db from 40 to 15,000 cps. The unit is housed in a vinyl-covered case, and weighs 28 lbs. Amplifier and tape deck may be removed from the case and housed separately in custom high fidelity installations. The Roberts Recorder is imported by Roberts Electronics, Inc., 1028 N. La Brea Ave., Hollywood 28, California. F-11

• **Power Indicator.** The Vantron Pow-R-Check meter is calibrated in watts as well as db, thus affording the hi-fi listener an accurate check of power output from his amplifier. A precision logarithmic scale



makes 0.1 watt as readable as a 10-watt indication. The db scale is suitable for use with a standard tone-modulated phonograph record to check such items as tone-control characteristics, relative efficiency of speaker systems, pickup response, and the like. For complete specifications, write Electronics Division, Van Norman Industries, Inc., Manchester, N. H. F-12

## NEW LITERATURE

• **Tung-Sol Electric Inc.**, 95 Eighth Ave., Newark 4, N. J., serves the interests of servicemen and others engaged in the retail selling of electron tubes with publication of a new wall-type chart covering "Suggested Retail Prices of Electron Tubes for Radio and TV." The 11 x 14 ins. chart shows, in easy-to-read form, the industry recommended retail prices for 839 electron tube types used in radio, TV and hi-fi applications. This includes virtually all known entertainment types available in today's domestic market. The chart may be obtained through Tung-Sol distributors. **F-13**

• **Specialty Electronic Components Department, General Electric**, Auburn, N. Y., illustrates and describes the new GE Type VIII cartridge with clip-in-tip stylus in a colorful folder which is available upon request. Full technical specifications and cutaway pictures are combined in one of the best examples of technical literature to cross this desk in many moons. There is virtually nothing to be known about the VIII cartridge which cannot be learned from this brochure. Requests for copies should specify Bulletin EI-235, and should be addressed to G-E Hi-Fi, Box 101, Liverpool, N. Y. **F-14**

• **Freed Transformer Company, Inc.**, 1767 Weirfield St., Brooklyn 27, N. Y., offers complete data on audio transformers for commercial and military applications in a new 48-page catalog which is available for immediate distribution. Included in the audio transformer listings are miniature, broad-cast-quality, professional-grade and replacement-grade units. Other Freed products listed are: discriminators, filters, high-Q reactors, magnetic amplifiers, power components, pulse transformers, and ultrasonic components. A copy of Catalog 581 will be mailed upon written request to the address shown above. **F-15**

• **Allegheny Ludlum Steel Corporation**, Oliver Building, Pittsburgh 22, Pa., is now distributing a 16-page data sheet on Selection grain-oriented cold-rolled three-per cent silicon steel, the type of steel used primarily in motors and laminations for power transformers. Entitled "Allegheny Ludlum Selection 11 Mil and 12 Mil," the booklet contains two tables and ten graphs. Text material includes typical curves, grading, annealing cycle and other pertinent information. Requests for copies should be addressed to the attention of the Advertising Department. **F-16**

• **Unimax Switch Division, The W. L. Maxson Corporation**, Ives Road, Wallingford, Conn., covers the Unimax line of precision snap-acting subminiature switches in a new technical bulletin which will be mailed on request. Shown in the publication are photographs, detailed drawings, descriptions, operating characteristics, and electrical ratings. Switches are shown in basic form and with a wide variety of actuators. This is an extremely worthwhile bulletin for designers of miniaturized electronic equipment. Requests for copies should be directed to the attention of Mr. J. Martinez at the address shown above. **F-17**

• **Switchcraft, Inc.**, 5555 N. Elston Ave., Chicago 30, Ill., incorporates a number of new products which have recently been added to its line of electronic components, in Catalog 8-58 which is now ready for distribution. Contained in the 28-page three-color catalog are illustrations, prices, schematics and dimensional drawings of literally hundreds of Switchcraft items, such as jacks, switches, plugs, connectors, "Mini-Mixers," and the like. A copy of this catalog will be of distinct value to all persons whose responsibilities include the purchase of audio components for industrial usage, as well as to all research and developmental laboratories. **F-18**



## NEW SUPER-CARDIOID ...and super value!

Difficult acoustic conditions are child's play for this sensational new super-cardioid microphone. Background noise, undesirable echo, and other unwanted sounds disappear when the ESL-SC403 is used for high fidelity broadcasting or recording of music and speech.

Excellent performance, inconspicuous size, and inexpensive price make this advanced moving coil microphone additionally suitable for lecture halls, churches, and conventions. A high impedance model is designated the ESL-SC403H. Write for details on other new ESL microphones.

	ESL-SC403	ESL-SC403H
FREQUENCY RESPONSE:	50 to 12,000 cps $\pm 3$ db	
DIRECTIONAL CHARACTERISTIC:	super cardioid	
INTERNAL IMPEDANCE:	200 ohms	45,000 ohms
OUTPUT LEVEL:	-50 db	2.2 mv/ $\mu$ bar
REFERENCE LEVEL:	1 mv/10 dynes/cm <sup>2</sup>	
DIMENSIONS:	2" x 1 1/2" x 3 3/4"	
NET PRICE:	\$25.50	\$28



FOR LISTENING AT ITS BEST

**Electro-Sonic Laboratories, Inc.**

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

Circle 55A

## WE ENGINEERED THE BEST—THEN IMPROVED IT

We just weren't satisfied with the best when we engineered the Tannoy Variluctance Pickup Cartridge. Our design engineers went to work right away and perfected the "Complidex", a brand new stylus assembly that gives increased magnetic efficiency within the gap plus improved mechanical efficiency of the cantilever by utilizing two separate metals in place of the conventional homogeneous material. Yet another development gives correctly graded damping without disturbing the optimum vertical-lateral ratio of compliance.

Like their predecessors, the new "Complidex" Styli—with either sapphires or diamonds—allow instantaneous replacement without tools.

The new "Complidex" Styli can be used to convert the original (Mark I) cartridge to Mark II specification.



## TANNOY MARK II 'VARILUCTANCE' PICKUP CARTRIDGE

### SPECIFICATION

Each cartridge hand-made and laboratory tested  
Frequency response within 2dB to 16,000 Kcs.  
No resonant peaks  
No undamped resonances in sub-supersonic range  
Simple turn-over mechanism  
Stylus assemblies completely independent  
Instantaneous replacement of styli without use of tools  
Optimum lateral to vertical compliance ratio  
Very low effective dynamic mass  
Output: 20 mV at 12 cm per second  
Termination load: 50,000 ohms  
Tracking weight: 6 grams for all discs  
Available with either diamond or sapphire styli



Tannoy (America) Ltd.,  
Box 177, East Norwich,  
Long Island, N. Y., U.S.A.  
Tannoy (Canada) Ltd.,  
36 Wellington Street East,  
Toronto 1, Ontario, Canada

Circle 55B



**FOR SALE**

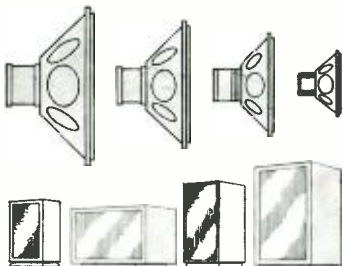
Practically new ranch house with 200-foot, poured-concrete, spirally curled, exponential bass horn; 12-foot multicellular midrange horn (24 cells); large inventory of assorted dynamic and electrostatic tweeters; three 2,000-watt water-cooled amplifiers; infinite-attenuation electronic crossover networks; master control-mixer-preamplifier console; two 1,500-lb. belt-driven turntables suspended in mercury bath; vacuum-sealed record-positioning chamber with servo-controlled record lifters and nuclear-reactor record deionizer; foam-rubber basement for acoustical feedback isolation; also complete blueprints for construction of identical house for stereo.

Will sacrifice; or trade for NORELCO speaker, which owner of house has discovered to be ideal for delightful hi-fi listening without electronic anxiety neuroses or showdowns with the loan company. For detailed and convincing confirmation of latter viewpoint, write to North American Philips Co., Inc., High Fidelity Products Division, Dept. 3A6, 230 Duffy Avenue, Hicksville, Long Island, N. Y.



**NORELCO®**

loudspeakers



a complete line of 5" to 12" high-fidelity speakers and acoustically engineered enclosures.

## TUNING METER

(from page 23)

with a ventilating hole, covered by a grille. Because codes, designations, data sheets and connection sequences are easily mislaid and forgotten, salient data are permanently affixed to the case with decals.

Interior construction and component arrangement are not very critical, as no high frequencies are present. Liberal use was made of tie points, to insure mechanical ruggedness, in accord with the tenets of the "brick outhouse" school of electronic construction. In happy consequence, a tuning meter of this type will have a minimum of "in service" failures, and is likely to outlast the receiver for which it is built.

### Adjustments

A tuning meter constructed in general accord with the foregoing instructions is essentially a vacuum-tube voltmeter, which needs only adjustment of zero and maximum settings before it is ready for use.

After checking all circuits, insert the tube and pilot light. Connect terminals 1 and 2 to case, set sensitivity to minimum, balance control at center, and shunt at minimum resistance. Connect power, turn the instrument on, and let it warm up for a reasonable time, such as fifteen minutes.

After warmup, slowly increase shunt resistance, noting meter deflection, and returning the pointer to zero, when necessary, by adjustment of the balancing control. If this cannot be done, look for a wiring error, a bad dual triode, or a defective cathode resistor.

When balance is attained (meter at zero) with shunt resistance at maximum, increase the sensitivity, noting changes in balance as it is moved toward maximum. Balance should remain within approximately one half of a scale division ( $\pm 5$  microamperes on a 1 mil meter) at all settings. If this is not the case, check linearity and compatibility of dual pot elements with a high resistance or vacuum-tube voltmeter, and check the 1-megohm fixed resistors.

Press the test button at various sensitivity settings. If wiring is correct, and components good, balance should not shift between temporary connections with test button up, and internal connections with test button down.

Leaving sensitivity at maximum, reduce shunt value to about one-tenth of full setting, connect terminal 2 to case, connect the negative terminal of a 22½-volt battery to terminal 1, and



Fig. 11. Rear of case, showing ventilating grille and decal markings.

the positive terminal to case. Increase shunt resistance until instrument pointer just reaches top mark of the scale (1 mil on a 0-1 mil meter). Lock shunt at this position.

The tuning meter will now hold top mark through a wide range of sensitivity adjustments. With this shunt setting, it is impossible to slam the instrument pointer no matter what negative voltage is applied between terminal 1 and ground. This is the same principle as the "burnout proofing" used by RCA in some of their VTVMs.

### Receiver Connections

Exact connection of a tuning meter to a receiver depends upon the receiver circuitry. Customarily, terminal 1 goes to the AVC line, and terminal 2 to either ground or some point on a voltage divider which supplies potential to offset the combination of delay voltage and contact potential in the receiver AVC circuit.

### Uses

Critical listeners often wish for a means of indicating correct tuning, and while the instrument described is of especial interest to the "ham" type of receiver, a little ingenuity on the part of the user could readily find the proper connection point for even an FM receiver—usually at the discriminator, but sometimes at the grid circuit of one of the limiter stages. When connecting to the discriminator, it will be noted that when tuning through a signal the voltage will cause the meter to swing up the scale and then retreat against the pin below zero. For this use, simply change the balance adjustment so the meter indicates center scale when no signal is being received. Correct tuning is then indicated by this same point as a signal is tuned in.  $\text{AE}$

# DYNAKIT

## Preamplifier

**Acclaimed as the finest available by laboratory test or critical listening—in money-saving kit form!**



This handsome new control unit gives crystal clear, noise-free reproduction from any modern program source. Its unique all feedback design by David Hafler sets a new standard of preamplifier performance. The design of the Dynakit preamplifier is a synthesis of outstanding features which produce smoother, more natural sound. Compare these features with any other units regardless of price.

### ★ Unequaled performance

Actually less than 1% distortion under all normal operating conditions. Response  $\pm 5$  db 6 cps to over 60 kc. Distortion and response unaffected by settings of volume control. Superlative square wave performance, and complete damping on any pulse or transient test.

### ★ Easiest assembly

All critical parts supplied factory-mounted on XXXP printed circuit board. Eyeleted construction prevents damage to printed wiring. This type of construction cuts wiring time by 50% and eliminates errors of assembly. Open simplified layout offers complete accessibility to all parts.

### ★ Lowest noise

Integral dc heater supply plus low noise components and circuitry bring noise to less than 3 microvolt equivalent noise input on RIAA phono position. This is better than 70 db below level of 10 millivolt magnetic cartridge.

### ★ Finest parts

1% components in equalization circuits to insure accurate compensation of recording characteristics. Long life electrolytic capacitors and other premium grade components for long trouble-free service.

### ★ High Flexibility

Six inputs with option of extra phono, tape head, or mike input. Four ac outlets. Controls include tape AB monitor switch, loudness with disabling switch, full range feedback tone controls. Takes power from Dynakit, Heathkit, or any amplifier with octal power socket.

### ★ Outstanding appearance

Choice of bone white or charcoal brown decorator colors to blend with any decor. Finished in indestructible vinyl coating with solid brass escutcheon.

### ★ Best Buy

Available from your Hi-Fi dealer at only \$34.95 net (slightly higher in the West), and yet the quality of performance and parts is unexcelled at any price.

Descriptive brochure available on request  
Pat. Pending

The Dynaco Pre-Amplifier has been selected for display at the Brussels Worlds Fair as representative of highest quality American High-Fidelity equipment!

## DYNACO INC.

617 N. 41st Street, Philadelphia, Pa.  
Export Division: 25 Warren St., New York 7, N. Y.

# LETTERS

## Trends

SIR:

My article on "Trends in Audio" in the April issue contained the erroneous statement that "AFC is now found in every fine FM tuner made today..." I apologize to those manufacturers of high-quality tuners whose products I unintentionally slighted by intimating that a tuner without AFC is not a first-rate instrument.

I should have stated that AFC appears in most fine FM tuners. But there are some very good ones, such as those of Fisher and Scott, which do not have AFC. Instead, tuning is facilitated by a wide-band detector and a tuning indicator.

There is usually substantial interval between preparation and publication of an article. At the time of writing, although aware of the trends toward wide-band detectors and increasing sensitivity, I did not realize to what extent these trends were resulting in the elimination of AFC.

HERMAN BURSTEIN,  
280 Twin Lane E.,  
Wantagh, N. Y.

SIR:

The article "Trends in Audio" in your April issue seems to have been written on very sound lines. I was pleased to read the author's reference to amplifiers with variable damping factor (rarely available in England) because this refinement has its uses with various loudspeakers in addition to the acoustic suspension type. I refer to speakers fitted with expensive, high-flux magnets, and to open baffle types.

It can easily be shown that high-flux magnets damp the main cone resonance, and lead to a loss of bass if the amplifier impedance is too low. Reducing the damping factor from 10 to 2 can make a difference of 7 db to the speaker output at about 40 cps, with a 14,000 gauss magnet. Broadly speaking, the necessity for a high damping factor in the amplifier recedes as magnetic damping is increased.

As regards open baffles, quite good results are now possible by using speakers with a resonance below 40 cps, but it is a pity to absorb everything in that region by excessive amplifier damping. With cone resonances above 40 cps—yes; but below 40 cps it is better to let things rip to a considerable extent. (There is not enough power in music, tapes, and records at these very low frequencies to do much damage.)

In a typical case of baffle mounting, the insertion of a 7-ohm resistance with the voice coil gave a rise of 3 db below 50 cps where the amplifier damping factor was 15.

After all, we must remember that NFB is used by amplifier makers to get rid of dirt; the resultant high damping factor is a by-product which has many virtues from the speaker angle. But if it duplicates the work of a good magnet, or reduces output unduly in speaker systems where the impedance rises steeply in the extreme bass or the extreme top, it should be controlled.  
G. A. BRIGGS,  
Managing Director,  
Wharfedale Wireless Works, Ltd.,  
Idle-Bradford, Yorks., England.

### Misleading Article

SIR:

Mr. Horowitz' article "High Power Audio Amplifiers" (March, 1958) tends to be misleading. He states that the efficiency of the EL34/6CA7 is superior to the 6550 and goes on to give some operating data, no doubt taken from the two manufacturers' data sheets for the two tubes.

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However, the harmonic distortion and IM for the two operating conditions are not given, nor does he point out that the 6550 is operating at 600 volts—far lower than the 800 quoted for the EL34 which would cost considerably more for smoothing capacitors, etc.

He says further that the UL condition of operating is preferable so that strictly the data quoted in Table I is irrelevant. I entirely agree that the UL circuit is preferable, but it is *not*, however, "a compromise." It is superior to the pentode connection both in efficiency (watts output for watts input) and for intermodulation, the latter being reduced to about one-third the pentode value. The output impedance is also reduced to about one third or one quarter. As triodes, tubes will give about one half the output obtained under UL operation, but, *at the same output* the UL distortion is lower than that for the triodes. Measurements I have made contradict Mr. Horowitz' statement that "maximum power considerations dictate the use of pentodes" and certainly the British KT88 (similar to 6550) gives its maximum output under UL operation.

The efficiency of most modern tubes is almost identical and depends largely on circuit conditions. The statement that the EL34 dissipates 26 per cent less power than the 6550 is misleading. The 6550 and KT88 can also be operated at a lower quiescent current, the choice of which being determined by the permitted distortion and the regulation of the plate supply. They both have a lower screen current than the EL34 due to the use of the aligned grid construction.

Mr. Horowitz' remarks on ventilation should be helpful to equipment designers. It is useful to remember that the tube with the larger bulb will usually run cooler. Measurements I have made with TEMPLAQ (Note "Q" not "C" as in article) show that the KT88 would operate at a maximum temperature some 50° C. below that of the EL34 at the same input.

G. R. WOODVILLE,  
M-O Valve Co. Ltd.  
Brook Green, Hammersmith,  
London W.6, England.

**Biflex Patented**

SIR:

In reference to the letters from Mr. H. A. Hartley and my answer to them which were published in the January, March, and July, 1956, issues of your excellent magazine in the LETTERS column, I wish to inform you that U. S. Patent No. 2,834,424 has been granted to me on the Biflex invention.

I hope you will see fit to publish this letter for the benefit of your readers.

ALEXIS BADMAIEFF,  
Altec Lansing Corporation,  
1515 S. Manchester Ave.,  
Anaheim, California.

**Acoustic Suspension**

SIR:

We thank you for your article about our Z200 speaker in the March issue. We note, however, that you refer to the woofer as being of acoustical suspension design. This is not the case.

Acoustical suspension, by definition in Mr. Villehur's patents, is one in which 50 per cent or more of all the restorative force imparted to the driver is through air compression. In our speaker, not more than 30 per cent of the restorative force is so gained.

F. D. WETHERILL, President,  
Neshaminy Electronic Corp.,  
Neshaminy, Penna.

## STEREO RECORDS

(from page 28)

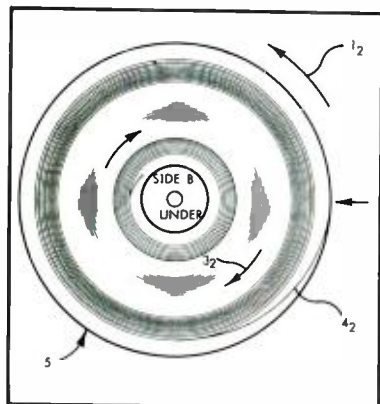


Fig. 2. The "B" channel is recorded in a counterclockwise direction at the same number of lines per inch as the "A" channel.

terclockwise. After processing, the recordings are locked in phase as regards the starting point on each and then pressed on opposite sides of the same disc. The two turntables must necessarily have been interlocked accurately to maintain proper relationships throughout the recording.

Both the "A" and "B" recordings must be played simultaneously, and since they are pressed on opposite sides of the same disc they must be played on a single turntable, such as the unit shown in Fig. 3. The platter 8 is driven by the motor 12 through an idler 13. The shaft 7 is extended about 1¼ inches higher than usual, and carries a small turntable 6 which, in turn, holds the special stereophonic disc.

As shown in Fig. 3, two tone arms 14 and 15 are used, each carrying a pickup head of its own. Each arm has its own base pivotally mounted, and the two can

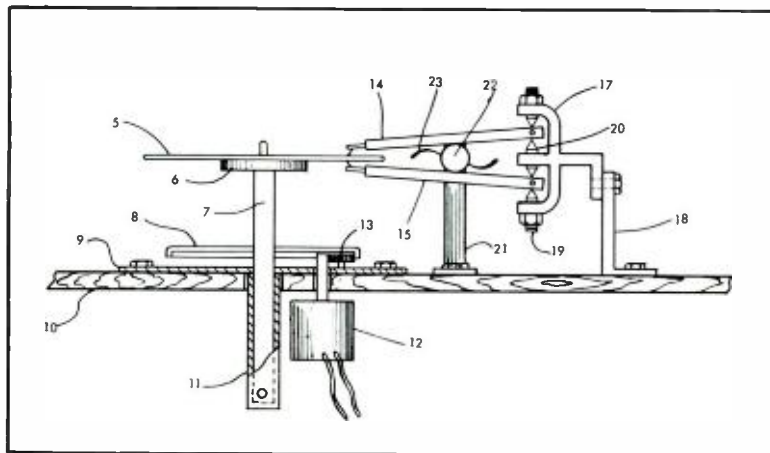


Fig. 3. Side view of turntable and dual pickup-and-arm arrangement required to play the two-sided stereophonic disc.

be locked to operate in unison or they can be operated independently to permit the use of the upper arm and pickup to play normal LP discs. The knob 22 carries a shaft on which is mounted an S-shaped cam which gradually releases the arms into playing position on the disc as the knob is turned. A turn in the opposite direction simultaneously lifts both arms from the record.

In the making and processing of this stereo record, the same equipment is used that made the present high-quality LP disc possible. Therefore, the recording and reproduction quality of this stereophonic disc must be the same as that of the best LP discs now available. Such a disc plays for one half hour, approximately, or as long as one side of a present LP.

Video and sound on the same tape will supply a stereo effect which is very effective—since the localizing can be aided by sight. To be sure, this is an illusion, but if it is satisfying to the eye and ear, that is all we want. It is only a matter of time until we will have both video and audio recorded on tape for home reproduction. But the writer feels that the proposed system of stereophonic disc recording is certain to give better quality even at the cost of reducing overall playing time from a given area of the disc.

While it is obvious that this form of stereophonic disc recording will work, and will result in quality comparable to present LP's, a demonstration is planned for the near future in the New York area. Minor details of the design of the reproducing turntable and arm assembly have not been described, but anyone familiar with phonograph equipment will readily recognize the requirements.

Æ

\* *audiofacts*

## Sound versus Noise

People who live next to the railroad tracks find—after a few sleepless nights—that human beings have a remarkable capacity to adjust to irritating sounds. Psychologists have learned, however, that while the conscious mind may shut out bothersome noise, the "inner man" continues to be irritated.

Watch a man listening to a phonograph or a tape recorder with a high-noise level, and you'll see these principles in operation. Over a period of time listener fatigue multiplies, until finally there is an irresistible impulse to turn the machine off—even though there has been no specific awareness of the background noise.

Of course, every machine makes a little noise, even the finest high fidelity equipment. In judging quality, studio engineers use the signal-to-noise ratio of a machine as a measure. Reduced to its simplest terms, the signal-to-noise ratio is the difference between the loudest electrical signal the machine can reproduce satisfactorily and the electrical noise it produces. It is always stated in decibels. The greater the signal-to-noise ratio, the less obtrusive the noise.

In tape recording and playback, most noise is caused by the machine. But some may also be contributed by the recording tape. This particular kind of noise, however, is very easily avoided. Simply use Audiotape. In Audiotape, you get a better dispersion of finer magnetic particles. As a result, you enjoy maximum freedom from troublesome tape noise. This is just one of the many reasons why Audiotape is the choice of discriminating recordists everywhere—professional and amateur alike. If you want more information on tape recording, you'll be interested in a book called "How To Make Good Tape Recordings." Write for free descriptive folder, Bulletin T, Box AA, Audio Devices, 444 Madison Avenue, New York 22, N.Y.

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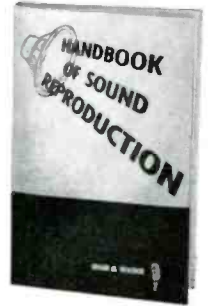
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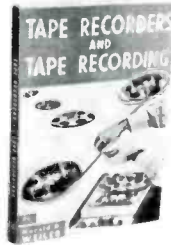
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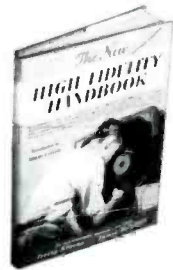
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## COMB FILTERS, ANYONE?

(from page 17)

either in front of it or behind it. But at the edge-on position you seem to get a curious "dissociation" effect. The sound seems to be reverberant, as if it comes from all over the room instead of the precise location of the loudspeaker.

This is exactly what happens in this particular set-up. The sound first radiated from the proper enclosure gives a true indication of source. It sounds as if it comes from the loudspeaker. The same sound radiated a fraction of a second later by the loudspeaker on the open baffle edge-on does not have this definite location of source. But the program is identified by the ear with that radiated a fraction of a second previously from the other loudspeaker. So it gives the impression of additional reverberation to the same sound.

This is precisely what the Lauridsen experiment produced and what was repeated at the recent demonstration. We could take a frequency response of such a system from the tape to any person's ears in the audience and discover that it resembles the output from a pair of comb filters—a different one for each ear, obviously—though the direct sound at the beginning of every musical tone will travel to the listener without benefit immediately of the comb filter.

### Effect with Headphones

Another way of producing the same effect described in the "comb filter" paper, uses headphones. The first pickup is played directly to both ears in the same phase, while the second pickup, collecting the same sound a fraction of a second later, is also mixed into the same pair of ears, but in opposite phase.

This same experiment has also been performed with variations, using loudspeakers. Over a year ago a demonstration was given of a system using a tape recorder in which two pickups were used a short distance apart along the tape and the output from the first pickup was connected to two separate channels feeding a pair of loudspeakers, such that the sound came from the two loudspeakers in phase, while the output from the second pickup was connected through a suitable electrical circuit so its program got played over the same loudspeakers but in opposite phase.

There are differences between the various methods. The recent paper mentioned that the equivalent delay produced by the electrical "comb filters" was about 2.5 milliseconds, while that used by Lauridsen, and in other experiments using spaced pickups, varies from 25 to 200 milliseconds. But to us it seems that this is merely an elaborate way of proving that twice two make four, or

that multiplication is just a shortened method of performing repeated addition.

The author of the paper seemed to draw an opposite conclusion. He says, "In the opinion of this writer, this result makes an explanation of the pseudo-stereophonic effect in terms of room acoustic delays (between direct sound and echos) look farfetched. Rather the simple fact that some frequencies enter the auditory center through one ear while other frequencies travel by way of the other ear may well be the real cause of the extraordinary effect discovered by Lauridsen."

Maybe we don't have this straight. Further work, with filters that produced alternate advance and delay of the phase in frequencies fed to each ear, "showed" that the intensity filtering was much more successful. It *should* be, because it comes much nearer to simulating what actually happens at each ear of a listener. So his experiments seem to confirm the importance of the delay, whether produced by electronic or acoustic means and whether described in terms of a time delay, or in terms of its mathematical equivalent, the complicated comb filter system.

The further comment in conclusion of this paper—that the experiments prove the aural effects in stereophonic presentation are not dependent upon phase relationships but more dependent upon relative *intensity* received by the two ears—seems to be rather redundant. This has been proved by much more direct methods previously and the experiment with comb filters only seems to confirm what has been found out before.

It certainly does not invalidate the principle that transients perform a very important part in the hearing process, particularly in identification of location and appreciation of stereophonic effects, which seems to be the implication derived from the author's conclusion.

After this particular session of the convention was over we met a noted authority in the auditorium foyer and asked him if he had a comb filter. "Yes I do," he replied and withdrew an ordinary hair comb from his pocket—one of the kind that has fine teeth at one end and coarse ones at the other. He proceeded to comment that "this has the capability of separating the small ones from the large ones." May we respectfully suggest that the time and money spent on the Bell Labs research that formed the subject of this paper would more profitably have been expended on the development of an electronic hair comb!

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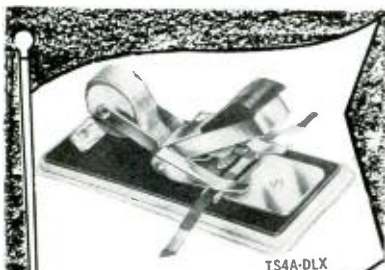
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(from page 19)

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## AUDIO ETC

(from page 32)

The literature on the Bu naB goes on (I have it before me . . .) to warn that in spite of the simplicity of design, your #7 Bu naB should be treated with the respect due to a delicate instrument. When not in use it should be kept in the box, which is designed so that the Bu naB may be safely carried in the pocket or purse.

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The #7 Bu naB is promoted as an ideal gift for that "hard to shop-for" person who already has everything that you can envision as a possible gift, and I go along with this idea. I doubt if most of your friends will have been given a Bu naB as yet—though after this article has been out awhile, I won't be quite so sure.

The improved #7 Bu naB is a product of Orville K. Snav and Associates, 111 North Jefferson, Mason City, Iowa, and can be had for the minimal price of 48 cents, shipment to be made directly from the Mason City factory, laboratory and warehouse. I suggest that if you are interested, you write immediately.

The Bu naB I have on hand is in three colors, red, blue and yellow. The ends are sealed in yellow plastic tape. Very decorative. The rest of the Bu naB, I note, is manufactured by General Cable, presumably for Snav.

What IS the Bu naB? Darned if I know.

Æ

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SELL used UNIVERSITY N2A, \$9; COBRAPLEX, \$11.50; SAHF, \$10.50; Electro-Voice T35, X36, \$22.50, 6HD, \$12. A. H. Clusick, 1296 Sheridan Ave., Bronx 56, N. Y.

AMPEX Model 350-C Console Recorder, re-producer 7 1/2-15 lbs, 60 cps, full track, (one remote control, wired, only 4 months old. Have 3, will sacrifice. T. L. Osborn Evangelistic Ass'n, Box 4231, Tulsa, Okla. Attn: Mr. L. R. Rex.

FOR SALE: REK-O-KUT M-12 disc cutting mechanism with 108 and 196 limo-per-inch feedscrews. 8-ohm cutterhead. Perfect condition, \$65.00. John Reiser, 1106 Belmar Pl., Ann Arbor, Michigan.

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## ADOLPH L. GROSS

Adolph L. Gross, president of Adolph L. Gross Associates, manufacturers' representatives, died Tuesday, April 22, of a cerebral hemorrhage while on a business trip to London.



Mr. Gross had been in the industry for thirty years, and was formerly with Terminal Radio Corporation and Newark Electric (later Hudson Radio), finally establishing his own company in 1952. He represented Pilot Radio Corporation, Birmingham Sound Reproducers, Wilcox-Gay, and Sony, and was associated with Audiogersh Corporation and Kingdom Products, Inc.

Mr. Gross is survived by his widow, Dorothy, and son, Roger, as well as his mother, a brother, and a sister. He had thousands of friends in the electronic industry, and his passing was a great shock to everyone who knew him.

## Industry Notes . . .

**Freelon M. Fowler**, formerly with ABC as manager of Public Relations Programming, has been appointed Public Relations Director for the IHFM, and will report directly to **Joseph N. Benjamin**, president. . . . One hundred and forty sound engineering contractors attended a three-day engineering seminar conducted by **Altec Lansing Corporation** at its headquarters plant in Anaheim, California, to familiarize them with equipment and with the problems encountered in sound installations.

**Fairchild Recording Equipment Corporation**, announced that it had delivered its first cutter system for making stereo discs by the 15-15 method. Recipient was Van Gelder Recording Studios. Unit mounts on standard recording lathes and can also cut lateral records. Further deliveries quoted as 6 to 8 weeks. . . . **Joel Ehrlich**, formerly with Fenton Company, Fon-Tone, Rockbar, and both CBS and NBS, has started his own consulting service—**Joel Ehrlich & Associates**—to supply advertising agencies with technical copy, brochures, manuals, trade and consumer promotions, and so on.

**Midwestern Instruments, Inc.**, manufacturers of Magnecord tape recording equipment, has appointed Dr. William H. Duerig to vice president in charge of Research and Engineering in order to accelerate its expansion. . . . **Shure Brothers, Inc.**, manufacturers of microphones and electronic components, announces a decision to acquire an additional electronics manufacturing firm with a range of products which would permit more efficient merchandising of electronic units at distributor levels. Stated aim is toward component manufacturers engaged in high fidelity sound reproduction and electronic industrial automation.

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Erases recorded signals and noise from magnetic tape without rewinding. Spindle mounting of reel permits rapid coverage without missed spots. Noise level reduced below level of standard erase heads. Restores tape to like new condition or better. Reel size range 5", 7", 10½". May also be used for demagnetizing record—playback—erase heads.

Model HD-11 Price \$27.50

## TELEPHONE PICK-UP COIL

For transcribing telephone conversations with recorder or making messages audible on amplifier. May also be used as probe for locating sources of hum. More constant signal level than base mounted units. Suction cup mounting on any telephone receiver. Supplied with 68 shielded cable, terminated with standard phone plug for recorder or amplifier.



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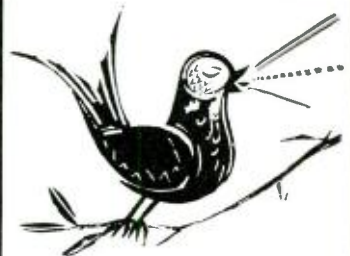
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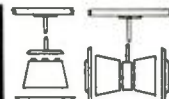
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**PRICE: \$39.00**

### 811B HORN

This superb ALTEC horn is identical in design concept and quality with the 511B but is smaller and has a frequency range from 800 to 22,000 cycles. The 811B with the 802D driver can be used with the ALTEC 803A bass speaker or with the 415A Biflex to extend this wide range speaker to a full 22,000 cycle system.



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Network—Impedance: 8 ohms; HF Attenuation: 10 db continuously variable; Crossover: 3000 cycles

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### 500D

#### DIVIDING NETWORK

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The 803A is used as the bass component in many of ALTEC's larger theatre speaker systems. Since it is intended for use with the 802D high frequency driver and either the 511B or 811B horn its efficient frequency range is limited to 30-1600 cycles. This 1600 cycle upper range assures a smooth crossover at any frequency up to 800 cycles. As a result the 803A has a bass performance far superior to that of loudspeakers designed to operate over a wider frequency spectrum.



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**PRICE: \$66.00**

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#### DIVIDING NETWORK

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