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AUGUST, 1958
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AUGUST, 1958 VOL. 42 No. 8

Successor to RADIO, Est. 1917.

AUDIO

ENGINEERING MUSIC SOUND REPRODUCTION

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COVER PHOTO—Entertainment center in Schwab House, New York, apartment of Mr. and Mrs. Milton D. Thalberg (Audiogersh Corporation). Equipment: 27-inch Conrac Fleetwood remote-control TV; Fisher 80R AM/FM tuner, 400 stereo master Control, two 55A power amplifiers; two Kingdom-Lorenz 3-way speaker systems with University N-3 crossovers; and, naturally, a Miracord with Stereotwin cartridge and a Miraphon with the Miratwin MST-2D cartridge. Photo by Bill Aller.

AUDIO (title registered U. S. Pat. Off.) is published monthly by Radio Magazines, Inc., Henry A. Schober, President; C. G. McProud, Secretary. Executive and Editorial Offices, 204 Front St., Mineola, N. Y. Subscription rates—U. S. Possessions, Canada and Mexico, $4.00 for one year, $7.00 for two years, all other countries, $5.00 per year. Single copies 50¢. Printed in U.S.A. at Lancaster, Pa. All rights reserved. Entire contents copyrighted 1958 by Radio Magazines, Inc. Entered as Second Class Matter February 9, 1950 at the Post Office, Lancaster, Pa. under the Act of March 3, 1879.

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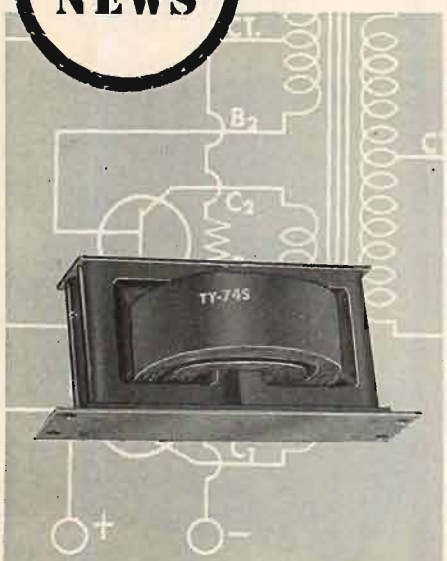
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AUDIOCLINIC??

JOSEPH GIOVANELLI*

Negative Feedback

Q. What is negative feedback, and what is its purpose? John Ivers, St. Louis, Mo.

A. By negative (inverse) feedback we mean that condition wherein a portion of the output is returned to a previous stage in phase opposition to the input signal. It may be looked upon as a peculiar kind of tug-of-war in which the output does nothing until the input receives a signal. Then the input voltage is opposed by what we call the feedback voltage. The main input signal voltage always wins the game, since it is impossible to reintroduce sufficient signal to the input circuit to cancel it completely.

Figure 1 shows a single audio-frequency

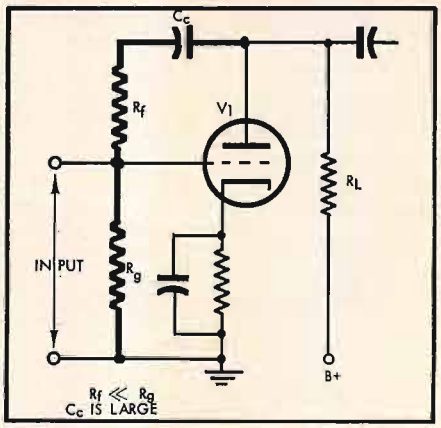


Fig. 1.

stage in which feedback is applied from plate to grid. There are two paths from the plate of V_1. One leads to a succeeding stage, while the other leads back to the input grid. The latter path delivers the signal to the input, and is known as the feedback loop.

From what has been said so far, it is obvious that a signal can be returned from output back to input with no difficulty. In order that we may call this signal *negative* feedback it must be in such a direction that feedback it must be in such a direction that it cancels some of the input signal. This circuit meets this requirement. At some portion of the input cycle the grid is made more positive with respect to ground. The tube draws more plate current, and the voltage dropped across the plate-load resistor, R_l, increases. This causes the plate to become less positive than it was with no signal applied to the grid. What I'm saying is that the plate and grid signals behave oppositely. Therefore, when the signal from the plate is fed back to the grid of the same stage, it is in such a direction as to cancel a portion of the input signal.

Not only is it important to be sure of the direction of the feedback, but it is also important to be sure of the *degree* of feedback. An examination of *Fig.* 2 will show that less feedback will be available to the input stage than was the case in *Fig.* 1. because the feedback resistor, R_F and the grid resistor, R_G form a voltage divider whose action is more severe in *Fig.* 2 than in *Fig.* 1.

Negative feedback is used for many dif-

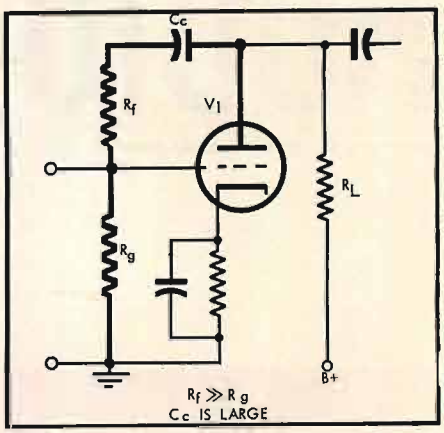


Fig. 2.

ferent purposes, some of which will be given here.

Negative feedback is used to correct frequency response. For example, if there is amplitude distortion present in an amplifier, the voltage produced at the distorting frequency will be greater (or less) than any other voltage fed to the feedback loop. (I am assuming, of course, that all voltages fed into the amplifier are equal.) Because the voltage of the distorting frequency at the output of the loop is greater (or less) than any other voltage at the output of the feedback loop, more of this voltage will be fed back to the input stage of the loop than at any other frequency. Thus, more (or less) of the distorting frequency signal will be canceled, and by this means response tends to level off. Notice I said *"tends* to level off." There is always present some error, much like that occurring in the governor mechanism of the old spring phonographs, wherein changes in spring tension were only partially compensated for by changes in the centrifugal force of the weights, and hence friction of the drum against its brake pads.

Another use for negative feedback is that of frequency compensation of the character found in tape and phonograph reproducers. The compensation is accomplished by making the feedback loop frequency sensitive. If what is needed is a circuit which will boost the lows, it is necessary to feed back more highs than lows, leaving the lows more or less unattenuated while the highs are considerably reduced in intensity. To accomplish this merely insert a small capacitor, C_c in series with the loop, as in *Fig.* 3. Because the reactance of the capacitor is high as compared to that of the feedback resistor, most of the lows are lost across the capacitor. The reactance to the highs, on the other hand, is small compared to that of the feedback resistor, and therefore, most of the voltage at these frequencies is available as feedback. If you desired to feed back more lows than highs, which you might in pre-emphasis networks, insert a small bypass capacitor in the loop. This will shunt the highs to ground, thereby bypassing the loop. This capacitor offers a low reactance path back to ground.

Sometimes the elements in these frequency compensating networks are made variable. When this is done we have a tone-control circuit most often referred to as

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

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THE Garrard PAGE

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Subject:

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Mr. Leonard Carduner
Garrard Sales Corporation
80 Shore Road
Port Washington, Long Island, N. Y.

Dear Leonard:

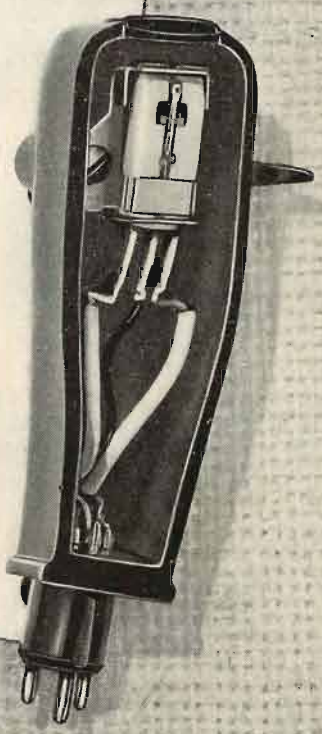
I am sure you will be very pleased to learn the results of our exporiments in using our Model 21D Stereo Cartridge with the Garrard record changer.

We used a regular changer, purchased at a local distributor and made no modifications other than the necessary wiring, which, due to your regular three-pronged connector, we found to be a simple matter.

The Garrard proved to be entirely compatible for stereophonic reproduction and we would have no hesitancy in recommending our cartridge for use in your changer.

Cordially,

Lawrence Le Kashman
Vice President, Sales



FAIRCHILD RECORDING EQUIPMENT CORPORATION

Mr. Leonard Carduner
Garrard Sales Corporation
80 Shore Road
Port Washington, Long Island, N.Y.

Dear Mr. Carduner:

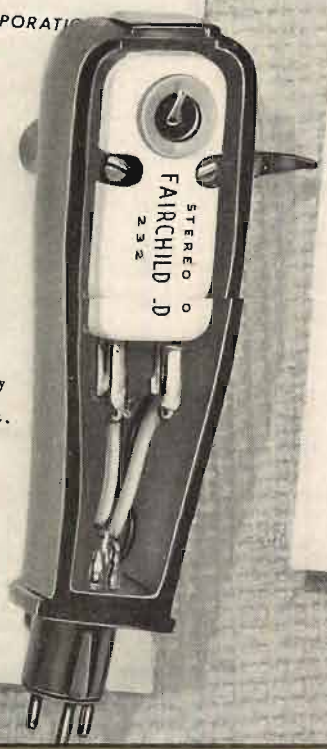
We have tested our XP-4 rotating coil stereo cartridge with your Garrard changer and find that it is perfectly suitable for playing stereo or other records with this changer.

We feel certain that when stereo records are available in quantity many people will purchase this or other FAIRCHILD STEREO cartridges to use with your changer, much as they have in using our Model 225 and other cartridges with your excellent player in the past.

Very truly yours,

FAIRCHILD RECORDING EQUIPMENT CORPORATION

Ruben E. Carlson
Vice President
REC:mmcl



Pickering and Company, Inc.
ENGINEERS AND MANUFACTURERS

Mr. Leonard Carduner
Garrard Sales Corporation
80 Shore Road
Port Washington, Long Island, N.Y.

Dear Leonard:

As you know, we have recently introduced a stereo cartridge. As a part of the original development program, and now in the market itself, we have been conducting extensive tests with turntables and record changers.

I think it will please you to know that we have used Garrard changers and Garrard Model 301 turntables in these tests and that the results have been eminently superior in every respect.

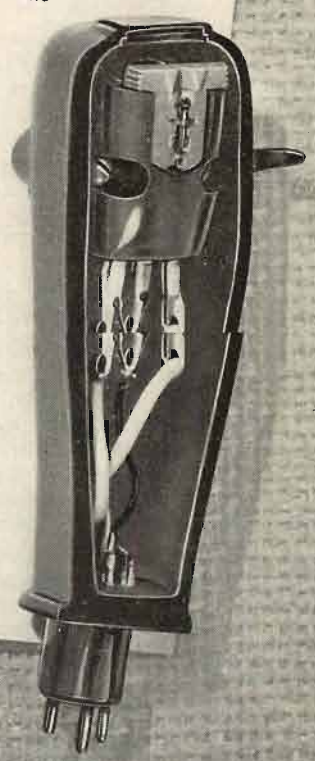
I am glad to see that our respective products continue to work together so well.

Sincerely,

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Robert Bell, assembly foreman at AR

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This test procedure is necessary because the sealed-in air of an acoustic suspension enclosure is a basic working element of the speaker system. In conventional speakers the cone works against the springy stiffness of its mechanical suspensions; in AR speakers this stiffness is missing, and the cone works instead against the springiness of the enclosed air-cushion. Like the new air-suspension cars, the speaker literally rides on air.

The patented AR system requires a small cabinet, so that the enclosed air will be springy enough. And since the air-cushion does not bind or reach its elastic limit as do mechanical springs, the AR-1 has created new industry standards in the low-distortion reproduction of music. The "bookshelf" size of AR enclosures is associated with an absolute advance rather than a compromise in speaker bass performance.

AR speakers have been adopted as reference standards, as test instruments for acoustical laboratories, and as monitors in recording and broadcast studios. Their most important application, however, has been in the natural reproduction of music for the home.

The AR-1 and AR-2, two-way speaker systems complete with enclosures, are $185 and $96 respectively in either mahogany or birch. Walnut or cherry is slightly higher and unfinished fir is slightly lower in price.

Literature is available on request.

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24 Thorndike St., Cambridge 41, Mass.

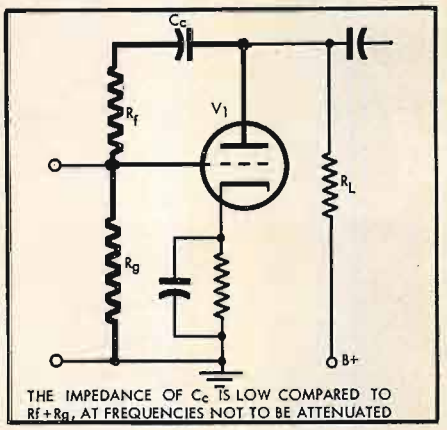


Fig. 3.

the Baxandall type. Such variable networks are also the means by which many phono preamplifiers achieve the various record compensation curves.

Still another use for inverse feedback is that of making an amplifier more nearly linear. This is accomplished in a manner similar to that discussed in connection with frequency correction. Any instantaneons peak or dip in a wave shape is automatically compensated for by an increase or decrease in the amount of feedback applied. This doesn't mean that all frequencies fed into the equipment will be converted automatically into sinewaves. This would be highly undesirable, since much of the transient nature of program material consists of steep wavefronts. The feedback removes the discrepancy between the signal being fed into the equipment and that which is reproduced in its output. This use of negative feedback will become increasingly important as more and more transistorized equipment comes on the market, because such amplifiers are operated Class B. Such operation is extremely nonlinear and can be overcome only by applying tremendous amounts of feedback.

Outside the field of sound reproduction feedback finds a wide variety of uses. Atomic reactors use feedback to control the rate at which neutrons are accelerated toward their targets. Such feedback is used in automation to reconcile differences between programmed work and the actual work produced. Various computer operations make use of the error signal from feedback as a means of arriving at the proper answer to the problem fed to the computer.

proper answer to the problem fed to the computer.

Dynamics, AVC, and Broadcasting

Q. I believe I understand the principle of the action of AVC circuits in radio receivers. However, one thing puzzles me. Wouldn't this action operate on the signal itself and compress the dynamic range of the program material. I have never yet heard a radio broadcast that sounds like a phonograph; there is always some sort of degradation which transmitter and receiver distortion does not always explain. William Devine, Detroit, Mich.

A. When AVC is used with AM receivers, the filter time constants are so chosen that the rapid modulation peaks are not smoothed out, but slow variations in carrier strength are. When the dynamics increase, the average strength of the carrier is maintained, whereas the peaks and troughs increase in size. If the time constants are chosen to be 100 milliseconds, frequencies as low as 20 cps can be transmitted without the AVC action smoothing them out unduly. As the time constant is shortened, more and more of the lows will be smoothed out, leading not to a reduction of the dynamic range, but to an erasure of the lows from the audio output.

When the volume varies during FM broadcasting, the sizes of the peaks and troughs remain constant. Volume increases manifest themselves as increases in frequency deviation from the center frequency. It is these frequency deviations which are detected, rather than any change in carrier amplitude. It should be obvious now that the clamping effect of the AVC and limiters can in no way impair the dynamic range of the program material.

Compression of dynamics probably comes from the broadcaster's desire to maintain as high a signal-to-noise ratio as possible.

Power Supply Filtering

Q. The power supply circuit for an amplifier I plan to build calls for an 8-H. choke and an 8-μf capacitor. Because of space limitations, I desire to substitute a resistor for the choke, and increase the size of the capacitor. I would like to know the relative value of RC filtering as opposed to LC filtering. I have noticed that when a choke is used in filter circuits, the capacitors are usually of smaller values than those used with a resistance-type filter. Does the use of RC filtering have any adverse effect, such as increased 120-cps hum or poorer voltage regulation? R. D. Dickson, San Francisco, Cal.

A. The advantage of LC over RC filtering lies in the fact that smaller associated capacitors need be used because, in addition to resistance, the choke possesses inductance which tends to oppose any change in the strength of the current passing through it. The resistor in the RC filter merely serves as a time constant to slow down the rate of change and discharge of its associated capacitors. The choke has some resistance along with its inductance, and can therefore perform this time-constant function to some slight degree. If the capacitor and resistor sizes are made large enough, the ripple content of the power supply can be very nearly that of the LC type. Where small currents are involved, the RC filter circuit works very well indeed. Where the power supply is called upon to furnish current which consists of transient variations, such as in power amplifiers, the RC type filter is definitely *not* recommended, because the filter resistor is so large that, on peak current demand, much voltage is dropped across it. The voltage dropped across the resistor robs the load voltage is dropped across it. The voltage dropped across the resistor robs the load of the constant voltage needed for proper linear operation.

Inductances in Series

Q. Given two similar unshielded chokes, salvaged from a TV power supply, which I want to add in series followed by a shunt capacitor to a choke-input power supply, is there a possibility of not getting combined inductance value unless they are connected in a certain way? If so, is there a simple method of determining the proper terminal arrangements?

A. When connecting chokes in series, you will find that their inductances will be additive, regardless of polarity of wiring. The only things which will change when the connections of such inductances are reversed will be the polarities of the back voltages. Even though the chokes are unshielded, coupling between them will not be sufficient to cause cancellations or reinforcements, as would be the case were the inductances wound on the same form. Æ

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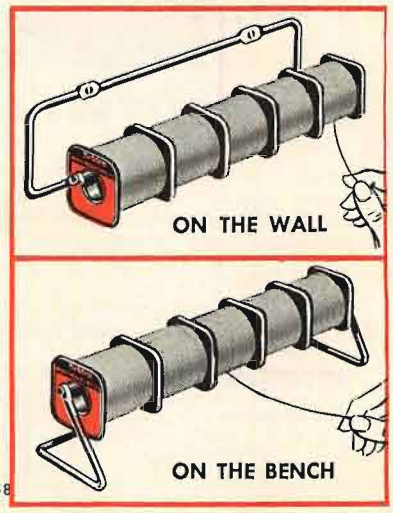


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LETTERS

Errata

SIR:

There is an error in the wiring diagram as it is presented in my article appearing on page 23 of the July issue. The return lead of R_9 does not go to the junction of R_8 and R_7, but goes to ground instead. Of course, the amplifier will work as shown, but there will be no balance in the push-pull.

NATHAN GROSSMAN,
2017 E. 24th St.,
Brooklyn 29, N. Y.

SIR:

In the July Audioclinic, the author states "as the frequency decreases, the reactance of L_2 (inductance) increases." This is an error, is it not?

DOUGLAS C. MCCALL,
2206 Edgewater Drive,
Orlando, Florida

(*It sure is. Sorry.* ED.)

Re July's Questionnaire

SIR:

For eleven years I have been an ardent Hi-Fi hobbyist. I have seen a lot of diagrams in that time including some using the letter "M" for thousand and "Meg" for megohm—very confusing, to say the least.

Here is an example of the written-out-value side of the argument: Last year I built from a diagram in one of the magazines the Mullard "520" circuit and upon completion I spent many a perplexing hour trying to find out why the cathode-coupled phase inverter produced an output signal 53 per cent unbalanced, when this type of inverter is said to be within 1 per cent. The mistake was found—the typesetters had merely dropped one "0" in both diagram and part list. Thus it read that the bias resistor was 8200 ohms instead of the 82,000 it should have read or—better yet, 82K.

If it had read 82K it would have taken less space, produced less confusion, and saved me a lot of "hair tearing."

As to using decimals—once again there is always the possibility of confusion, misplacement, or omission.

There is no mistaking the letter K—either it is or it isn't. I think that most of us now accept the letter K as standing for Kilo or thousand. Furthermore, if another letter were used by mistake it would surely be seen sooner by the proofreaders than an added or eliminated zero.

It is obvious from the foregoing that I, for one, favor the letter K.

TERRY MCCONNELL,
1101 Kalamazoo,
Petoskey, Mich.

SIR:

I am completely in favor of using the letter K in resistance designations. It is well understood to stand for Kilo, meaning thousand, and there is no ambiguity in its use. Kω *always* stands for a thousand ohms.

The ambiguity comes from the use of M for thousand (which, of course, is perfectly legitimate from the latin word for thousand, and used thus in Roman numerals) as well as for million, in place of the abbreviation "Meg." However, there is no ambiguity if M is avoided entirely, and only K and Meg are used.

There should be no confusion if both K and M appear in one diagram, for thousand and million respectively, or even Mω and Megω, but it is certainly to be preferred that K and Meg be used. Keeping M and Meg straight could easily be a headache to proofreaders and—if you will pardon me—even editors.

PHILIP N. BRIDGES,
5100 Randolph Road,
Rockville, Md.

SIR:

The Editor's Review for July suggests the term "monophonic" for a single-channel audio reproducing system. This term is already in common use in the music world in accordance with the dictionary definition, "one tone at a time."

Applying "monophonic" to audio with another meaning will certainly be confusing. Musical instruments, including electronic organs, are or have features that are often specified as monophonic or polyphonic. The features of electronic organs could easily be misinterpreted if the term monophonic is promoted to have another meaning. We have monophonic and polyphonic features as well as single and multiple audio channels in current merchandise allied with the audio industry.

C. G. CONN, LTD.,
Serge L. Krauss,
Electronic Product Design,
Elkhart, Indiana

SIR:

. . . I know what K means and would not be confused by its use. I'm sure some others do not know, and so I feel that the universally understood 99,000 is better than 99K.

"Monaural" used to bother me too. Hooray for your stand.

. . . The enthusiasm and continued high quality make each person feel as though the magazine were written for him. Don't ever let Mr. Canby go.

ROBERT P. BLAIR,
Department of Chemistry,
The University of North Carolina
Chapel Hill, N. C.

(*Thanks for the kind words. It has always been our intent to make the magazine seem to be directed to each reader. And we like ETC; too.* ED.)

SIR:

Yes, Yes, by all means use the "K" to designate 1000. Everybody else does, why not you also; even JAN specs call for it. Your practice has been to use 0.27 Meg. for example, instead of 270K, which would be much better. For values less than one megohm why not use fractions, such as ¼ Meg. or ½ Meg.? Instead of just using the letter "M" for megohm, use "Meg." always.

I agree with you that the word "magazine" should be used rather than cartridge for the tape machines which use *magazines* of tape.

WM. H. HARDY
3930 69th St.,
Sacramento 20, Calif.

(Result: *We are adopting the use of "K" for all values from 10,000 up to 999,000; we will use "Meg" for values from 1 Meg up. In the interest of clarity, we shall write out the figures for all values up to 9999, rather than use terms such as "4.7 K," which involves the decimal point again, with its suspectibility to omission.* ED.)

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stereo sound equipment . . . and here it is!



stereo tape deck kit

HEATHKIT MODEL TR-1D $143.95

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 3¾ and 7½ IPS. Frequency response ±2 db 40-12,000 CPS at 7½ 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

CENTER SECTION MODEL SE-1 $149.95

SPEAKER WING MODEL SC-1L or R $39.95 ea.

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 ¾" 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 precut and predrilled. 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 $89.95

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-2 $56.95

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 $54.95

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.



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HEATHKIT MODEL UA-1 $21.95

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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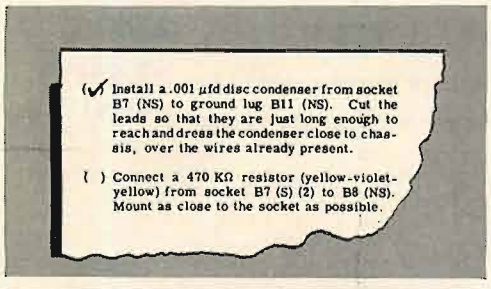
easy-to-build

high quality

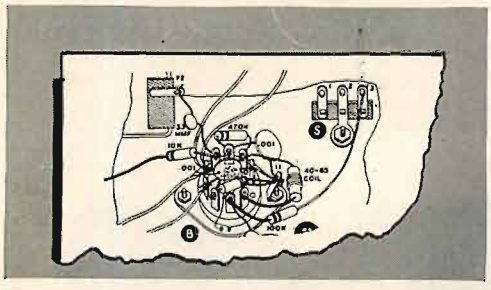
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Look . . . how simply you can assemble your very own high fidelity system! Fun-filled hours of shared pleasure, and an everlasting sense of personal accomplishment are just a few of the rewards. Heathkits cost you only HALF as much as ordinary equipment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



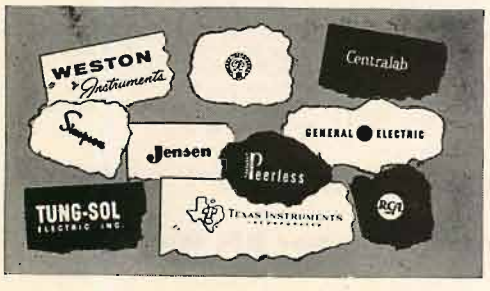
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Read the step . . . perform the operation . . . and check it off—it's just that simple! These plainly-worded, easy-to-follow steps cover every assembly operation.



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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

$27.95

NEW

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.

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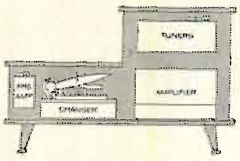
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NEW This beautiful equipment enclosure will make your hi-fi system as attractive as any factory-built professionally-finished unit. Smartly designed for maximum flexibility and compactness consistent with attractive appearance, this enclosure is intended 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 ½" and ¾" 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 35½" D. Shpg. Wt. 46 lbs.



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For noise and static free sound reception, this FM tuner is your least expensive source of high fidelity material. Efficient circuit design features stablized 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.

88 to 108 mc. Shpg. Wt. 8 lbs.

MODEL FM-3A $25.95 (with cabinet)



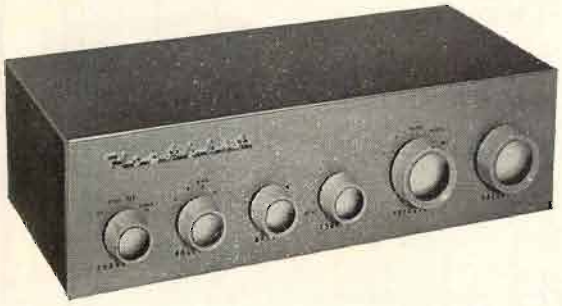
HEATHKIT

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.

easy tuning. Your "best buy" in an AM tuner. Shpg. Wt. 9 lbs.

MODEL BC-1A $25.95 (with cabinet)



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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 ± 1½ 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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HEATHKIT 25-WATT MODEL W-5M **$59.75**

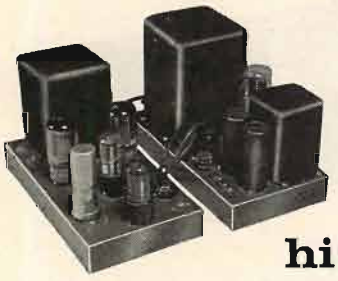
high fidelity amplifier kits

HEATHKIT 70-WATT MODEL W-6M **$109.95**

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 **$49.75**



HEATHKIT SINGLE-CHASSIS MODEL W4-AM **$39.75**



HEATHKIT

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 **$35.50**

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HEATHKIT

electronic crossover kit



MODEL XO-1 **$18.95**

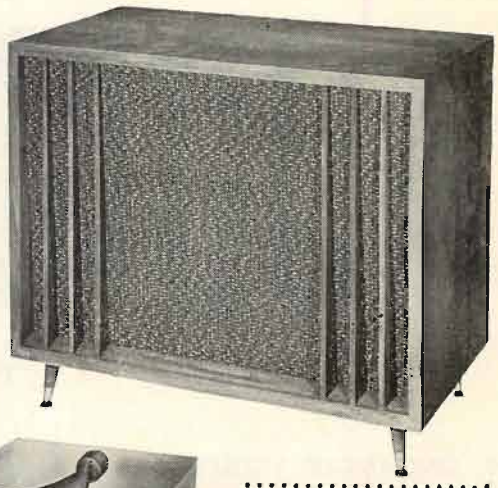
One of the most exciting improvements you can make in your hi-fi system is the addition of this Heathkit Crossover model XO-1. This unique kit separates high and low frequencies and feeds them through two amplifiers into separate speakers. Because of its location ahead of the main amplifiers, IM distortion 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.

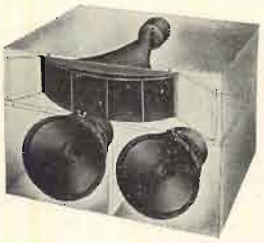
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MODEL HH-1-C
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MODEL HH-1-CM
(African mahogany)

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HEATHKIT BASIC RANGE

HEATHKIT RANGE EXTENDING



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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.

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AUDIO ETC.

Edward Tatnall Canby

1. UNGANGED STEREO

In this time of rapidly developing stereo it isn't easy to set up your own private course of action in respect to stereo equipment. If you're reckless and enthusiastic, you'll have no trouble spending your money. You don't even have to be reckless; it practically spends itself. Already there is so much equipment on hand, of so many sorts, that you can bust your bankroll and at the same time get yourself hopelessly snarled in complications without ever being involved in other than excellent stuff. There's something for every taste and need, for every situation. ("Situation" can be defined as having the wrong equipment in the wrong combinations.)

Therefore many of us are now warily holding off, looking at the scads of equipment from a safe distance, until we shall be able to set up our own personal schematic of wants and don't wants. Frankly, I am not yet out of that stage, though I've been scanning the stereo horizon for a long time already. I've been sampling around the edges, but am just beginning to get to the point where I am fairly clear as to a permanent policy—permanent, at least, for a reasonable equipment life-span. I'm in the stage where I'm setting up ideas, establishing principles. You are too, most likely.

For instance—in the May issue I let loose one of the new principles that is settled in my mind. No AM-FM stereo for me. I'm waiting for FM multiplex, and if it isn't forthcoming, I'll get along very well, thanks, on stereo disc, tape, and cartridge! (Since then I've talked to the gent who seems to be ahead in developing the FM multiplexing of sum-and-difference stereo signals and I expect to have something to say about it later on.) Now, for this month, I've come to another basic decision.

From here on out, I do no more stereo listening via two separate amplifiers, unganged. I've tried it, and I've had enough.

I've been using a simplified form of ganged, matched stereo in my RCA Victor stereo tape deck for a good deal more than a year and though it has its low-priced lacks (such as a level balance between channels) it works much too well not to have impressed me. I've also tried out for a short while one of the new dual stereo amplifier systems—and liked it so much that I quickly decided I'd have one for myself, for longer trial. It'll be arriving any day and I'll discuss it later on; but I know already that its basic feature will be OK with me. Two amplifiers controlled from one control panel, via one volume knob. That is the only way to *listen* to stereo music.

I'm aware that there are all sorts of in-between arrangements possible that will provide the end-result I'm talking about. I'm theoretically ready to compromise in any way that is practical (a big word) so long as I come out, in the end, with the basic essential, a single volume control that turns my stereo music up or down in volume, without complications.

I'm ready to fiddle with extra adjustments, with added features, provided they don't get in the way of solid listening—once the adjustments are made. I'm all for the useful and often-necessary balance control, a single knob that adjusts volume balance between channels; I can use a "reverse stereo" switch now and then (though if we would only learn to keep our lefts and rights straight it wouldn't be necessary). It's OK with me to have such luxuries as channels A and B mixed, A alone on both speakers, B alone, etc.etc. (One of these is essential, of course, for playing half-track non-stereo tapes.) But these things must be out of the way, as must all tricky connections involving stereo recording inputs, outputs, monitorings, and so on.

Some of the intermediary gadgets now on the market intended to convert present mono equipment (monophonic) to stereo look as though they really might work out in practice. Others, I suspect, would leave me in a welter of wires and cables and misconnections, channel A hopelessly intermixed and confused with channel B and probably out of phase, at that. I've had some nerve-wracking experience already on this general score and I don't want much more.

The trouble is that most people think an amplifier is an amplifier—and that's that. Take two amplifiers, hook your two stereo outputs to them, and you're off, with stereo listening. I'm here to confirm what every engineer knows in his heart of hearts, that there just ain't any two amplifiers alike. Not even two of a kind—though they in theory should be identical. The differences are only of minor practical importance when an amplifier is used by itself for ordinary hi-fi purposes. But as soon as two of them are teamed together, all sorts of troubles and confusions pop up to prevent a smooth, balanced equality in the two sound tracks.

A. Electronic Mismatches

There seem to be three kinds of mismatchings: electrical (electronic), lay-out differences, and informational differences.

Electrical mismatchings are the most obvious. One amplifier has a different input impedance from the other, making for a serious difference in tonal response in, for example, some ceramic stereo cartridges. The E-V stereo ceramic tripped me up on this factor with a vengeance—I borrowed one from RCA (that is, a head man at RCA said, "Here, want to try one?" and tossed me a cartridge out of a pile on his desk) and so it had no instructions; I didn't discover for a good while the reason for the shrill, tinny, bass-less sounds it produced in my two different amplifiers—it screeched differently in each one, at that! Wrong input value, not high enough. E-V requires a higher impedance than has been common in many amplifiers at the "high-level" or piezo input. The dual stereo amplifier I borrowed already had the correct input value on each ceramic input channel—and the E-V ceramic sound was transformed. Quite astonishingly good, too.

Then there's the little matter of gain in the preamp. Also sensitivity—in preamp and power amp. Dollars to doughnuts, if you use two different amplifiers, even of the same power rating, you'll find that their respective volume knobs must be set at utterly different positions, in order to achieve the same output from the same level of input. One of mine, with a low-output Fairchild stereo cartridge (XP-4), had to be turned all the way around for a reasonably room-filling sound, on its channel. The other amplifier—roughly equal power rating—jumped so much more quickly that for the same volume I had its knob turned only about a third around.

Equalization, to RIAA, should theoretically be identical if your two amplifiers are set with the tone controls "flat"—but it almost never is under the direct comparison of two stereo channels. Maybe the tone control knobs are off a bit in calibration; more likely, the RIAA position is only a reasonable approximation—quite legitimate in this imperfect world and plenty near enough for ordinary monophonic one-channel hi-fi sound. But the other amplifier, also "reasonable", is reasonable differently. As soon as you play your two stereo channels together you hear the difference, by simultaneous AB comparison. It can be disturbing. And so it goes. . . .

B. Lay-Out

Don't think that internal circuitry is all that is involved in those annoying differences between two amplifiers teamed for stereo. Just as annoying, to me anyhow, is the difference in the physical shape of the control systems on two amplifiers of unlike model. I have taken to painting all my volume knobs red, these days, so peeved am I at having to relearn the volume knob position every time I change amplifiers. (I also tend to stick a big piece of sticky tape across the Loudness Control, so it can't be used by the unwary.)

But even red knobs aren't enough, when you are trying to balance two separate amplifiers working on the same stereo recording. You have to cope also, remember, with two treble and two bass controls, not to mention all sorts of other knobs not in any identifiable sequence. In the difficult business of adjusting stereo balance by ear (which requires that you listen from a midpoint in the room, usually well removed from the amplifier controls!) four times out of five you'll find yourself turning a treble tone control up instead of the volume, or maybe switching by mistake from RIAA to EUR 78 on one amplifier! This, of course, after you've finished tearing your hair over the setting-up problem—plugging batches of cables that go to utterly different places in each amplifier, trying to figure out rough volume equivalents, as a starter, getting yourself balled up again and again as to which channel is on which amplifier, which output goes to which speaker. . . .

I do not exaggerate. We have a certain happy degree of rough standardization now in our amplifier controls, and it's far better than it used to be. But you can't operate two amplifiers at once—yet—and expect to reach for the controls and the connections and find them where you think they ought to be. It's always the *other* amplifier that has the volume where you reach; on this one

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

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STEREOPHONIC EQUIPMENT

HF85: Stereo Dual Preamplifier selects, preamplifies & controls any stereo source — tape, discs, broadcasts. Distortion borders on unmeasurable. Self-powered. Works with any 2 high-quality power amplifiers such as EICO HF14, HF22, HF30, HF35, HF50, HF60. Available shortly.

HF81: Stereo Dual Amplifier-Preamplifier selects, amplifies & controls any stereo source — tape, discs, broadcasts — & feeds it thru self-contained dual 14W amplifiers to a pair of speakers. Monophonically: 28 watts for your speakers; complete stereo preamp. Ganged level controls, separate focus (balance) control, independent full-range bass & treble controls for each channel. Identical Williamson-type, push-pull EL84 power amplifiers, excellent output transformers. "Low silhouette" construction. Kit **$69.95.** Wired **$109.95,** incl. cover.

MONAURAL PREAMPLIFIERS (stack 2 for Stereo)

HF65: superb new design. Inputs for tape head, microphone, mag-phono cartridge & hi-level sources. IM distortion 0.04% @ 2V out. Attractive "low silhouette" design. **HF65A** Kit **$29.95,** Wired **$44.95. HF65** (with power supply) Kit **$33.95.** Wired **$49.95.**

HF61: "Rivals the most expensive preamps" — Marshall, AUDIOCRAFT. **HF61A** Kit **$24.95,** Wired **$37.95, HF61** (with power supply) Kit **$29.95.** Wired **$44.95.**

MONAURAL POWER AMPLIFIERS (use 2 for STEREO)

HF60: 60-Watt Ultra Linear Power Amplifier with Acro TO-330 Output Transformer; wide band-width, virtually absolute stability & flawless transient response. "One of the best-performing amplifiers extant; 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, same specifications at 50 watts. Kit **$57.95.** Wired **$87.95.** Matching Cover E-2 $4.50.

HF35: 35-Watt Ultra-Linear Power Amplifier version of the HF60 above. Kit **$47.95.** Wired **$72.95.**

HF30: 30-Watt Power Amplifier employs 4-EL84 high power sensitivity output tubes in push-pull parallel, Williamson circuit, 20 db feedback, & high stability margin. 2-EZ81 full-wave rectifiers for highly reliable power supply. Unmatched value in medium-power amplifiers. Kit **$39.95.** Wired **$62.95.** Matching Cover E-3 $3.95.

HF22: 22-Watt Power Amplifier version of the HF60 above. Kit **$38.95.** Wired **$61.95.**

HF14: 14-Watt Power Amplifier of the HF81 above. Kit **$23.50.** Wired **$41.50.**

MONAURAL INTEGRATED AMPLIFIERS (use 2 for STEREO)

HF52: 50-Watt Integrated Amplifier with complete "front end" facilities & Chicago Standard Output Transformer. Ultra-Linear power amplifier essentially identical to HF50. "Excellent value" — Hirsch-Houck Labs. Kit **$69.95.** Wired **$109.95.** Matching Cover E-1 $4.50.

HF32: 30-Watt Integrated Amplifier combines excellent HF30 power amplifier above with versatile preamplifier featuring tape head & microphone inputs, scratch & rumble filters, all amplifier facilities. Kit **$57.95.** Wired **$89.95.** Both include cover.

HF20: 20-Watt Integrated Amplifier complete with finest preamp-control facilities, excellent output transformer that handles 34W peak power, plus a full Ultra-Linear Williamson power amplifier circuit. "Well-engineered" — Stocklin, RADIO TV NEWS. Kit **$49.95.** Wired **$79.95.** Matching Cover E-1 $4.50.

HF12: 12-Watt Integrated Amplifier provides complete "front end" facilities & excellent performance for any medium-power application. "Packs a wallop" — POPULAR ELECTRONICS. Kit **$34.95.** Wired **$57.95.**

SPEAKER SYSTEMS (use 2 for STEREO)

HFS2: Natural bass 30-200 cps via slot-loaded 12-ft. split conical bass horn. Middles & lower highs: front radiation from 8½" edge-damped cone. Distortionless spike-shaped super-tweeter radiates omni-directionally. Flat 45-20,000 cps, useful 30-40,000 cps. 16 ohms. HWD 36", 15¼", 11½". "Remarkable realism; eminently musical; unusual suitability for stereo." — Holt, HIGH FIDELITY. 15¼", 11½". "Remarkable realism; eminently musical; unusual suitability for stereo." — Holt, HIGH FIDELITY. Completely factory-built: Walnut or Mahogany. **$139.95;** Blonde, **$144.95.**

HFS1: Bookshelf Speaker System, complete with factory-built cabinet. Jensen 8" woofer, matching Jensen compression-driver exponential horn tweeter. Smooth clean bass; crisp extended highs. 70-12,000 cps range. Capacity 25 w. 8 ohms. HWD: 11" x 23" x 9". Wiring time 15 min. Price **$39.95.**

FM TUNER

HFT90: surpasses wired tuners up to 3X its cost. Prewired, pre-aligned, temperature-compensated "front end" — drift-free. Precision "eye-tronic" tuning. Sensitivity, 1.5 uv for 20 db quieting — 6X that of other kit tuners. Response 20-20,000 cps ±1 db. K-follower & multiplex outputs. "Drift absolutely absent; audio quality excellent; novel tuning quite effective." — ELECTRONICS ILLUSTRATED. Kit **$39.95*.** Wired **$65.95*.** Cover $3.95.

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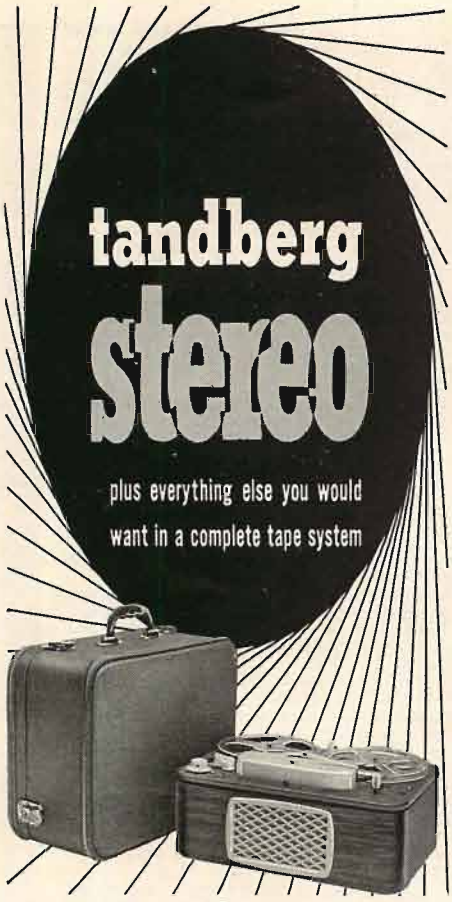
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the new dimension in sound...

Designed for the highest of reproduction standards . . . Scandinavia Styled from fine grain mahogany.

STEREO 3-Speed Tape Phonograph and Tape Recorder – Tandberg Model 3-Stereo—for at home listening pleasure . . . or conveniently portable in luxury-styled luggage type carrying case for traveling enjoyment.

For the finest in sound reproduction, two extremely well-balanced power playback amplifiers are built-in with such efficiency of design that the distortion of each amplifier is under 1%. A specially manufactured in-line stereo head, unique in design and construction, provides a clarity of reproduction and a range of response heretofore unattainable.

The model 3-Stereo weighs 27 pounds, and is priced at **$369.50.** Complete with microphone and carrying case.

The Tandberg stereo-trio including model 3-Stereo recorder/reproducer and two perfectly matched speaker systems . **$469.95**

Tandberg

10 East 52nd St., New York 22, N. Y.

its the on-off switch and one channel obligingly conks out for you.

If you use two *identical* amplifiers, you can safely discount this factor. But not even two models of different number from the same company are enough alike to make dual control motions simple and easy. They never are easy, even at best.

C. Information

There is, finally, the annoyance of different information, as printed on different amplifiers. I mean simply the visible words or numbers that tell you which socket, what knob, does what. They ought to be simple enough, and they are—once you figure out the logic of your own amplifier. You get used to the system. Like the AUX 1 and AUX 2 on my older-model GE amplifier (and probably on the current model too): both of them were high-level inputs, but one had an input level-set, the other didn't. That I soon memorized.

Some amplifiers have LO-MAG and HI-MAG. Others say LO-LEVEL PHONO, or perhaps just PHONO. For your stereo ceramic, you may have to pick and choose between PIEZO, XTAL, PHONO, CERAMIC—or maybe TV or RADIO. This will apply double, first when you plug in your two leads to the two amplifiers and again when you come to setting the frout selector switch to the proper position. Chances are that you'll have a dif-ent setting for each amplifier.

When it comes to the various more complex switching facilities on amplifiers, you'll really bog down with two of them. Don't try—don't *ever* try—to fix up two amplifiers so that you can do all the standard things in stereo form—listen to tapes, stereo records, AM-FM broadcast, make tapes off the air, etc. Each change from one mode of operation to another will involve you in mental hazards enough to confuse a wizard. If you're not careful, you'll get mixed up and your entire dual system will have to be unplugged, untangled and reassembled for a new start.

Nope—I do NOT like two separate amplifiers for my stereo.

What Can You Do, Then?

Well, what *can* you do, if you have a perfectly good single amplifier and you want to convert to stereo?

If you own two Scott amplifiers (that is, if you own one and plan to buy another), you can hook up the little H. H. Scott Stereo-Dapter, a passive switching center designed specifically to be used with Scott amplifiers so that one knob does the volume-setting for both amplifiers. You'll find an account of this device in the May, 1958, issue (Equipment Review, p. 39).

The Stereo-Dapter can also be used with certain combinations of other amplifiers, if all the complex factors are just right. But, since it does just about everything—reverse stereo, channel A or B on both tracks, monophonic play, recording on tape, playing tapes, discs, etcetc—the two amplifiers must necessarily be very exactly right.

As a matter of fact, I rashly called up Mr. Scott and asked for one on the chance that it might work with my two big amplifiers, for a demonstration of stereo disc and tape that was coming up. He told me that it might *not* work, if I had the wrong amplifiers, but, silly me, I said sure, I know, and tried to match things up when the little unit arrived, a couple of days later.

I got it to work with one amplifier, the Dynakit. But the other one couldn't be hooked up at all without breaking into some of the circuits inside. You can understand why easily enough, I think, if you'll consider that any switching system for two amplifiers must get itself between the preamp outputs and the main amplifiers. That's the big transfer point. The Dynakit happens to come in two pieces, which is just dandy. The Eico, the other one, is a one-chassis amplifier and there doesn't happen to be an outside connection that cuts in *after* the main control switch, but before the amplifier-proper. No reason why there should be—except for this special purpose.

Nope—you can't use the tape output from the preamplifier—because you haven't anywhere to plug it back in again; the direct inputs to the main amplifier (high-level inputs) are on the main switching selector—which is already set for the signal input. Get it? I took a good long while to figure this simple problem out myself, what with the multiplicity of cables, plugs, inputs, outputs and what-not on the two amplifiers *and* the Scott Stereo-Dapter.

If you'll make yourself a new input to the main amplifier, you can approach the in-business stage with the Stereo-Dapter. Provided, of course, that impedances of this and that input etcetc are going to come out right. (He tells you what's needed.) If not, you may get a balance for one mode of operation, but it will be completely haywire for other modes. (Reverse stereo, for instance. If your amplifiers are unlike, or your preamplifiers, or both, your balance will be off when you switch channels aronud.)

Frankly, I found the Stereo-Dapter a handsome and somewhat terrifyingly complex bit of mechanism, but I honestly can't see that this does more than reflect the stereo situation, as is. I'd only offer two suggestions, in a mild way. First, the gadget might have a wider usefulness if it didn't try to cope with so many potential uses—*all* the potential uses you ever heard of. And secondly, I found the markings and the instructions, shall I say, earnestly complex. It's all there, and you can figure it all out; but boy, you'll have to study awhile. I still can't get out of my mind the marking on two of the inputs on the rear, TO RECORD JACK. On the face of it, I wouldn't know what that meant. I figured it out.

The Stereo-Dapter matches up neatly with Scott amplifiers of recent vintage, with the same handsome gold and vinyl exterior. I'll recommend it for two Scott amplifiers any day. But try it on others only if you are pretty clear as to what is involved. It's a lot, and you can't blame Scott.

What else? A great deal. But I haven't got along yet to trying out some of the other approaches to this critical teaming-up of two amplifiers. I think, however, that some principles are fairly easy to set down, or have already been set down by various makers in terms of new equipment.

Dual Preamp-Control

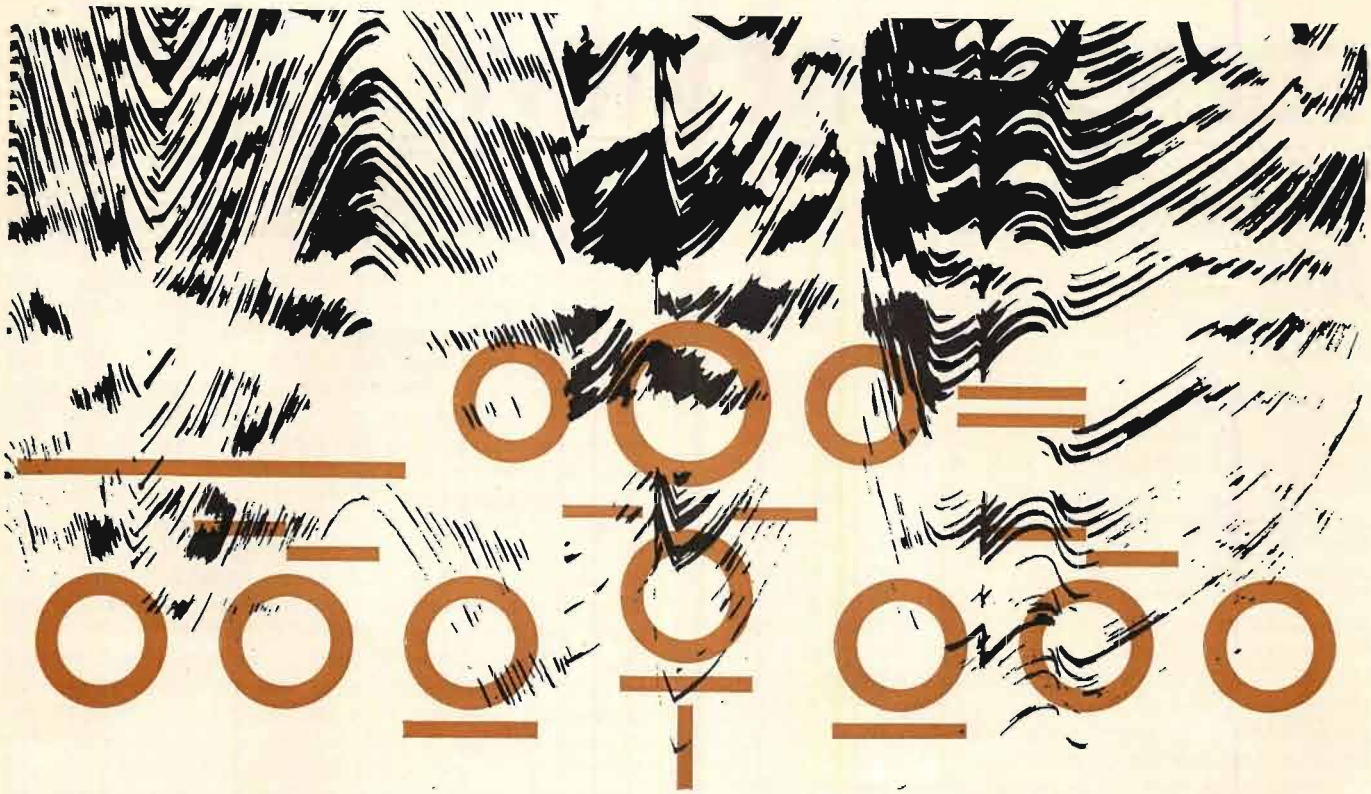
The biggest and simplest principle is that if you will acquire two matched preamplifiers in a conversion unit, along with internal switching, you have solved the major problems involved in the use of two separate amplifiers.

Yes, you'll waste the preamp you already own. It's perfectly good, but it can't be ganged to another one in any satisfactory way, let alone be matched to any but its own double. It seems to me that it is worth this much sacrifice, in order to dodge the multiplicity of headaches that will be yours otherwise.

Conversion units involving this idea are already for sale in various forms, as you've probably discovered. (Maybe you make one in your own factory.) It's a sound idea, whether there are also amplifiers attached or not. Once the dual interconnected pre-

(Continued on page 72)

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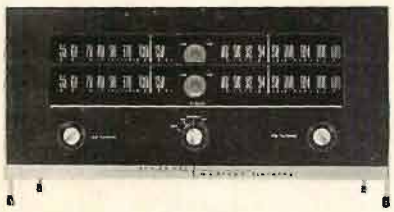
STEREO BY DESIGN. From its drawing board inception, Madison Fielding was designed for stereo high fidelity reproduction. Here is true flexibility of components made for each other . . . matched to each other. Even used monaurally, the results are beyond comparison. Here, then, is Madison Fielding.

Series 340 Madison Fielding Stereophonic Master Control Console.



With the development of the mixer facility, this control console adds a new dimension to audio flexibility. With the 340, you have complete control over any of the available stereo or monaural sources. The mixer switch permits the combination of any two compatible signals for professional effects in recording or playback. Other unique features include: third channel output and balance control and twin calibrated Micro Beam level indicators. With brushed brass front panel—$150.00. Ebony cabinet—$23.00. Cabinet in walnut, mahogany or blond—$18.00.

Series 330 Madison Fielding Stereophonic AM/FM Tuner.



Behind the beautiful wood panelled escutcheon lie two complete tuners: broad-band AM and sensitive FM. Combined with its matching Series 320 stereo amplifier, this unit provides the sensitive FM. Combined with its matching Series 320 stereo amplifier, this unit provides the nucleus for the finest stereo high fidelity system. Switching permits operation of each tuner individually, or in concert for stereo broadcasts. Individual level controls and FM multiplex outlet. With ebony front panel—$160.00. Matching cabinet—$25.00. With walnut, mahogany or blond front panel—$150.00. Matching cabinet—$20.00.

Series 320 Madison Fielding 40-Watt Stereophonic Amplifier.



Two complete 20-watt amplifiers each combined with its own flexible preamplifier section are mounted on this brilliantly engineered chassis. Provides inputs for Series 330 tuner, disc, tape, or microphone for each channel. Features unique Stereoscopic Dual Magic Eye which permits balancing of equipment for stereo programs without special calibrating signal, in addition to master volume control. With ebony front panel—$180.00. Matching cabinet—$25.00. With walnut, mahogany or blond front panel—$170.00. Matching cabinet—$20.00.

madison fielding stereo

For complete specifications write: Brand Products Inc., Dept. B-8, 11 Lorimer Street, Brooklyn 6, N. Y.
Marketing organization for Madison Fielding Corporation

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EDITOR'S REVIEW

FM/MULTIPLEX STEREO SURVEY

As an adjunct to the lead article in this issue (page 19), we sent a questionnaire to every FM station in both U.S.A. and Canada to inquire as to their M/X activities at present as well as in the future. Over half of the stations responded, and we have accumulated thereby a lot of valuable information. Of the 343 replies, 28 stations are currently employing M/X for various applications—background music, paging, functional, and Muzak—most being on the air from 18 to 24 hours daily. 91 plan to use M/X in the foreseeable future, four report M/X installation now in progress, 8 will probably install M/X eventually, and 56 are considering the possibility. 156 stations report that they definitely do not plan to use multiplex in the foreseeable future. Thus over half of the stations responding are either employing M/X now or plan to do so in the foreseeable future. Since it requires a special dispensation from the F.C.C. to use multiplex for stereo, only four stations report the experimental use for this service.

Stereo broadcasting is certainly a desirable step forward. Within two years, at the most, it is doubtful if any monophonic phonograph records will be on the market—with the exception of the juke box and "popular" material which usually has a life not exceeding three months. It is doubtful if anything but the cheapest portable phonographs will be monophonic in that same two years. Thus people will become accustomed to stereo reproduction, and will certainly want it on radio as well.

AM/FM stereo does provide one type of stereo service, unquestionably. However, it limits the material to that which can be recorded in such a manner that either channel alone provides a satisfactory program. Anyone who has listened to either channel of a stereo tape by itself already knows that this does not apply to all stereo recording, particularly to a full orchestra. When WCBS (New York) broadcast the Newport Jazz Festival by stereo—AM/FM—last month, they compromised the signal so greatly that it was difficult to tell if the broadcast actually was two-channel. To protect the investment and sponsor revenue, the AM channel was fairly good by itself—in fact, the AM channel was fairly good by itself—in fact, rather better than both together. On page 20 of this issue, WQXR's chief engineer tells of that station's experience with AM/FM stereo broadcasting, and it is indicated that considerable care is exercised in choosing the material. The principal objection to AM/FM stereo broadcasting is that it ties up two channels to provide only one program, and either one alone is somewhat less than ideal.

On the other hand, FM/multiplex can provide an excellent signal on FM for those who have only the standard FM receiver, and in addition it can provide the second-channel information for those who are willing to install the M/X adapter, and it ties up only one communication channel. True, there has to be some reduction in effective signal strength on the main channel—we still can't get something for nothing—but this may perhaps be offset by the greater satisfaction from stereo broadcasting.

In the last few years, many stations have found the commercial aspect of M/X to be a life saver, and they may derive income from this secondary service so they can stay on the air with high-quality programming on the normal FM channel, which is certainly creditable. But not every station is employing background M/X now, and those who are would perhaps not need to go to stereo. The F.C.C. is currently studying proposals for setting aside a national subcarrier frequency for stereo use—50 kc has been suggested as the standard—and it is hoped that the Commission will rule favorably on this proposal before long. We firmly recommend it—for what it is worth—and believe that broadcasters should support the plan wholeheartedly. The present 67 and 41 kc bands, and others, could be retained for those stations who wished to use them for commercial applications, but for stereo applications the 50 kc subcarrier would be standard. Thus the adapters or complete receivers made for home use would not tune to the other bands—or at least not satisfactorily, and thus would not detract from the income-producing commercial service. We do believe, however, that for the greatest good to the greatest number, a national subcarrier frequency for entertainment use is desirable. No one would be forced to buy another receiver if he didn't want to—he would still have good reception on the standard FM channels. There is no similarity to the argument raised against moving an entire band—as was done some years ago. In that case everyone's existing FM set became obsolete overnight.

Stereo isn't indispensable—but it is awful nice, and we'd like to hear more of it—preferably on FM/multiplex.

MULTIPLEX BACKGROUND STATIONS

Those of our readers who are interested in exploring Multiplex will want to know which stations are doing it now and on what subcarrier. But first, a caution—the Multiplex service is practically a point-to-point communication, and as such is restricted by law to some degree. We doubt—and this is only an opinion—that anyone cares if a few of us experiment with an adapter in our homes. But *don't* make the mistake of putting one in a restaurant so as to be able to pirate a Multiplex broadcast. In other words, for study and even for home entertainment it is likely to be okay; even for home entertainment it is likely to be okay; for profit it certainly is not.

The following stations replied that they use M/X, with a subcarrier of 67 kc except where otherwise indicated. Where two frequencies are employed, the "&41" indicates 67 and 41; when not on 67 at all, the X precedes the frequency in use.

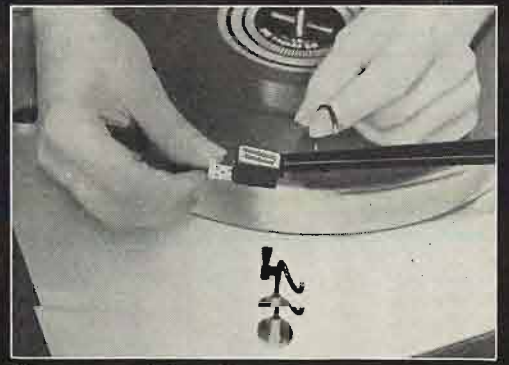
California: Bakersfield, KQXR; Los Angeles, KMLA, X65. *Connecticut:* Brookfield, WGHF, &41. *D.C.:* Washington, WWDC, X26,65. *Georgia:* Augusta, WBBQ-FM. *Illinois:* Chicago, WCLM, &41.5. *Massachusetts:* Boston, WRKO-FM, X32.5; Waltham, WCRB-FM. *Michigan:* Grand Rapids, WJEF-FM. *Minnesota:* St. Paul, &41. *Missouri:* Kansas City, KCMO-FM, X65. *New York:* Buffalo, WBNY-FM; Cherry Valley, WRRC, &41; DeRuyter, WRRD, &41; Ithaca, WRRA, &41; New York, WBFM, X65; WRFM, X32.5. South Bristol, WRRE, &41; Troy, WFLY, X32.5; Wethersfield, WRRL, &41. *Ohio:* Cincinnati, WSAI-FM; Cleveland, WHK-FM; Toledo, WMHE. *Pennsylvania:* Philadelphia, WCAU; Pittsburgh, WKJF, WWSC; Sharon, WPIC-FM.

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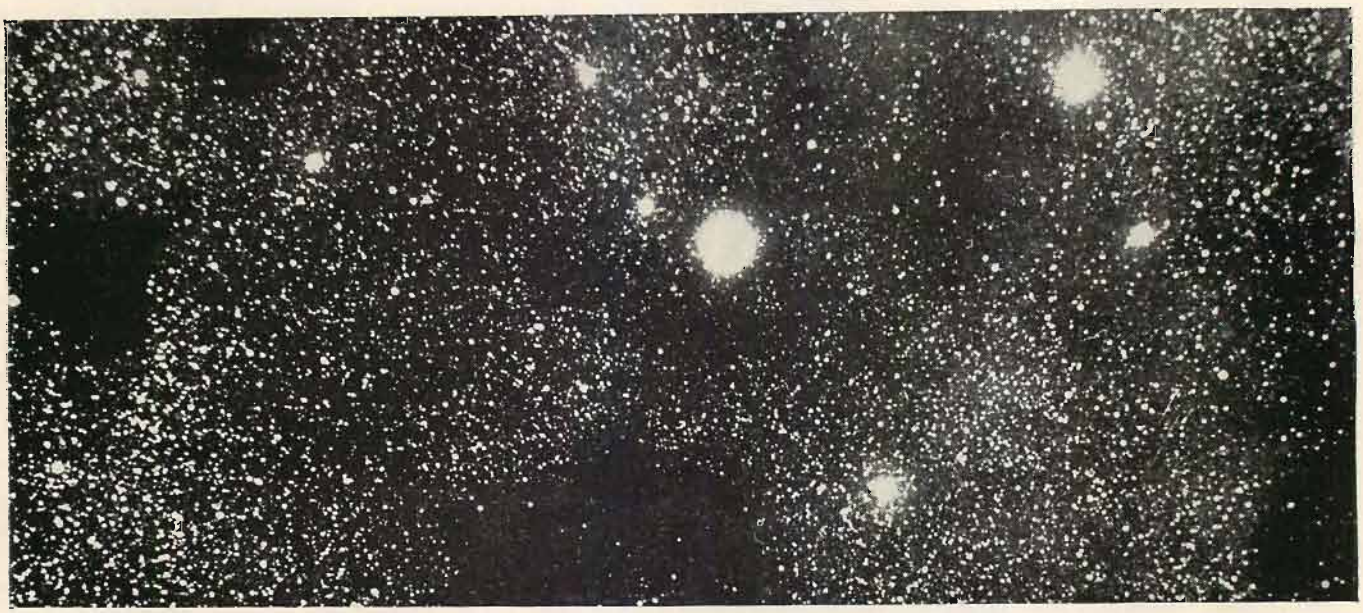
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Courtesy Mount Wilson Observatory

FROM BEYOND THE SKY TO BENEATH THE SEAS

In the field of communications, two extraordinary events have occurred within a short span of time. One was the linking of Europe to America by the submarine telephone cable. The other was the sending of radio signals from U. S. satellites in outer space.

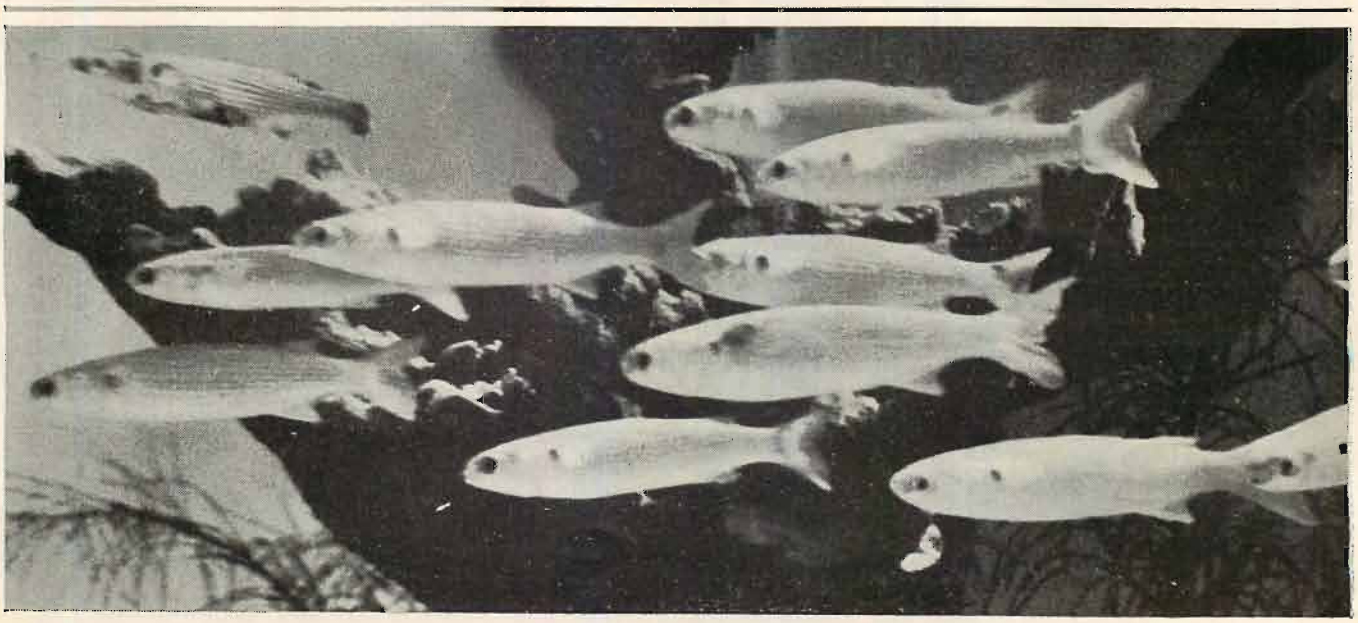
Both achievements depended on developments from Bell Telephone Laboratories. The cable was made possible by development of long-life electron tube amplifiers able to withstand crushing pressure on the ocean floor. The satellites derive their radio voices from transistors—products of basic research in semiconductor physics.

The deep sea amplifier and the transistor illustrate the wide range of work at Bell Telephone Laboratories. Here, over 3000 professional scientists and engineers explore and develop in physics, mathematics, electronics, chemistry, mechanical engineering, even biology—in every art and science which can help improve electrical communications.

Through this work, Bell Telephone Laboratories has helped make your telephone service the world's finest—and will keep it so.

BELL TELEPHONE LABORATORIES

WORLD CENTER OF COMMUNICATIONS RESEARCH AND DEVELOPMENT



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The FM/Multiplex Converter

HAL DAY*

The principles of operation of an FM/Multiplex translator are straightforward, and while there are many ways of obtaining the desired result, this one is simple enough for home construction for experimental use and possible future stereo broadcasting.

THE LATEST INNOVATION which may make stereo broadcasting really practicable is FM multiplexing. This new system has many advantages over the old AM-FM in combination. The system is all-FM allowing the well-known advantages of FM in both channels. Noise free, wide band, hi-fi performance of each channel can be obtained merely by tuning in a single station on the FM receiver.

* *Wendy Lane, Burnt Hills, N. Y.*

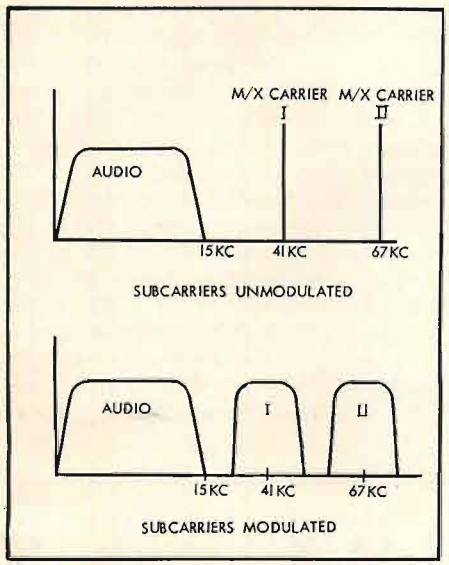


Fig. 1. Frequency spectrum at the output of a standard FM receiver (before de-emphasis) with receiver tuned to a station which is multiplexing. Each channel is independent of the others and may carry its own program. Some stations use only a single subcarrier at about 34 kc, and most turn off the subcarrier when it is not being modulated.

it is not being modulated.

The usual AM-FM stereo broadcasting systems have to use two separate transmitters sometimes located at different sites. The effective radiated powers of the two transmitters often differ widely while the variations of propagation and the reception in two separate receivers form an equally non-ideal link in the system. In addition to all this it is almost unnecessary to mention low fidelity limit imposed by the usual narrow-band superheterodyne AM receiver.

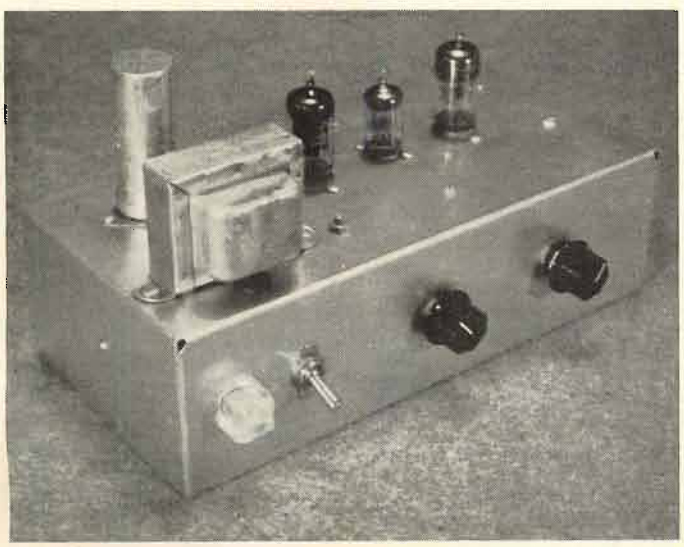
In the multiplexed system both channels are broadcast by the same transmitter and antenna. The ratio of power in the two channels is controlled at the transmitter and cannot change due to propagation. The fidelity need only be limited by the quality of the electronic components being used and not by the basic laws of the system.

Much has been said elsewhere about the virtues of this new system and about plans and attempts to get something on the air. As the reader is probably aware, many stations are now using a multiplexed system for transmitting programs of background music on a subscription basis.[1] The usual practice is for the FM station to rent the receiving equipment to the subscriber who may also rent the public address system or use his own if he chooses. The receiving equipment is not yet being sold to individual users.

The sale of backgrounnd music service

[1] See "Multiplex Survey," page 16.

[1] See "Multiplex Survey," page 16.



Experimental multiplex translator as described by the author.

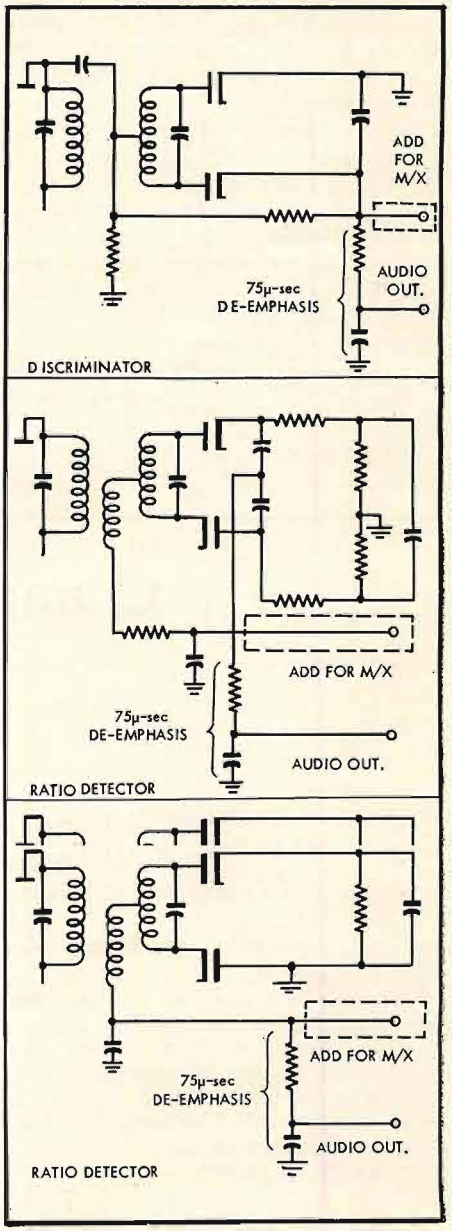


Fig. 2. FM detectors of three typical commercial receivers indicating proper point to connect the multiplex output. The connection is always made just before the de-emphasis network. In each case there still remains a small capacitor shunting the MX output to ground. It serves to bypass the 10.7-mc carrier, and does not interfere with the MX signal.

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has proven to be life-blood of many FM stations. In general, the stations we audiofans like best are the ones which have the toughest sledding financially. People who like high-quality programming invariably prefer high-level commercials and even then a minimum of those. Although highly desirable, this is just not good business, and the stations who wish to provide good programming have been pulled out of the fire by the background music business.

One immediately wonders why anyone must pay for the background music since it is broadcast. The answer is that it is not "broadcast" but is "transmitted." These words have two different meanings and are clearly distinguished by the F.C.C. The law pertaining to such transmissions forbids unauthorized reception and use for profit (such as playing it in a place of business or doctor's office). To the author's knowledge it has never been determined legally whether or not listening to such a transmission in the privacy of one's own home constitutes "reception and use for profit." Nevertheless we should keep in mind that the existence of the stations we like best quite likely depends upon our respecting the law. We should never take advantage of multiplexed programs in such a way as to in any way interfere with the normal background music subscription business.

Stereo programs are not transmitted on a subscription basis and so far there has been no indication that they are not intended to be free, but so far the F.C.C. has not made any provision for stereo broadcast use of multiplex. Vague statements have been made by multiplex equipment manufacturers regarding the possibility of setting up toll systems or selling key cards to decode a previously scrambled program. There is a tendency for enthusiastic equipment salesmen to be rather glib when discussing the difficulties associated with any but a direct-wired toll-program system whether it be TV or FM. It is the author's opinion that multiplexed stereo will have to have commercial sponsors and operate on a broadcast basis in order to be successful. Since several stations are already broadcasting multiplexed stereo on an experimental basis and no translators are commercially available this article should fill a definite need. The reader is again admonished not to use the multiplexed "transmissions" in a place of business or otherwise illegally and he is requested to report to the radio station any infringement of which he may become aware.

Definition

Multiplexing is an old idea and is a general term referring to any scheme for putting more than one subchannel of information onto a single main channel. There are many systems for multiplexing and the one used by FM stations is actually a rather simple one. In this system the modulation at the transmitter is accomplished in such a way that after the received signal passes through an ordinary FM receiver there appears at the output of the ratio detector or discriminator not only the usual program material but one or more additional signals (*Fig.* 1).

The main program material contains all frequencies in the audio range but cuts off beyond it, at about 15 kc. The additional signals occur at, or vary around 41 kc and 67 kc, well beyond the audio range.

Consider subcarrier I at 41 kc. If there is no modulation the carrier is stationary at 41 kc and is entirely independent of what is going on in the bands below 20 kc or at 67 kc. When modulation is impressed on subcarrier I, the signal varies plus and minus from 41 kc in a typical FM manner. The same kind of action occurs at 67 kc independently of the other two channels. The two subcarriers sitting there at 41 kc and 67 kc may be thought of as two new independent FM stations broadcasting at two rather unorthodox frequencies just above the audio band rather than near 100 mc. It should be stressed that these subcarriers only appear after the main FM signal has passed through the discriminator.

It will be clear now that what is needed to "translate" subchannel I is another FM receiver tuned to 41 kc and

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Q and A on Stereo and M/X

LOUIS J. KLEINKLAUS

WQXR, New York

The Chief Engineer of one of the first "high fidelity" and "good music" stations answers many of the common questions on stereo broadcasting.

TO THE DESK of the WQXR Engineering Department come all manner of inquiries, and, like most radio stations, we are glad to be of service to our listeners so they may better enjoy our broadcast services. At this time, the companion subjects of stereo and multiplex account for most questions. The following are composite queries received from our listeners. Our replies, we believe, are typical.

1. Please give me information on your stereo programs.

WQXR has been broadcasting a regular schedule of stereophonic programs, both live and recorded, for the past six years, using the so-called AM-FM method. Those listeners within the coverage areas of our transmitters have accepted this scheduled service with overwhelmingly good response. In the process of broadcasting stereophonically, contrary to some opinion, we do not degrade either channel monophonically, thus there is no loss to the single-channel listener. It has been established and it is our experience that microphone spacing need not be extreme in order to provide adequate stereo effect (on our live originations, our microphones may be as close together as six inches). To guard against poor microphoning on recorded stereo, WQXR auditions the stereo tapes and discs beforehand to avoid this trouble.

2. Using AM and FM for stereo, doesn't this create two disparate channels?

Six years of AM-FM stereo has shown us that both channels need not be identical. In fact, the stereo programs are now being enjoyed in the homes where any one of their AM radios is used with the FM installation. The advantage here is that stereo can be had now with equipment already on hand. It can be said without question that the better each channel is, the better the stereo. In no way can it be said that, automatically, AM is inferior. Actually, WQXR has always had response on AM to 15,000 cps, and many of its listeners have long been taking advantage of it.

In all justice to the AM broadcaster who cares enough to provide good response on AM, we should explode the myth that exists that AM is *limited* to a maximum modulation frequency of 5,000 cps. Although the Federal Communications Commission assigns AM stations to frequencies but 10,000 cps apart, the F.C.C. does not do so in the same geographic locality.

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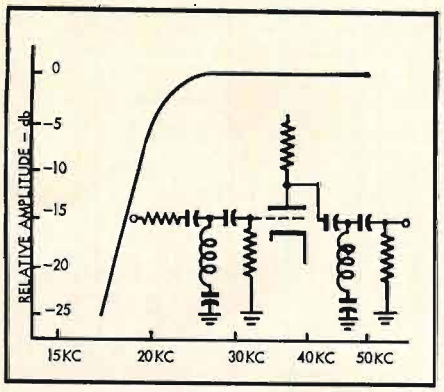


Fig. 4. Frequency response of first two filters. High-pass is tuned to 20 kc, and removes the main audio channel.

attached, not to the antenna, but to the output of the discriminator in the regular FM set. Subchannel II likewise requires a 67 kc receiver. Now the question arises, where does one get a 41–kc or 67–kc FM receiver? These days he builds it. The problem is not great because little gain is needed and only fixed frequencies are involved. The circuits shown here will enable the reader to have his own multiplex translator after a few evenings' effort.

Most recent tuners have been provided with "multiplex" output jacks. If your tuner is not so equipped you can easily provide one. It should be connected to the point where audio is obtained from the discriminator or ratio detector, but *before the de-emphasis network*. Circuits of the detectors of several standard FM sets are shown in *Fig.* 2 with the proper connection indicated. Often two output jacks are provided after the de-emphasis network. In late model sets one of them has simply been transferred to the point just before the network and labeled MX. It's easy as that for the reader, too.

It is generally conceded that one channel of the stereo program will be carried on the main audio channel and the second stereo channel will use the 41–kc subchannel. The 67–kc subchannel will carry background music. However, this arrangement although likely, is not yet absolutely certain. In order to be prepared for future developments, the values of components are given for both the 41 kc and 67 kc translators. Most of the early multiplex stations are still transmitting background music on a single 32 to 35 kc subchannel, which can be received on the 41 kc subchannel translator. The circuit shown in *Fig.* 3 employs a "bandswitch" in order to permit testing on all three frequencies. Such construction, although not necessary for stereo, presents no serious problems and is a convenience in areas where stations using different subcarrier frequencies can be received.

The fidelity to be obtained from a multiplex translator increases asymptotically with effort and expense, as it does with most hi-fi gear. In the interest of

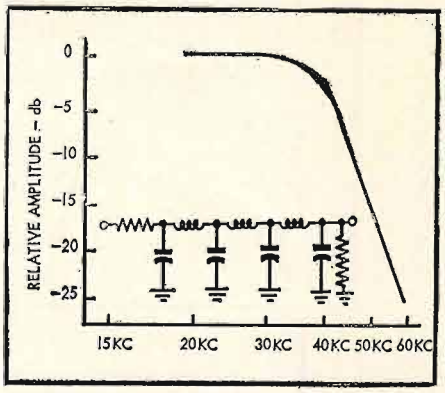


Fig. 5. Frequency response of the low-pass filter, tuned to 55 kc, which removes the 67-kc subcarrier and high-frequency noise.

cost and ease of construction, these circuits provide good performance, although admittedly not the ultimate. They will give the stereofan something to listen to while the audio companies are developing the expensive versions, which *may* have better performance. The tuned circuits have intentionally been designed to be rather broad in the interest of fidelity and to render them as insensitive to circuit values as is practical. Nevertheless, some discretion should be used in selecting the capacitances and inductances in the tuned circuits. The values of the 50-μμf capacitor and the 0.11-megohm resistor on the grid of the

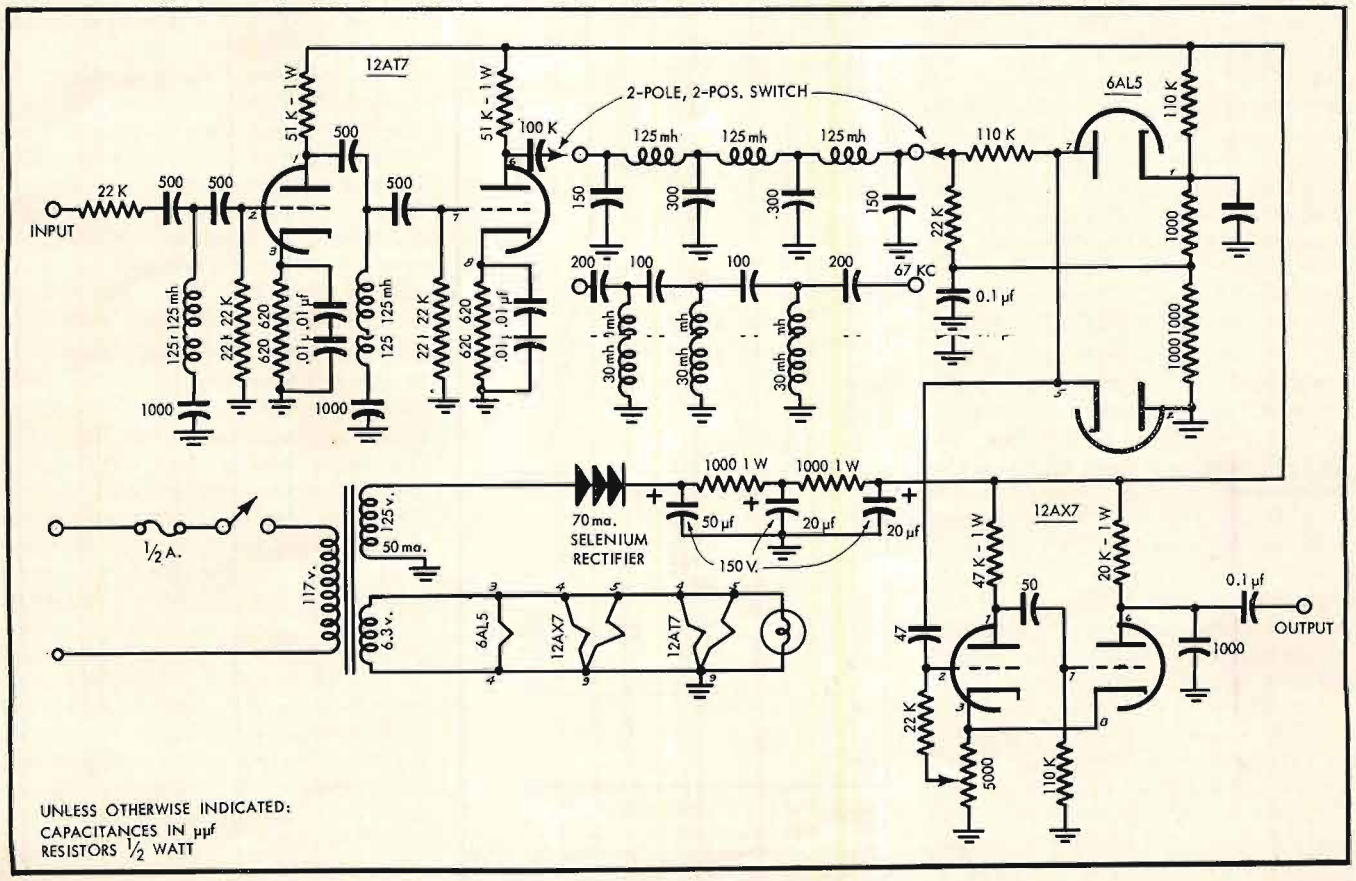


Fig. 3. Three-two multiplex translator described in text. Standard available components are used throughout. A band switch provides for reception of all currently used subchannels.

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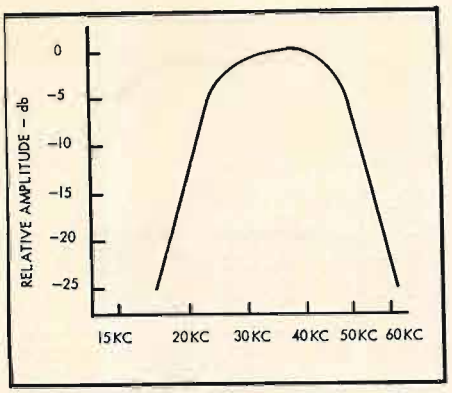


Fig. 6. Frequency response of amplifiers and all filters before limiter when set for 34–41 kc. Band is wide enough to pass both 34- and 41-kc subchannels. This is permissible since they never occur simultaneously.

12AX7 should be correct within ten per-cent. No other components are critical.

Circuit Functioning

The translator consists of a two-stage bandpass amplifier which suppresses the main program and the undesired subcarrier, followed by a limiter and a pulse-counting FM detector in the form of a multivibrator. These circuits were chosen because they use standard parts. Special parts, when available, may improve performance slightly but cannot be counted on to lower the cost.

Since the subcarrier frequencies are so low, the 10- to 20-kc bandwidths required in the amplifiers present more formidable problem than they would at higher carrier frequencies. Although simpler circuits can be used when special low frequency I.F. transformers become available it is possible to synthesize suitable circuits from conventional chokes and capacitors without becoming unduly involved. A combination of high-pass and low-pass filters has been found most satisfactory and least sensitive to circuit values. Since stations either have subcarriers at 41 kc and 67 kc or 34 kc alone, it is possible to use one set of coils to pass both 34 kc and 41 kc and another set for 67 kc. It is somewhat difficult to separate the main audio program from the 41-kc subchannel and it is also difficult to separate the 41-kc and the 67-kc subchannels. It has been found desirable to use the three-section filters shown. In case the translator is to be used exclusively for receiving a station using only one subcarrier, the one appropriate filter can be selected from the "bandswitch."

The pass-band characteristics of the various filters are shown in *Figs.* 4, 5, 6, and 7. The first two filters, separated by a triode, are of the hi-pass variety and tuned to 20 kc. They effectively remove the main audio program. The bandswitched units are three-section filters that cut sharply between 50 and 60 kc. One is a low-pass filter to remove the 67-kc subcarrier and the other is a high-pass filter to remove the 41-kc subcarrier. At first glance it would appear that the two 20-kc hi-pass filters would be unnecessary when using the hi-pass tuned to 55 kc for receiving the 67 kc subcarrier. This is not true, however, since if they are omitted, the first or second triode amplifiers are over-driven by components of the main audio channel and clipping occurs too soon. This clipping generates many harmonics and permits these lower frequencies to multiply up into the subchannel of interest in the following resonant circuits, producing crosstalk.

If it is found that a hiss persists on the 67-kc channel after all adjustments have been made, the band pass filter shown in *Fig.* 8 may be used to follow the high-pass filter on the bandswitch. In case the station is modulating the 67-kc subcarrier only and not the 41-kc subcarrier, the bandpass circuit may simply replace the high-pass circuit. It is suggested that the bandpass filter be used only if it is found necessary to limit the response above 80 kc, since the capacitors are more critical than those in the high-pass circuit. The reactive elements of the bandpass filter should be accurate to five per cent or better.

The potentiometer in the cathode of the multivibrator, the 12AX7, is for threshold setting, and should require adjustment only once. Its position is determined by the output of the FM set and the clipping level of the limiter. It should be turned toward the cathode end until oscillation stops (the output will be quiet). As the tap is turned toward the ground end, oscillation will begin but will be unstable, causing a noisy output.

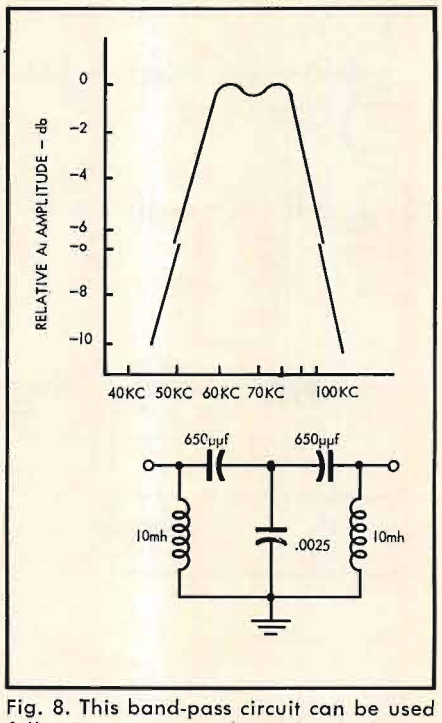


Fig. 8. This band-pass circuit can be used following or to replace the high-pass filter if it is found necessary for the 67-kc subchannel. Its purpose, as shown in the response curve, is to limit the response of the amplifier to noise lying above 80 kc.

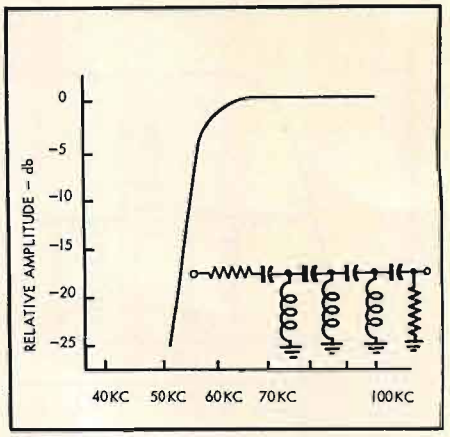


Fig. 7. Frequency response before limiter when set for 67-kc subchannel.

As it is turned further, the multivibrator will fire solidly once for each cycle of the subcarrier producing an undistorted output. As the tap is turned still further toward ground, the oscillator will again be unstable since the multivibrator will try to fire twice for each cycle. The proper setting can be determined by listening, and should not be critical. If this setting is found to be critical, it is probable that full limiting is not occurring and the situation can be improved by taking the usual steps to increase signal strength to the receiver, such as using a better antenna. Insufficient limiting in the translator will also be indicated by excessive crosstalk from the main program into the subchannel program.

Even in the best installations a slight amount of cross-talk from the main channel is perceptible when there is no modulation on the subcarrier to mask it. The commercial translators incorporate a muting circuit which is operated from the transmitter to eliminate the crosstalk during the silent intervals. This operation is accomplished by turning off the subcarrier when it is not being modulated and the amplifier in the receiver is keyed on and off by a resonant circuit tuned to the subcarrier frequency. The multivibrator in the circuit shown here automatically performs this function. When the music stops a slight click will be heard, followed by complete silence. Then later another slight click precedes the music as the subcarrier is turned back on. If the translator does not go silent when the subcarrier is turned off the level on the multivibrator cathode potentiometer is probably set too high. In some cases where the signal at the output of the FM receiver is too high, there may be no setting of the potentiometer which will quiet the translator in the absence of the subcarrier. This can be remedied by increasing the input resistor to reduce the signal. A variable attenuator on the order of one megohm may be found useful at the input of the

(*Continued on page 97*)

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A Variable Stereo Suppression Control

Improved performance from stereo records and tapes can usually be obtained from a device which puts the control of the over-all stereo effect in the hands of the listener, providing what is often called a "blend" control. The author's suggestions are easily followed for almost any installation.

JOHN E. D'ERRICO*

AT FIRST BLUSH, the idea of suppressing stereo might seem to be outright heresy—throwing away the three-dimensional quality for which we paid so much. But there are many conditions calling for a slight mixture or even a complete fusion of the two channels.

Complete fusion is the simplest case, and is attained by connecting one channel directly to the other at an appropriate point. Thus, stereo cartridges may be made to play monaural records by tying together their "hot" leads. *If this is not done,* the vertical undulations of the record and the vertical rumble will be reproduced. Tying the leads causes these undesirable components to be self-cancelling without detracting from the musical program. (Cf. instructions with Electro-Voice Model 21D stereophonic cartridge).

It is essential, then, to provide some kind of shorting device to take care of monophonic records. (This is done at present in H. H. Scott's Stereo-Daptor, Model 135). The same device may be used with a stereo record to show our friends and customers the difference between a true stereo program and a monophonic program played through two speaker systems.

Now, instead of providing a simple shorting switch between the two channels, let us use a variable resistor. For most cases, this will be a 0.5-megohm linear potentiometer, with the arm connected to the top of the volume control on one channel, and the clockwise terminal connected to the same point on the other. The counterclockwise terminal is not used, nor are there any taps. A switch can be put in series with the control to isolate the channels completely, for there is some leakage, even when the resistance is at maximum.

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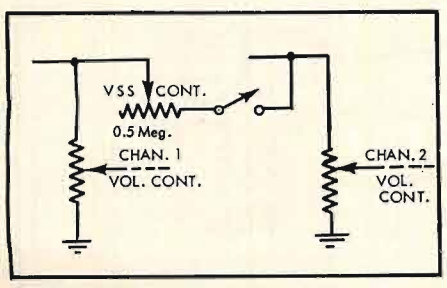


Fig. 1. Simple variable-stereo-suppression control.

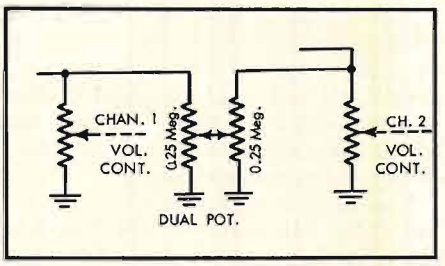


Fig. 2. Self-isolating variable-stereo-suppression control. The central ground permits no "bleeding" of channels when the control is at minimum.

A more elegant control which needs no switch for complete isolation is shown in *Fig.* 2. Two ganged potentiometers of 0.25 megohms each are used, with the sliders common, the clockwise terminals connected as shown, and the counterclockwise terminals grounded.

In either the simple or the self-isolating control, a clockwise rotation will cause the stereo program to cover a smaller and smaller area between the speakers, finally ending up emanating from a point between them (if they are well matched).

To what purpose? First, some "stereo" recordings are almost completely synthetic: one group of instruments plays the melody from one speaker, while the rhythm accompaniment chatters from the other. (Cf. Audio Fidelity's *Dukes of Dixieland* Stereodise). This serves well to show lack of crosstalk, and is spectacular for a while, but may become tiresome for listening after two or three times. So we turn the variable stereo suppression control until the group occupies the entire space between the two speakers.

A second indication arises in the case of speakers which are spaced too far apart. In many cases, stereo suppression may help to fill the void in the center.

Mismatched speaker systems provide a third reason to have stereo suppression available. The owner of an expensive three- or four-way system may not wish to invest in a matching top end. Since there are many peaks in three- or four-way systems, mismatch may cause musical instruments near the center to be emphasized first on one speaker, then the other. Offhand, it would not seem that variable stereo suppression would help this condition, but in practice, the "tightening up" of the two channels seems to help considerably. If the flitting from side to side is not actually reduced physically, it is reduced psychologically. Thus, a judicious mixing of the two channels may give less stereo effect, but more stability and less fatigue.

Installation in Non-integrated Systems

The listener who has two separate control panels needs an integrating device in any case. He will usually enter the circuits at the tops of the volume controls, leading out to a set of ganged volume or loudness controls in a separate cabinet. The variable-stereo-suppression control can be tied across the circuits at this point. A workmanlike installation will use two wires in separate shields. The cable must be of low capacitance if the impedance is high, and

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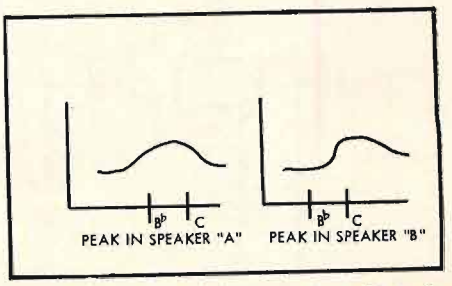


Fig. 3. As center violin goes from B♭ to C, it seems to change position from one side to the other.

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A Stereo Compatibility Translator

HERBERT M. HONIG*

For complete flexibility for all sorts of stereo sources, try this simple amplifier-and-switching circuit which may be built as a separate unit or incorporated in a home-built preamp.

A TRULY COMPATIBLE stereo reproducing system requires flexibility in conversion of vertical/lateral groove excursions, 45/45 groove excursions, left-right stereo signals, and sum-difference stereo signals. Fortunately such flexibility is easy to obtain; a simple, low-cost, two-tube converter, designed for home construction, is shown in *Fig.* 1. This device will permit a 45/45 pick-up to respond only to the lateral component of a conventional recording, thus eliminating all vertical components resulting from turntable rumble and other noise sources. Any other conversion of left-right or sum-difference signals that may be required can also be effected.

This circuit will also permit all forms of stereo-to-monophonic conversion and provides complete flexibility in transposing left and right channels. It also permits controlling the electrical phase of one channel with respect to the other, to permit loudspeaker phasing.

Now that stereo has come of age we learn that two kinds of stereo signals can exist. One is known as the left-right signal and the other is the sum-difference signal. Either type can be used on the record, in the signal channels of equipment, or in the antenna as transmitted through the air. The left-right signal is best known, since it is found in the classic stereo system using two separated microphones driving two separate amplifiers through simple transmission and amplification paths.

The sum-difference signal has arisen from new, sophisticated techniques that promise practical solutions to many problems of commercial stereophony. This signal finds particular use in compatible stereo-monophonic systems. We

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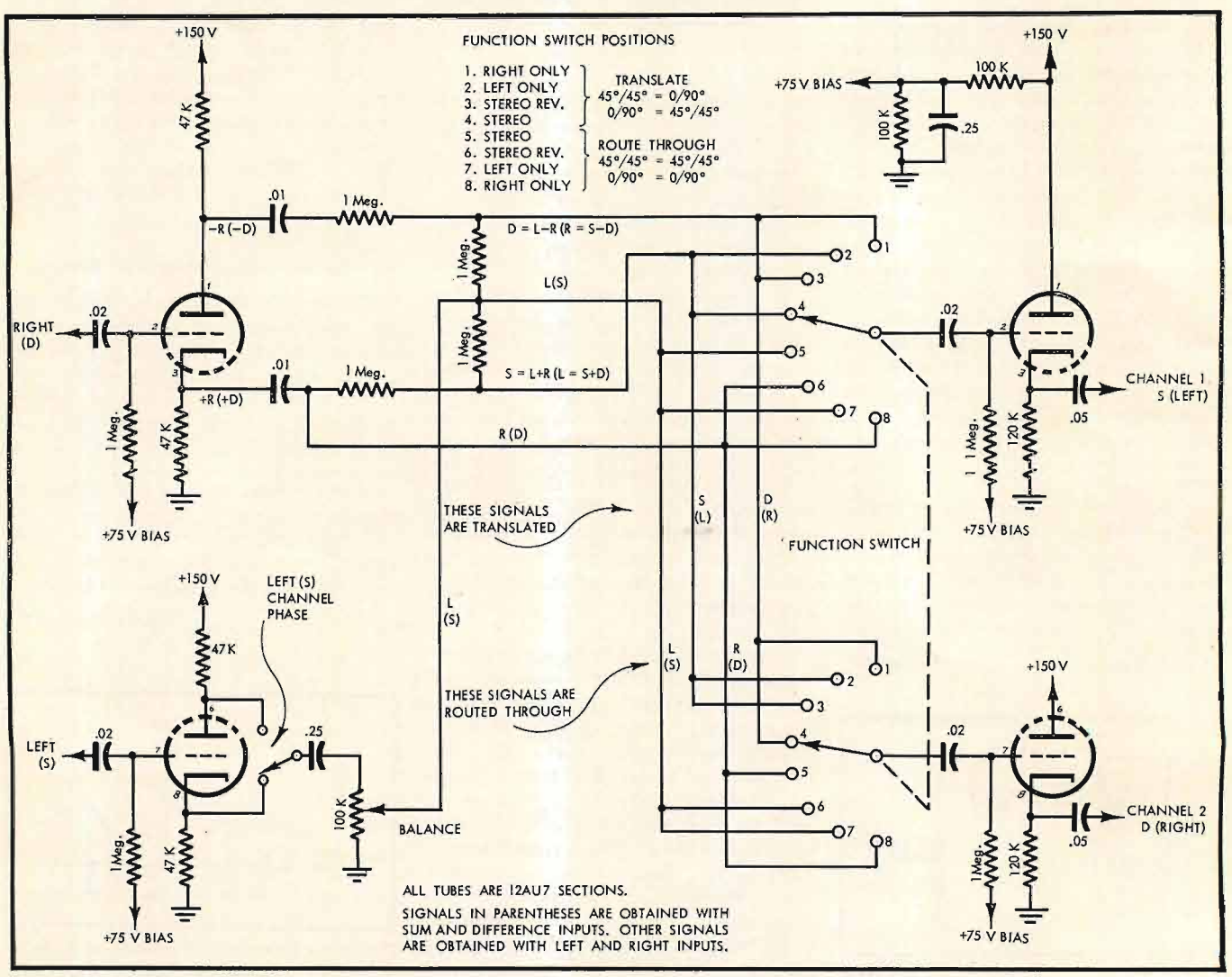


Fig. 1. Schematic of multipurpose device for complete control of all types of stereo signals.

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TABLE 1

Input source: 45/45 record to 45/45 pickup (L − R source).

FUNCTION SWITCH	SIGNALS		OPERATION
	CHANNEL 1	CHANNEL 2	
1	L − R	L − R	Monophonic mixture (D or S)*
2	L + R	L + R	Monophonic mixture (S or D)*
3	L − R	L + R	Translated stereo reversed
4	L + R	L − R	Translated stereo
5	L	R	Stereo
6	R	L	Stereo reversed
7	L	L	Left input to both outputs
8	R	R	Right input to both outputs

* Conditions reverse with operation of **LEFT CHANNEL PHASE** switch.

have already seen some interesting evidence of the usefullness of sum-difference signals in recording[1] and microphone techniques.[2]

It has also been shown[2] that the same technique used to translate from sum-difference signals to left-right signals, and vice-versa, can be used to obtain 45/45 signals from 0/90 pickups, and vice-versa. Thus a stereo pickup designed for one system can play a recording made with the other system.

The converter shown in *Fig.* 1 permits this translation, with the option of feeding signals through the stereo equipment without translation to extend the utility of any stereo system. This circuit permits considerable experimentation with stereo techniques and helps guard against equipment obsolescence. Features include provision for switching from stereo to monophonic, using either input channel to both stereo reproducers, or mixing both input channels to feed identical signals to both stereo reproducers. The left and right channels may be transposed (that is, violins may be placed on either the left or right side), and the electrical phase of the left channel may be reversed to ensure that both channels are properly phased. This latter provision permits correcting for the "hole in the middle" effect that results from incorrect phasing. Used with the translation circuit, this provision will select either a full lateral or a full vertical component from a 45/45 pickup to permit playing either lateral or hill-and-dale recordings with a minimum of noise.

[1] Goldmark, Bauer, Bachman, "The compatible stereophonic record," AUDIO, May, 1958.

[2] Boré and Temmer, "M-S stereophony and compatibility," AUDIO, April, 1958.

TABLE 2

Input source: Monaural (one vertical or one lateral track) recording to 45/45 pickup (Monaural S − D source).

Output: Monaural for all cases.

FUNCTION SWITCH	SIGNALS		OPERATION
	CHANNEL 1	CHANNEL 2	
1	S − D	S − D	Vertical or lateral component*
2	S + D	S + D	Lateral or vertical component*
3	S − D	S + D	V or L to Ch. 1, L or V to Ch. 2*
4	S + D	S − D	L or V to Ch. 1, V or L to Ch. 2*
5	L + V	L − V	Sum of both inputs on Ch. 1, cancellation of both inputs on Ch. 2*
6	L − V	L + V	Cancellation of both inputs on Ch. 1, sum of both inputs on Ch. 2*
7	L + V	L + V	Sum or cancellation*
7	L + V	L + V	Sum or cancellation*
8	L − V	L − V	Cancellation or sum*

* Conditions reverse with operation of **LEFT CHANNEL PHASE** switch.

TABLE 3

Input source: 45/45 record to 0/90 pickup such as Western Electric 9A, or 0/90 record to 45/45 pickup (S − D source).

FUNCTION SWITCH	SIGNALS		OPERATION
	CHANNEL 1	CHANNEL 2	
1	R	R	Right or left only*
2	L	L	Left or right only*
3	R	L	Stereo reversed
4	L	R	Stereo
5	L − R	L + R	Translated stereo
6	L + R	L − R	Translated stereo reversed
7	L + R	L + R	Monophonic mixture (S or D)*
8	L − R	L − R	Monophonic mixture (D or S)*

* Conditions reverse with operation of **LEFT CHANNEL PHASE** switch.

Circuit Description

The circuit consists of two phase splitters, switching networks, and separate cathode followers for each output. To show how the translation of either type signal—R − L, or S − D—to the other type is accomplished, the signal paths have been labeled with both types. The signals resulting with S − D inputs are shown parenthetically.

The right signal feeds one phase splitter to develop two signals with 180-deg. phase difference (+R and −R). The left signal feeds the other phase splitter to develop +L and −L. One of these signals is selected by the LEFT CHANNEL PHASE switch and fed through a variable gain (BALANCE) control to permit balanced outputs in both channels. A mixing network (four 1-megohm resistors) combines L with −R to give the difference signal, D, and combines L with +R to give the sum signal, S.

The result of this mixing is the matrixed outputs, D and S. These signals are the sum and difference translations of the original inputs, R and L. The original inputs, R and L, are also made available. These four signals feed a FUNCTION switch that permits multipurpose service.

Operation

The FUNCTION switch selects either the

The FUNCTION switch selects either the translated signals or the original signals and feeds them to the output cathode followers, for conventional stereo service. Either input channel—translated or not—may be fed to either output channel to keep the violins on the left or place them on the right. The phase of the left channel may be reversed, by using either +L or −L for this stereo service, by means of the LEFT CHANNEL PHASE switch.

The FUNCTION switch can also connect either input channel—translated or not—to both output channels for monophonic listening from only one input through both outputs. Use positions 1 or 2 for translation, and 7 or 8 for direct feed. Both channels may be mixed, for monophonic listening on both output channels from both input channels, by using that

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The New "Isodyne" Phase Splitter

E. F. WORTHEN*

This recently patented circuit leads to an amplifier that maintains an IM distortion value below 0.1 per cent up beyond the rated output value of the transformer employed—and practically perfect balance from d.c. to Channel 7.

EXCEPT FOR APPLICATIONS of new tubes, the apparent lack of new or refined circuitry in audio amplifiers leads one to believe that there is not much left to be invented. It is indeed fortunate that this is not true. Actually, the action of series-fed direct-coupled or capacitor-coupled amplifiers is pretty well established, but the possibilities of negative feedback are virtually unlimited. The discussion here is principally about a special phase splitter circuit and its application to a complete power amplifier. The results are outstanding. There are better amplifiers built for laboratory purposes, but their bulk and weight and phenomenal cost rule out their use in the home. The amplifier described here has extremely low distortion and very high stability at a realistic cost.

Conventional phase splitters are subject to certain faults. They normally provide low gain—in many cases less than unity—so that a driver stage has commonly been required between the phase splitter and the power output stage of large amplifiers. They are generally incapable of precise balance over a wide range of frequencies, so that unbalance must be compensated within the amplifier system by means of negative feedback. They are easily unbalanced by variation of tube constants or by aging of circuit components, even when initially perfectly balanced, and they are not readily balanced by unskilled personnel.

Requirements

A phase splitter should be inherently self balancing, both to input signals and to d.c. bias; it should be direct coupled so as to eliminate any phase shift; it should be fully balanced to ground (capacitively) at all conditions of operation; it should provide an output signal of high amplitude and low output impedance, which should be balanced on both sides; and it should be capable of employing only two tube envelopes. To develop such an inverter was the object of the writer's work.

Figure 1 shows a direct-coupled series-fed circuit using a 12AX7. It has high gain, no capacitors, and its output is from a cathode follower. The problem was to merge two such circuits into a successful phase splitter. Going through intermediate stages, we arrive at *Fig.* 2. However, this circuit is difficult to keep in balance at high signals, when d.c. bias varies so much that distortion is prohibitive. *Figure* 3 is an improvement, but as yet the first half of each side is still not balanced to d.c.

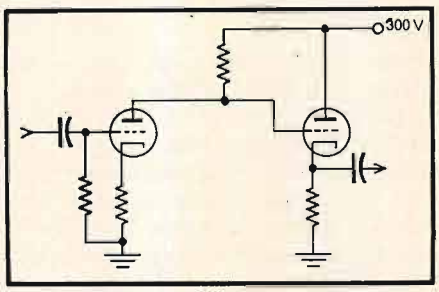


Fig. 1. First step in developing direct-coupled phase splitter was the single-ended two-stage amplifier using a 12AX7.

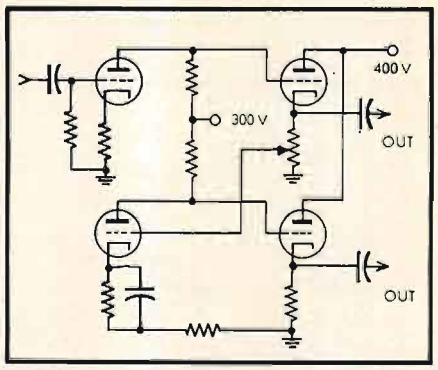


Fig. 2. Two circuits similar to Fig. 1 are combined, with the input signal for the lower section derived from the cathode circuit of the upper.

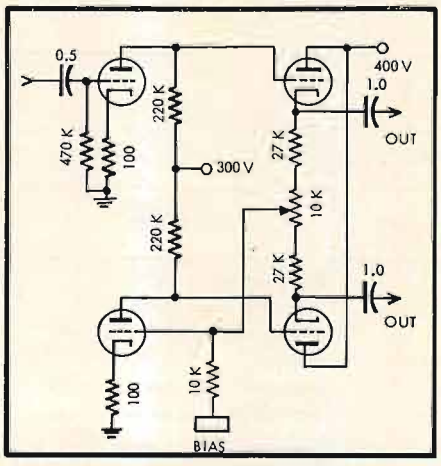


Fig. 3. The third step approaches balance to a.c., but not yet to d.c. bias.

Figure 4 approaches a solution. Amp. #2 seems satisfactory, but Amp. #1 is not sufficiently identical to provide reliable balance throughout its operation. However, if resistor X—the grid resistor for the first half of the phase splitter—is returned to signal ground through the bias control, both halves of the circuit are operating with the same d.c. conditions. Results were beyond expectations. It is now only necessary to adapt this circuit to a complete amplifier, as it is in *Fig.* 5. In the meantime, the advantages of the phase splitter by itself were sufficiently important to warrant filing a patent application. After due course, U. S. Patent 2,833,871 issued to the writer.

R_7 in *Fig.* 5 serves as an a.c. balance control, while the bias is controlled independently. Referring to a typical amplifier using this phase splitter, R_7 is the signal or a.c. balance control, while R_{26} adjusts the d.c. bias on the input stage. It can be seen that resistor R_{24} is floating between the grids of the opposite amplifiers, the junction point (the arm of R_7) is free to appear at the point which represents balance for the particular signal at which the circuit is operating. This freedom is an important factor in the over-all stability of the phase splitter.

The phase splitter alone is capable of driving directly a Class AB or Class B push-pull output stage, and since the output from the phase splitter is derived from a cathode follower its impedance is low. All elements are direct coupled up to the input of the output stage so there is an absolute minimum of phase shift. Balanced operation up to a frequency of 1000 kc can be achieved easily.

The Amplifier

Figure 5 is the complete circuit of an amplifier employing the phase splitter de-

* *Worthen Labs, 152 Avon St., Manchester, N. H.*

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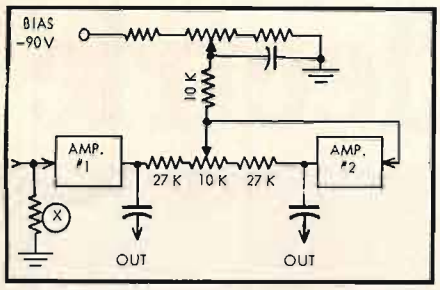


Fig. 4. Circuit of Fig. 3 in block schematic form.

scribed. The pentode section used for the first stage provides considerably higher gain than the triode used as an example in describing the operation of the circuit. R_{26} adjusts operating bias for the first stage, and should be set at approximately 2 volts. R_7 adjusts for a.c. balance of the phase splitter, and once R_{26} and R_7 have been adjusted, they usually retain the adjustment indefinitely. C_4 should have a value of 1500 μμf, and C_8 should be 82 μμf; there is no C_7 or C_9. R_{20} has a value of 750 ohms for the transformer specified when working at 16 ohms. The transformer may not be critical to the circuit, but as with any tetrode or pentode power amplifier using feedback, the components in the feedback circuit may require adjustment with a square-wave generator and an oscilloscope. The screens of the two 6AN8's should be operated at 60 to 62 volts, while the plates should measure around 95 volts. At the power supply, the output-stage tap is 470 volts; the plates of the triode sections of the 6AN8's should be 410 volts, and the voltage at the junction of R_4 and R_5 should be 300 to 310 volts. Bias on the output stage measures at 37 volts on the grids, and is adjusted by R_{22}; R_{12} balances the plate current in the two output tubes. It may be necessary to select two 6AN8's to get a good balance between them, but once balanced they should remain so.

There is no reason why this amplifier could not be constructed with output transformers other than the one specified, but the characteristics of transformers vary appreciably, and some of the circuit constants would have to be readjusted.

In layout, it is important that leads should be as short as possible. The coupling capacitors leading from the cathode followers should go direct to the output stages without crowding to ensure a good capacitive balance. It is desirable that the a.c. balance control, R_7, be located between the phase splitter tubes, and R_{26} should be close enough so that R_{24} runs directly between the arms of the two pots.

Performance

Measured IM distortion on the amplifier was below 0.2 per cent up to 30 watts, reaching 0.6 per cent at 45 watts, and 2 per cent at 51 watts. Frequency response is within ±0.5 db from 10 to 10,000 cps (for the phase splitter alone it remained balanced and "flat" to over 1 mc). An input signal of 2 volts is necessary to overcome the very heavy feedback and drive the amplier to a 50-watt output.

The amplifier described—as well as the phase splitter itself—is not commercially available, but its performance makes it well worthy of investigation by the advanced experimenter. *AE*

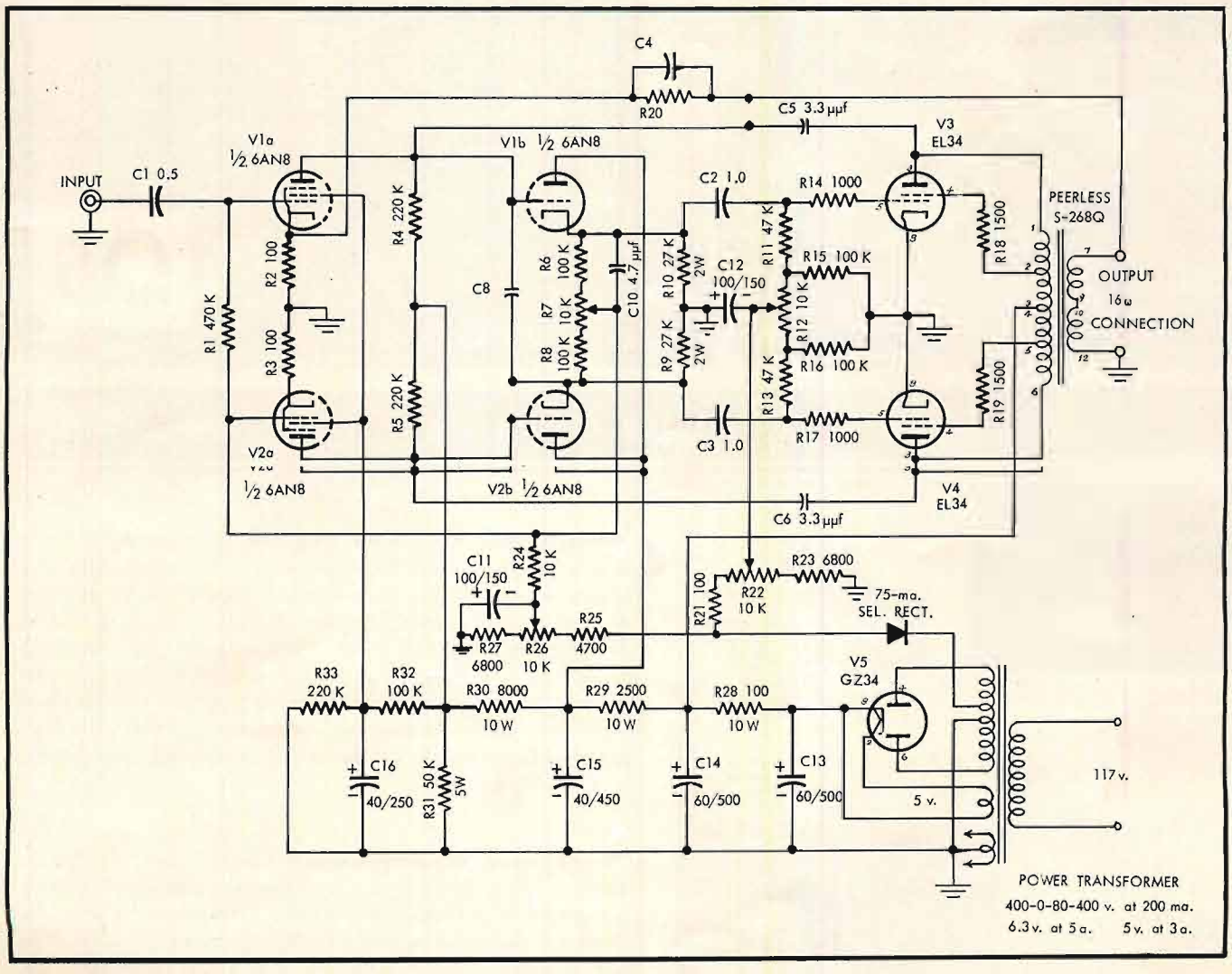
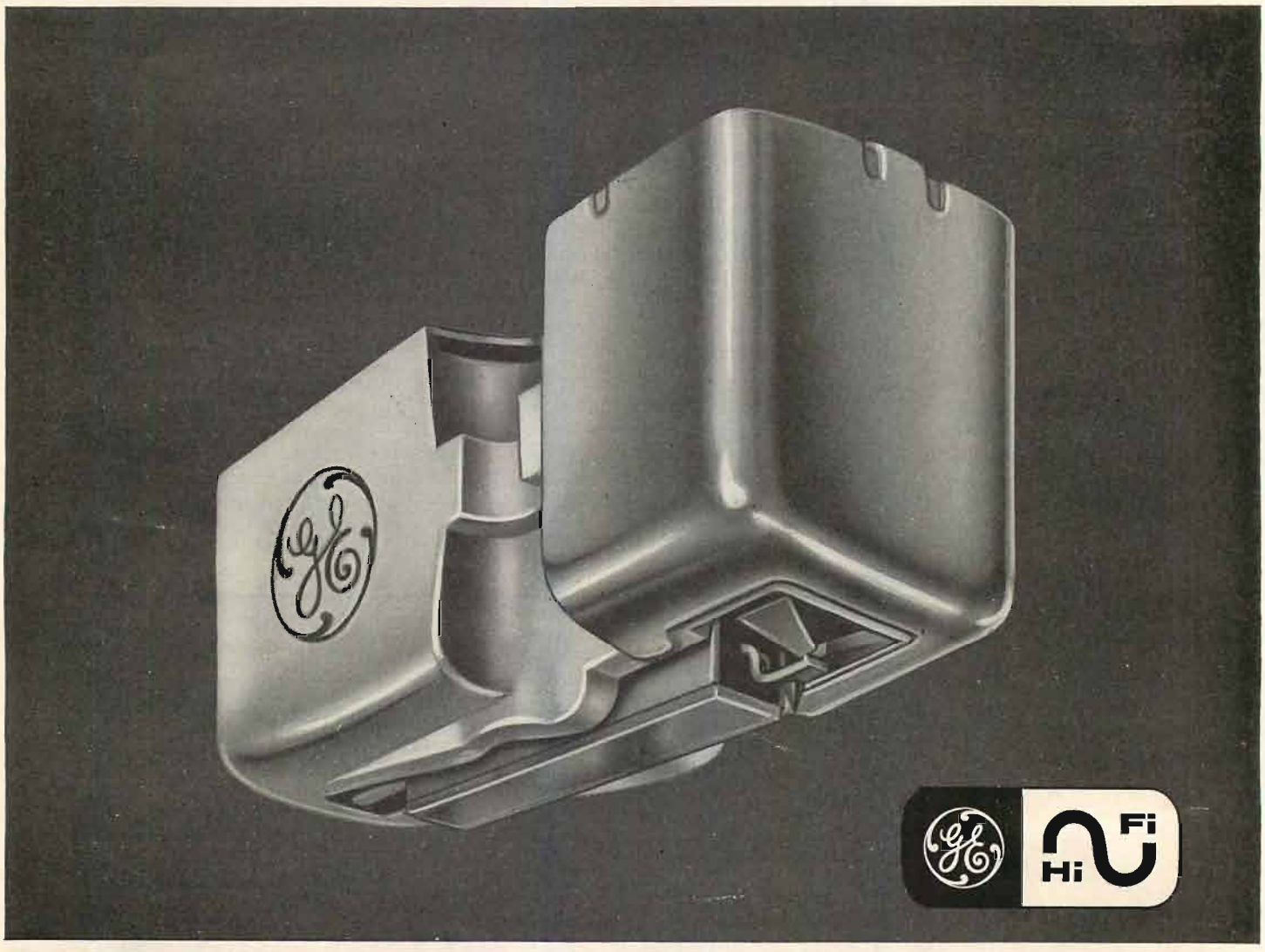


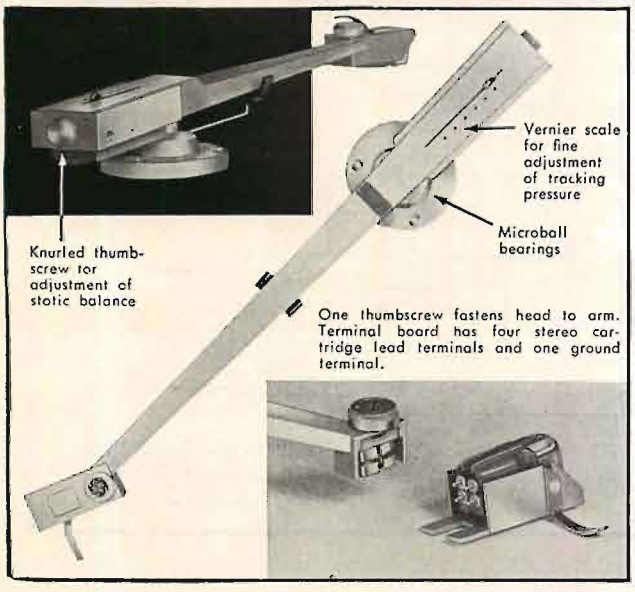
Fig. 5. The complete amplifier using a pair of EL34's in the output stage reaches a new low in distortion and unbalance.

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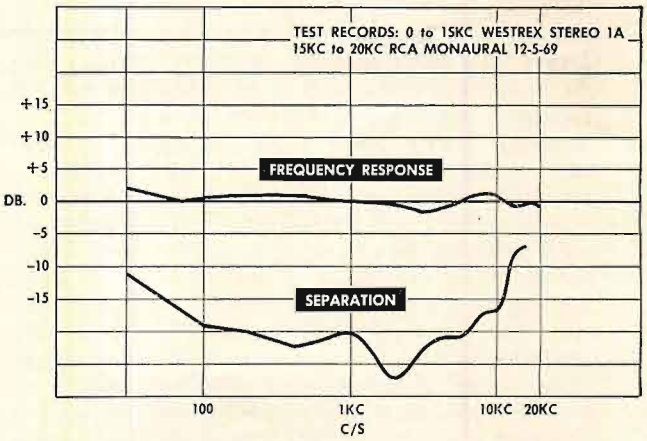
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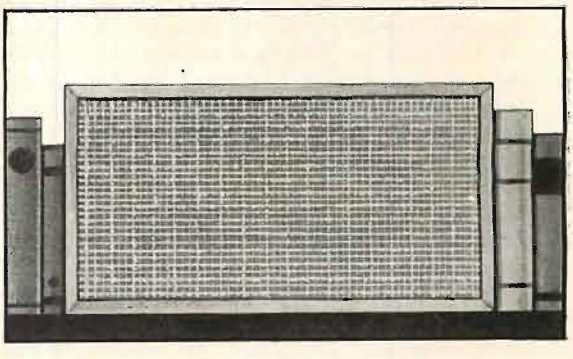


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Manufacture of a High-Quality Cartridge

RUBEN E. CARLSON*

The mechanics of a stereo pickup are fairly simple in theory, but when the dimensions must be maintained to accuracies on tens of thousandths on parts measured in thousandths the construction problem is somewhat complicated.

EVERY PHONOGRAPH in use today—well, almost—employs some kind of electro-mechanical transducer in order to get an electrical signal from a record groove and that means that there are millions of them. But only engineers call them transducers. The public knows them as pickup cartridges, or, more commonly, just as cartridges. In spite of the fact that there are so many pickups in use, very little has been written, at least for the general public, about the manufacture of these intricate and interesting devices. The following short outline will give some idea of the sort of problems associated with the manufacture of a precision quality phonograph pickup, and with the design of a new cartridge for stereo use.

As is well known in the industry, Fairchild Recording Equipment Corporation has for many years designed and manufactured phonograph pickups (as well as other audio and playback equipment). While Fairchild is, of course, not committed to the manufacture of any one type of cartridge, it is also well known that most of its pickups have been of the moving-coil type, and hence it will probably not seem surprising that in stereo pickups, Fairchild has again selected this design as capable of a high quality of sound production.

Moving coil designs differ from other magnetic types (variable reluctance or moving iron) in that the coil moves in a magnetic field exactly like a tiny generator of electric current (which of course it is) and this motion produces a voltage output which is proportional only to the velocity of the coil motion and not to the displacement. Hence it is inherently linear and if carefully constructed is capable of an extreme degree of fidelity. Since it is also a rugged mechanism it offers great rewards in return for the patience and skill required of the builder.

Stereo Recording Fundamentals

For those who have not had opportunity to think about the mechanical problems associated with the playback of stereo records, a few words of introduction may be helpful. It is doubtless well known to this magazine's readers that the stereo recording method universally agreed upon is that known as the 45/45 system, so called because the two channels of information are recorded neither vertically nor laterally, but at an angle of 45 deg. to both, and hence at an angle of 90 deg. to each other. The only other practical arrangement would be vertical-lateral (vertical stylus motion for one channel, and horizontal, or lateral motion for the other) and this indeed has not only been proposed, but actually used. The final decision in favor of 45/45 is based chiefly on the fact that in this system all properties of the recording (good and bad) are identical for each channel which they cannot be in any other geometric arrangement.

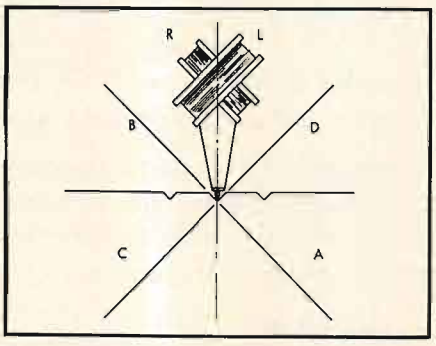


Fig. 1. "Schematic" arrangement of coils in the Fairchild moving-coil stereo cartridge.

An interesting problem presents itself here, and one which may not be widely understood, for if the stylus is to be pushed up or down a 45 deg. slanted path for one channel, and *simultaneously* pushed up or down a second path at right angles to the first, then some combinations of these pushes will produce vertical motion, some will produce horizontal motion and, of course, some will give intermediate ones as well. The exact direction will depend upon the phase relation between the two signals.

As far as the stylus is concerned, therefore, we have just two basically different motions into which all others may be resolved: vertical and horizontal (or lateral). All motions of the stylus can be resolved into some combination of vertical and lateral components. The reason is very simple. Gravity acts in a vertical direction and has an effect on the operation of the stylus when moving up or down, but gravity has *no* effect on the action of the stylus when moving laterally, since it is acting at right angles to the lateral plane of motion and can therefore have no component of force in this direction. Therefore, even though the two *channels* are recorded 45/45, the two *motions* which must be traced are vertical and lateral.

These points are of importance to this whole problem, because a good stereo pickup must (even in the 45/45 system) be a good vertical pickup as well as a good lateral pickup. Vertical pickups have not been much used since the days of the Edison record for home phonographs, but until fairly recently much use has been made of the system in making transcriptions for broadcast use (and in the early days of sound pictures, for the sound recording). The system is known also as the "hill and dale" type of recording since the stylus goes "up hill and down dale" to produce the electrical output. Lateral pickups are, of course, the conventional type used in all of today's recordings; and in this system the stylus is pushed from one side to the other by the two sidewalls of the groove. Making a good pickup for either system is not easy, but making one which is excellent for *both* types of recording simultaneously is indeed a Herculean task.

To illustrate by means of a somewhat more familiar example, the hill and dale stylus travels along the recording much like the wheel of an automobile going up and down over roadway bumps. This ultra-miniature "automobile" must zip along over some of the worst road surfaces imaginable, without doubt, and it must do so without producing the faintest ripple in the automobile "body"—in this case, the *phono arm*. In addition, the "wheels"—or the stylus—must never leave the "ground" or the record groove.

In the case of the lateral record, the

* *Fairchild Recording Equipment Corporation, 10-40 45th Ave., Long Island City 1, N. Y.*

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stylus is something like a bobsled going along a winding course with such turns as to make even the stoutest-hearted expert wince. For, if the bobsled were to go 100 miles per hour around a corner of radius 100 feet, it would surely be considered a most hazardous course. This amounts to about a 7 "g" acceleration, and would require a banking angle of about 82 deg. But, in the case of the innocent looking phonograph record, accelerations of up to 1000 "g" are frequently encountered! An 8- or 10-g pullout is considered rough for combat airplanes. Col. Stapp, in his famous acceleration tests in a rocket sled at Edwards Air Force Base found that accelerations of 10g, even under ideal conditions, were likely to cause some physical damage. Very few applications run as high as 100g and as for 1000g, suffice to say that many experts in other fields demand proof when such accelerations are mentioned. And yet, it is quite true that they exist, and that these accelerations must be withstood by extremely small components which are also expected to *follow* the action without a variation of even as much as a hundred thousandth of an inch, or there will be (you guessed it) *distortion.* Yes, it is a bit of a problem.

Pickup Design

In approaching the design of the miniature precision bobsled-automobile combination which the stereo pickup resembles, basic design factors must of course be considered. The inertia of the moving parts (or the "moving mass") must be kept small, and the compliance high. The damping must be a minimum but still control the "rebound" of the "wheels" and in stereo pickups the damping, mass and compliance should be kept approximately equal for all directions of motion. But beyond this, experience in dealing with such exceedingly minute motions must be brought into play, for in this area exact mechanical measurement of every quantity often is not practicable. In many cases, the equipment needed does not even exist. Hence a considerable amount of information must still be *deduced* not only from test results, but also from rather subjective listening tests, and a certain amount of "cut and try" engineering is almost inevitable.

Many models were built by Fairchild before arriving at the design described here, an outgrowth of the Model 603 which holds the distinction of being the first stereo cartridge ever to be made commercially available. While its price was high ($250 including arm), it served a very valuable purpose in testing early stereo recordings so that studios could have a reasonable idea of how the records would sound in actual use. The following descriptions apply principally to the 603 and to the later XP-4 cartridge.

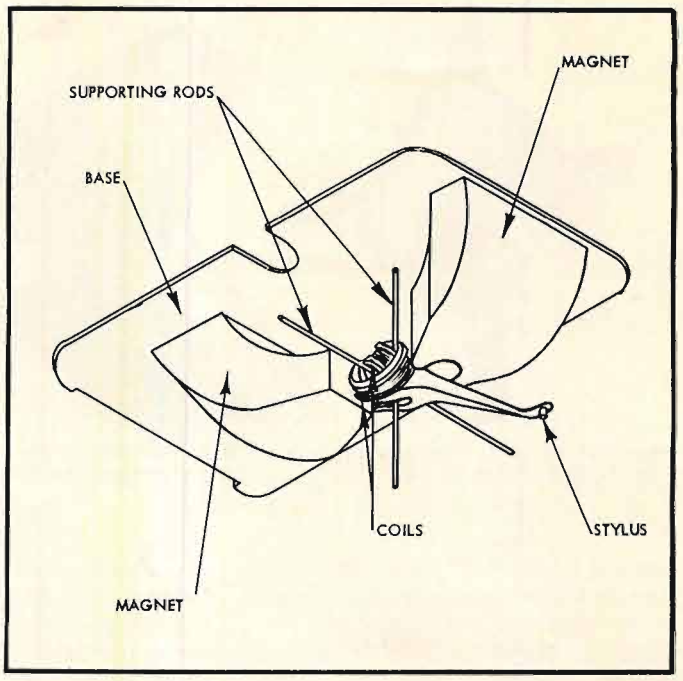


Fig. 2. Physical arrangement of coils, stylus arm, and stylus in relation to the magnet assembly.

Figure 1 shows the arrangement of the coils with respect to the record grooves and modulation. It will be seen that coil *L* must be pivoted to give maximum rate of change of flux when the stylus moves along the line AB, with coil *R* doing the same when the stylus moves along CD. Also, coil *L* must give *no* output (and hence have no rate of change of flux) when the stylus moves along CD. These conditions are met if the coils are mounted at right angles, and oriented to the stylus arm *SD* as shown in *Figs.* 1 and 2. The degree of isolation between channels is therefore determined by the accuracy with which the coils can be placed at right angles to each other and parallel to the groove walls. The equality of signal from the two channels is determined by the uniformity of the field and of the motion of the coil assembly. This requires some sort of "universal-joint" suspension for pure motion.

Figure 3 shows the suspension system for an early made Fairchild stereo pickup. Since it is more important to get such parts made quickly rather than by the method which may ultimately prove most economical, all of the various parts required for this prototype cartridge were hand-made in the Engineering Model Shop. The coils (here shown without wires for clarity) are supported by the two thin rods which pass through the central coil support. This coil support is also shown enlarged, (A) in *Fig.* 4, with about 40 times magnification, while (B) shows the head of a common pin at the same magnification, for purposes of comparison. Incredible as it may seem, these pieces are made to a drawing. They are turned on a lathe, shaped and finished, and then drilled with two holes which are 0.006 inches in diameter and at right angles to each other, with the centers of the two holes passing each other only 0.0065 inches apart. (Although such manipulations would seem to be almost impossible, they are everyday tasks for these Model Shop technicians, who take such outlandish requests in stride.) The "rods" are passed through these holes, in which they are a tight fit, and cemented. The entire coil assembly is then fastened to this single-point suspension and secured to the mounting frame shown in *Fig.* 3 to form a complete sub-assembly.

Production Model Design

The same basic design has been retained in later pickups, but instead of a hand-made cylinder with holes accurately drilled for locating the supporting rods, a piece of molded rubber is used and the

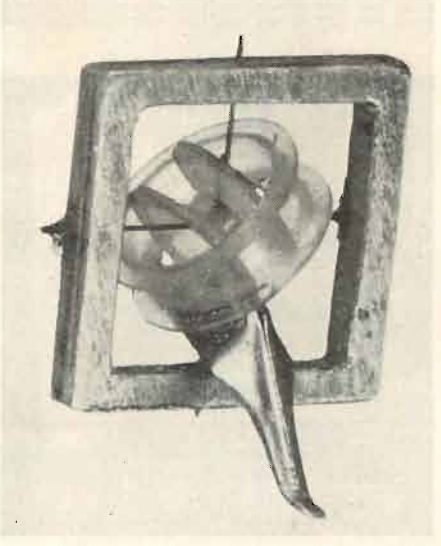


Fig. 3. Photograph of the coil assembly shown in Fig. 2.

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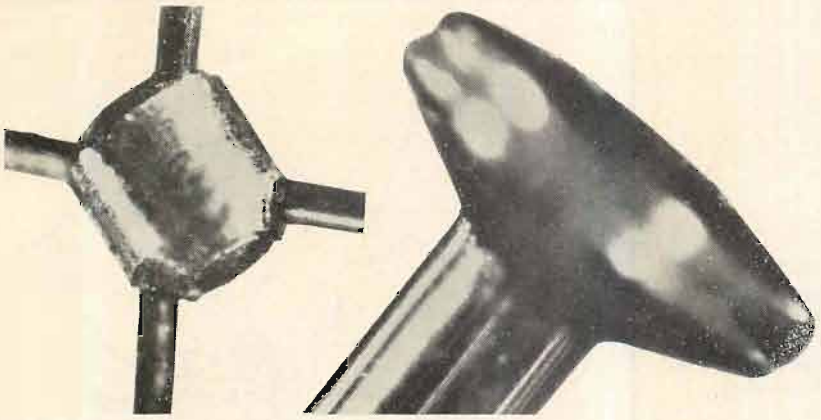


Fig. 4. (A), left, microphoto of center piece, approximately 40 times actual size. (B), right. Head of a common pin to the same magnification for comparison.

accuracy is obtained by jigs which align the rods before they are pushed through the rubber piece. In this way, the accuracy of an expert machinist is made applicable to many finished units instead of one. *Figure* 5 shows one of these jigs. The rods, which actually are like fine wires, are first given a very sharp point and then placed in the jig as shown. Since the area presented to the rubber is extremely small, the resulting pressure is enormous and the rods can be pushed through with ease. But in actual use, the total force (which is designed to be a maximum of 4 grams) is distributed over a relatively large area and is well within the elastic limit of the rubber.

The wire from which these miniature rods are made was the subject of a lengthy search before the right material could be found. Most wire will kink or curl and will resist any efforts at straightening or, if it will retain its "rod" properties in these diameters, it is too brittle. The wire finally selected is a special alloy and is very tough but also resists kinking to a remarkable degree.

The search for the best types of wire and its handling in the shop is indeed one of the large problems facing a manufacturer of small precision devices such as pickups. For example, many years ago considerable trouble was being experienced with failure of coils due to corrosion of the wire. Such failure is not only highly annoying to the user but expensive to the manufacturer, for a manufacturer of integrity must replace on warranty all such failures which are clearly due to causes not in any way under the user's control. Fairchild's solution to this problem has been the adoption of a special wire consisting of a copper-silver alloy that is triple gold-plated, then enamelled. Because gold is so inactive a metal, this wire has solved the corrosion problem almost completely, the number of failures from this cause being practically zero. But the cost of such wire is very high—in fact, it is approximately $24,000 per pound. Pure gold being worth about $960 per pound, this wire is approximately 25 times as costly as gold!

This special wire is used exclusively in all Fairchild cartridges, and in the stereo cartridge the wire used has a diameter of 7/10 mil, or 0.0007 inch. This is literally finer than a human hair (actually a human hair is about three or four times as thick), and such wire requires extremely delicate handling. Since the breaking strength of this wire is 12 grams, two nickels could be supported by it, but not three (a nickel weighs about 5 grams) and original wire-handling devices had to be worked out for making these coils. *Fig.* 6 shows this prototype coil winding machine, which handles all accelerations of the wire and spool without a bobble and winds uniformly spaced and accurately filled coils.

Another device which required considerable attention was the stylus arm itself. It is well known that all weight must be kept to a minimum in the moving parts of a pickup, but it is equally true that the moving parts should be absolutely rigid, for any flexing or lost motion will result in resonances, loss of frequency range, distortion, and many other problems. The stylus arm, having to transmit forces associated with accelerations of up to a thousand g's, must obviously be carefully designed or part of the stylus motion will be lost in the stylus arm instead of being passed on to the coil (or other generating element). The shape adopted is a compromise between the structure theoretically offering the greatest stiffness per unit of inertia (or moving mass) and the requirements of mounting a diamond of finite dimensions, instead of a point. It must also take into account the practical requirements of *efficient forming* of the metal in production. The final shape is as shown in *Fig.* 2 and the material is an alloy of magnesium with nearly all the desired properties.

(*Continued on page 94*)



Fig. 6. Coil winding machine for pickup coils.

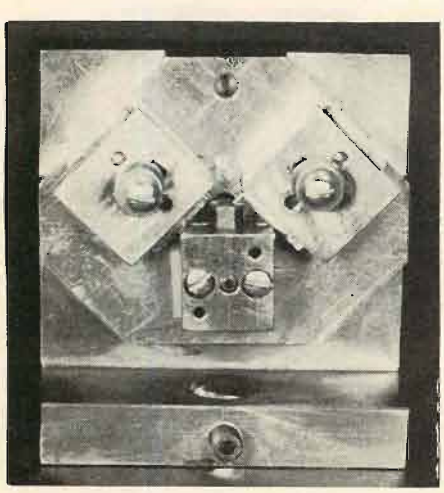
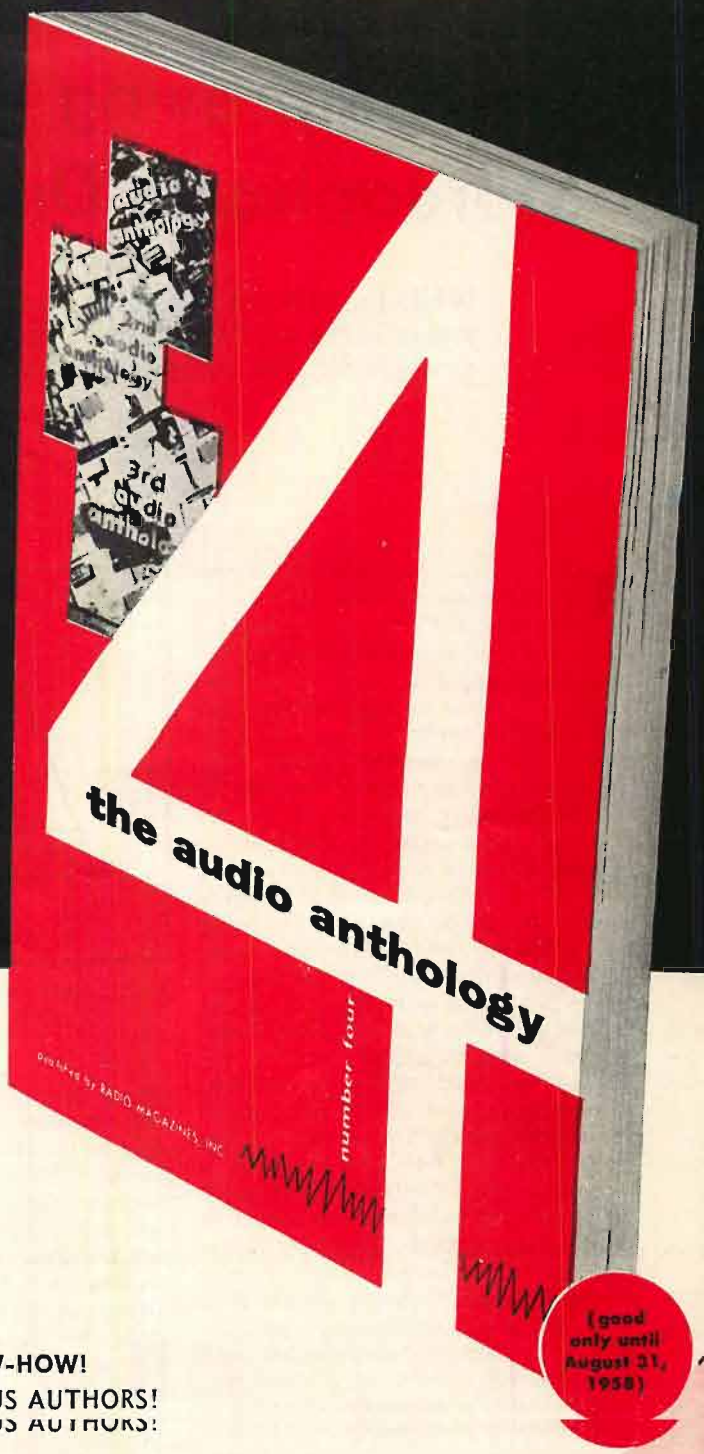


Fig. 5. Jig for inserting wires through rubber center piece.

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Improving Performance of Stereophonic Disc Playback Systems

While the difference is not as great as might be expected, there is still some increase in the rumble and noise output from a stereo pickup as compared to the monophonic. The author tells what steps may be taken to minimize the trouble.

B. B. BAUER*

ANYONE DOING EXPERIMENTAL WORK with disc stereophonic systems soon discovers that they tend to show up design and equipment faults more readily than the monophonic systems. For example, rumble tends to be exaggerated and acoustical feedback is more likely to arise in the former than in the latter. Therefore a greater care is required in the selection of equipment and in the design and construction of stereophonic systems than was customarily expended on a monophonic system. It is the purpose of this article to explain the problems which are apt to occur and to suggest some solutions for these problems.

The perception of rumble and the inception of feedback in any phonograph playback system is tied in with the signal-to-noise ratio of the disc, which in turn depends upon the modulation of the record groove. The commercial releases of stereophonic discs recorded in accordance with the latest advances of the art have a modulation level equal to or near that of the contemporary microgroove records.[1] Despite this fact some stereophonic playback equipments tend to exhibit a less satisfactory signal-to-noise ratio than that experienced with monophonic equipment of similar type. This tendency is especially apparent in This tendency is especially apparent in the case of conversion of existing monophonic to stereophonic players by the owner or the service-man—and one may expect many such conversions to take place in the months to come. Thus, the importance of using properly engineered equipment and components and the selection of records mastered and processed by the most advanced techniques is readily apparent.

Rumble Sensitivity

That a stereophonic pickup is apt to be more sensitive to rumble than a monophonic pickup becomes quite obvious if one considers that the latter responds only to the motions along a horizontal *line* at right angles to the groove, while the former responds equally well to any motion in a *plane* in which the stylus is designed to move. Referring to the vector diagram in *Fig.* 1 for the monophonic pickup, let the stylus move from P to Q along the line of maximum sensitivity Y-Y say, due to a rumble vibration. If a voltage E is generated by this motion then the power produced in a pickup load resistance R will be E^2/R. Next, let the motion PQ take place along a line at an angle θ with the axis Y-Y. The component of motion along Y-Y will be $PQ_Y = PQ \cos\theta$, and the corresponding voltage will be $E \cos\theta$. Therefore, the power across the load resistor is given by:

$$W_\theta = (E^2/R) \cos^2\theta \qquad (1)$$

It will be noted that θ may be any angle with respect to the axis Y-Y, not necessarily confined to any particular plane. A stereophonic pickup is sensitive along two sets of axes L-L and R-R at 45 deg. to the vertical, as portrayed by the vector diagram of *Fig.* 2. These axes correspond to the Left and the Right stereophonic channels, respectively. Let the motion of the stylus take place from P to Q at any arbitrary angle θ in the plane of normal stylus motion. Then, the projection of PQ in the L direction is $PQ_L = PQ \cos(\theta - 45°)$; and the projection of PQ in the R direction is $PQ_R = PQ \cos(\theta + 45°)$. Assuming that the corresponding voltages E_L and E_R are produced in the left and the right channels, then $E_L = E \cos(\theta - 45°)$ and $E_R = E \cos(\theta + 45°)$. The total power in a pair of load resistors R across the channels may be computed by the following series of trigonometric manipulations:

$$\begin{aligned} W_\theta &= (E^2/R) \cos^2(\theta - 45°) + (E^2/R) \cos^2(\theta + 45°) \\ &= (E^2/R)(\cos\theta \cos 45° + \sin\theta \sin 45° \\ &\quad + \cos\theta \cos 45° - \sin\theta \sin 45°) \\ &= (E^2/R)(2 \cos^2\theta \cos^2 45° \\ &\quad + 2 \sin^2\theta \sin^2 45°) \\ &= (E^2/R)(\cos^2\theta + \sin^2\theta) = E^2/R \end{aligned} \qquad (2)$$

Eq. (2) proves that regardless of the direction in which the stylus tip of a stereophonic pickup is deflected in the normal plane the total generated power in the load will remain proportional only to the amount of deflection.

Now, let the motion PQ transmitted to the record (and hence to the stylus tip) owing to the rumble be directed at tip) owing to the rumble be directed at an angle ϕ with respect to an axis *perpendicular to the normal plane.* The component of motion projected on that plane will be PQ sin ϕ. The total power

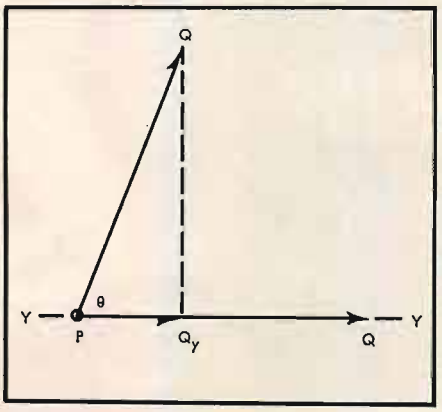


Fig. 1. Vector diagram of effect of noise on a monophonic pickup.

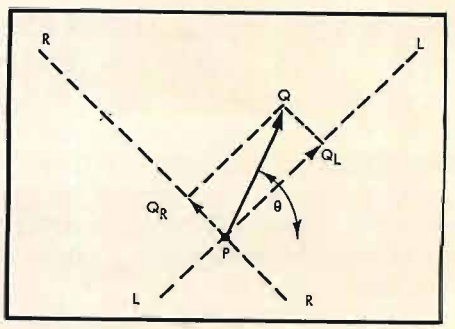


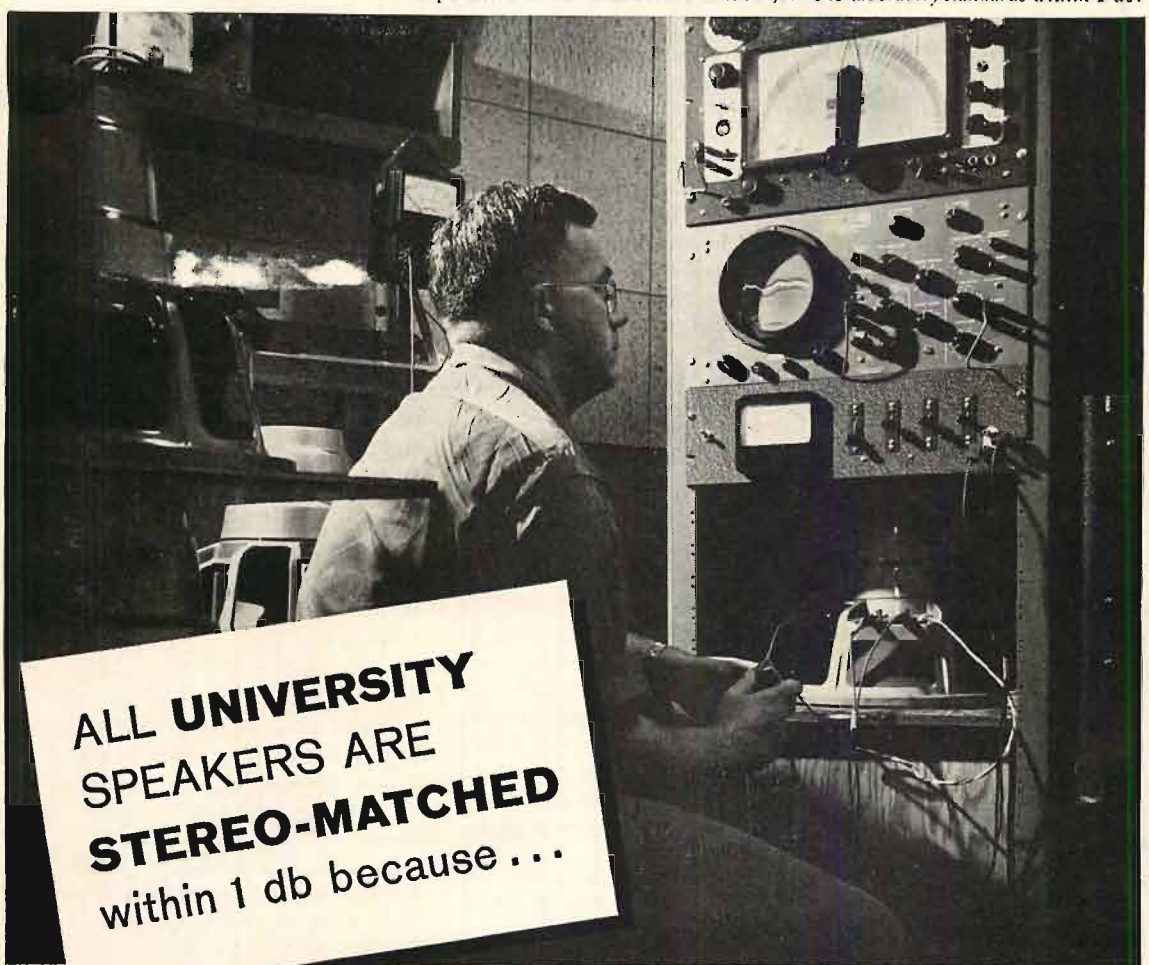
Fig. 2. Vector diagram of noise or rumble in a stereo pickup.

* *CBS Laboratories, New York, N. Y.*

[1] P. C. Goldmark and B. B. Bauer, "Problems in stereophonic disc recording and reproduction," presented at the spring meeting of the Acoustical Society of America, Washington, D. C., May 10, 1958.

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This is part of one of the four testing bays at University where each speaker that leaves the factory goes through a series of exacting tests. Here we see a Model 315-C 15" 3-way Diffaxial being tested for frequency response. As the speaker is "swept" through the entire frequency range, its audio output is fed via a sound box, microphone and amplifier to the oscilloscope where marker lines check that it conforms to laboratory standards within 1 db.



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across both load resistors will be:

$$W_\theta = (E^2/R) \sin^2 \phi \qquad (3)$$

The mathematical expectation of the rumble power may now be calculated for both cases. For the monophonic case the expectation is, using Eq. (1):

$$W_m = (E^2/R) \int_0^{\pi/2} \sin \theta \cos^2 \theta \, d\theta = (1/3)(E^2/R) \qquad (4)$$

For the stereophonic case, the expectation is, using Eq. (3):

$$W_s = (E^2/R) \int_0^{\pi/2} \sin \theta \sin^2 \theta \, d\theta = (2/3)(E^2/R) \qquad (5)$$

It is seen, therefore, that if any direction of arrival of the rumble vector were equally likely, the stereophonic player would be expected to pick up and transmit twice the rumble power of the equivalent monophonic player. To express this difference in terms of decibels, $10 \log 2 = 3$ *db*, which is then the probable increase of rumble sensitivity of a stereophonic player compared to monophonic. Many a turntable which is quite acceptable for monophonic use may not be satisfactory for stereophonic use, and therefore, selection of a high-quality low-rumble turntable is essential.

Mechanical Feedback

In many stereophonic players or conversion units the loudspeaker for one of the channels is housed in the main cabinet together with the record-changer or turntable. The vibrations created by the loudspeaker are apt to be transmitted —mechanically and acoustically—to the record and pickup, creating a tendency toward feedback, especially at low frequency. In the factory engineered players the necessary precautions are observed to eliminate this type of feedback. This is done by suitable placement of components with respect to each other, the use of wooden cleats and braces to prevent the cabinet members from vibrating, suitable isolation of the motorboard, and so on. These precautions may not be enough when a monophonic player is converted to stereophonic use because of the vertical sensitivity of the stereophonic pickup. Therefore, conversion units may experience feedback trouble where the previous monophonic operation was satisfactory.

The feedback problem may be cured in several ways. The suspension of the motorboard may be examined and found wanting. New springs or foam rubber pads may be needed to avoid any direct mechanical contact between the motorboard and the cabinet. The loudspeaker may be isolated from the cabinet proper, or mounted on soft grommets. Of course, the best way of avoiding mechanical feedback problems in home-built equipment is to mount the loudspeaker in an enclosure separate from the turntable or changer.

Since the turntable of a record changer often has a diameter of 9 inches, a 12-in. record will overhang it by 1½ inches. The flexible record edge and the compliant cartridge tip will establish a low-frequency resonant system with the mass of the pickup arm, and this system may be excited by aereal vibrations from the loudspeaker. This resonance sometimes may be cured by closing any apertures between the loudspeaker and the changer. Another helpful temporary procedure (not recommended as a permanent solution!) is to place a second record under the first to support its edge and damp the resonance.

Mixing the Low Frequencies

One of the methods which may be used to alleviate stubborn cases of rumble and feedback is to mix the right and left channels electrically at low frequency, say below 250 cps, and to depend upon the frequencies above 250 cps to create the stereophonic perspective. Subjective evaluation indicates that this scheme does not degrade the resulting stereophonic effect. It can be shown that by adding the outputs of the two channels the pickup in effect loses its vertical sensitivity and the tendency to accentuate rumble is eliminated.

A simple method for mixing the low frequencies is shown in *Fig.* 3 which portrays a ceramic stereophonic cartridge which has a common terminal A and two individual channel terminals B and C. For normal operating conditions the pickup is so connected that lateral motion of the stylus in accordance with the arrow X will generate equal potentials at B and C with respect to A; while a vertical motion in the direction of the arrow Y will generate equal and opposite potentials at B and C, with respect to A. If a resistance R is connected across the terminals B and C, then the potentials at these terminals will be unaffected for X motions, but they will tend to cancel each other for Y motions.

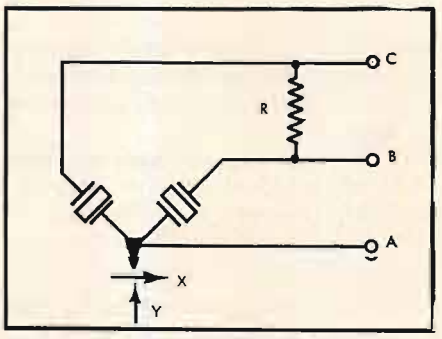


Fig. 3. Simple method of mixing lows with a ceramic pickup to decrease the effect of rumble.

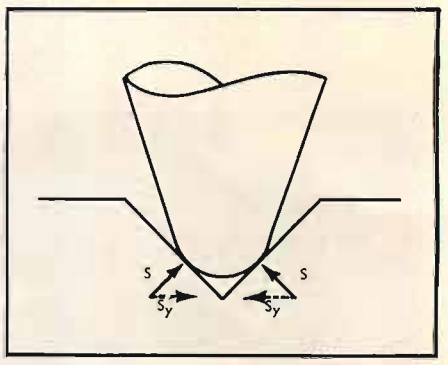


Fig. 4. Diagram of noise vectors acting on stylus of stereophonic pickup.

To achieve the proper frequency selective action R should be comparable to the capacitative reactance of the pickup and circuit capacitance C at the frequency where it is desired to achieve a mixing action—½ to 1 megohm often will do nicely, but the optimum value of R is best determined by experiment.

Surface Noise

With the latest advancement in the recording and processing techniques for stereophonic records, the surface noise is found to be equal to that of the best LP's. As a matter of fact, much of what passes for record noise is really the hiss of the master tape recorded on the record.

However, under any conditions a stereophonic pickup will reproduce somewhat more surface noise than a monophonic pickup. This may be seen by reference to *Fig.* 4 which portrays the groove and stylus and a pair of noise vectors S acting at each groove-wall. In the case of a monophonic pickup the stylus is responsive to the horizontal projection of S only, which is $S_x = .707$ S. A stereophonic pickup being equally sensitive in directions perpendicular to the groove wall will reproduce the full value of S. Therefore, the stereophonic pickup will accentuate hiss in a ratio of $1/0.707 = 1.414:1$ relative to a comparable monophonic pickup. This amounts to a difference of 3 db.

The only sensible precaution which can be used to minimize the possibility of audible hiss is by using a stereophonic pickup which has a smooth, uniform frequency response. A smooth response of the loudspeaker system is also very important. With these precautions, the hiss level on well processed discs will generally be inaudible, or in any event limited only by the hiss level of the master tape.

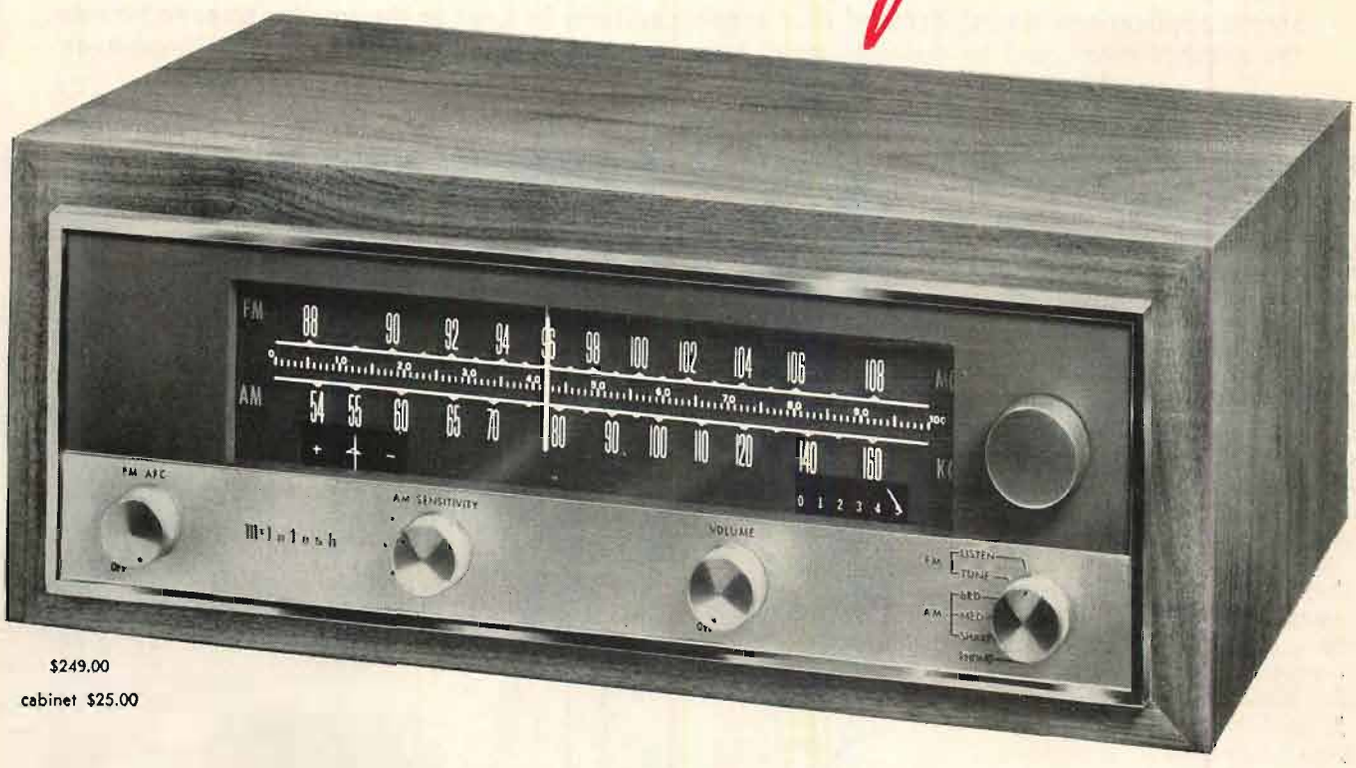
Summary

Stereophonic disc reproduction today offers the intrinsic quality of LP record reproduction with the added realism of three-dimensional sound. To achieve its

(*Continued on page 93*)

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Compact Ultra-Linear Speakers for Stereo

VICTOR BROCINER*

Stereo applications almost demand that speaker systems be kept in the smaller sizes to fit into the average room, and to maintain good bass response in small cabinets becomes important.

STEREOPHONIC REPRODUCTION, with its requirement for two sound sources, increases the importance of a satisfactory solution to the old problem: how to fit the loudspeaker into the decorative scheme of the living room. Fortunately for the audio fan who wants full-range reproduction in stereo, there are now available compact, good-looking speaker systems that provide uncompromisingly good bass reproduction, in addition to extended highs. The use of two such systems affords maximum flexibility in accommodating to the arrangement of existing furniture in the room.

Bass response down to 30 cps is attained in two typical systems—the University Ultra-Linear S-10 (shown in *Fig.* 1) and S-11—through a novel application of time-tested, proven principles. What these are is best answered by examining the desirable design parameters for good bass reproduction from a direct radiator:

1. In general, the free-air cone resonance of the speaker should be low.
2. The enclosure must not raise the system resonance above the lowest frequency to be reproduced—for the same reason.
3. The speaker must be capable of undergoing large excursions without appreciable non-linearity, to enable it to deliver appreciable power at the lowest frequencies.

The requirement for low speaker resonance is met by means of a high-compliance suspension and a fairly heavy cone. It could be obtained by either of these means alone, rather than both. However, with a light cone, the mid-frequency response would be higher than that attainable in the bass range. Since the objective of the design is the flattest possible response, the cone mass is selected to match the mid-frequency output to the low-frequency output. As a result, the over-all efficiency of the speaker system becomes low. However, this is not a matter of concern today, when moderate-priced amplifiers of 20 watts or higher rating are generally available.



Fig. 1. Typical arrangement of two Model S-10 speaker systems in a stereo set-up.

Skipping to the third requirement for the moment, linearity of response for large excursions of the voice coil is accomplished primarily by using a voice coil that is appreciably longer than the magnetic gap. Large displacements of the cone can then take place without changing the number of voice-coil turns in the gap. As long as the same number of turns of the voice coil remains in a uniform flux field, the driving force developed is always proportional to the current in the coil.

The suspension of the cone-and-voice-coil assembly is also designed to be linear for large displacements. Since this means that displacement will be linearly proportional to force, and we have seen to it that force is proportional to current, we have a system in which displacement is linear with respect to current, and requirement No. 3 is met.

Enclosure Design

The choice of enclosure is dictated by the requirement that system resonance be kept low and that size be kept at a minimum. A completely sealed box meets these conditions fairly well, since the "stiffening" effect of even a small box does not raise the system resonance much above the lowest frequencies to be reproduced. However, improved performance can be obtained with respect to efficiency and minimization of distortion, by other means. This turns out to be a version of the well-known bass-reflex principle: the ducted-port cabinet, shown in *Fig.* 2.

The use of a duct on the port of a small cabinet permits the port opening to be made sufficiently large to keep

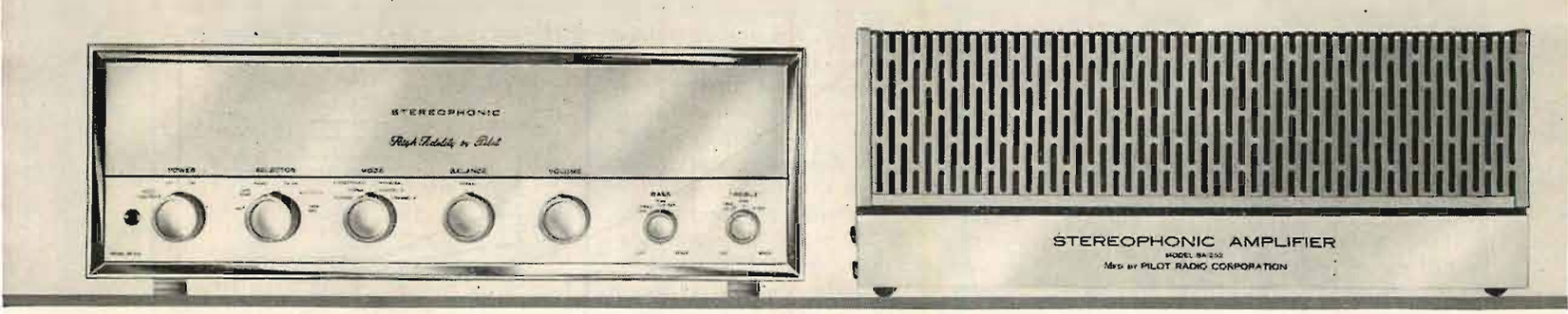
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The SP-210 is housed in a modern, low silhouette metal cabinet with brass control panel. Price is $89.50 complete, less power supply. The P-10 Power Supply is priced at $19.50.

The SA-232 and SA-260 Basic Stereo Amplifiers each consists of two identical power amplifiers. The SA-232 delivers a total of 32 watts of undistorted power (64 watts peak) the maximum power obtainable without exceeding the tube manufacturer's specifications. The SA-260, with 60 watts of undistorted power (120 watts peak) is well within operating characteristics of the output tubes. Both units have power tap-offs for operating the SP-210.

The SA-232 is priced at $89.50, and the SA-260 at $129.50. Both are supplied with brass finished metal covers. (Slightly higher in West.)

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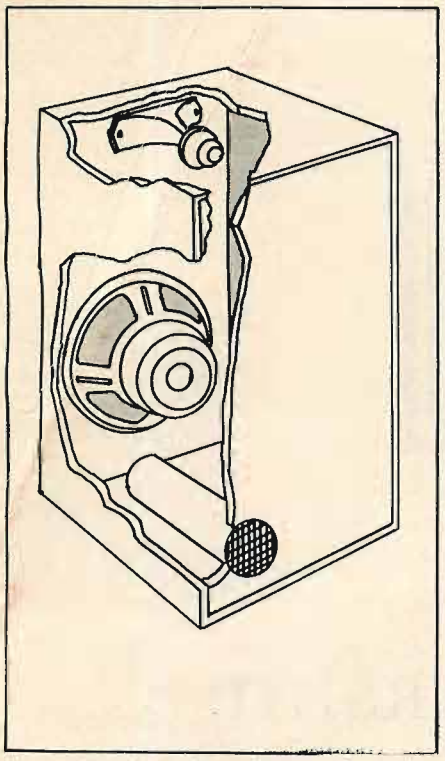


Fig. 2. Phantom view of type of speaker described by the author.

losses due to viscous friction sufficiently low for proper phase inversion.

While this means of enclosing the speaker is certainly not new, the design principles followed are different from previous methods. It will be recalled that the usual procedure for the design of a bass-reflex box has been to tune it to a frequency equal to, or slightly less than, the free-air resonance of the speaker. This produces two peaks in the impedance curve, one below, and one above, the speaker resonance. The belief is rather widely held that this extends the low-frequency performance to the region of the lower peak. However, a careful analysis of the electrical analog or equivalent circuit indicates that this is not the case. At the lower impedance peak, the radiation from the port is almost 180 deg. out of phase with the radiation from the speaker itself,[1] causing a sharp drop in response! The bass range actually extends down only to the neighborhood of the valley between the two peaks, where the port radiation reinforces the speaker radiation. This effect occurs approximately at the cabinet resonance. Since, as stated above, this is placed near the speaker free-air resonance in conventional enclosures, it may be concluded that the usual design procedure merely maintains good response down to the speaker free-air resonance. In effect, it enables one to use a box of moderate size in place of a very large "infinite baffle" or closed cabinet, with improved response down to speaker resonance and a rapid drop below this point. In the past it has been used mainly with speakers of relatively high resonance.

In the case of the "Ultra-Linear" systems, the problem is a different one. The free-air resonances of the woofers used are very low—15 to 20 cps. The cabinet is tuned to 30 cps and provides enhancement of efficiency in this region. *Figure* 3 shows typical frequency response curves for the woofer alone in the two systems. In addition it presents a high impedance to the driver at this frequency, reducing amplitude of cone excursion, and so, also reducing distortion. *Figures* 4 and 5 show distortion values for various operating conditions. The result is an enclosure that produces flat response to a lower frequency than a closed box, with higher efficiency, and less distortion. Efficiency is still rather low, but sufficient to afford satisfactory operation with amplifier power of the order of 20–25 watts. It should be pointed out that the amplifier must be capable of producing full power down to 30 cps, if the excellent bass reproduction of these speakers is to be utilized fully.

[1] L. Beranek, *"Acoustics,"* p. 252.

Practical Application

The principles outlined are embodied in two complete speaker systems. Model S-10 uses a 12-inch woofer, a 1500-cps crossover, and a compression-type tweeter, to cover the range of 30 cps to

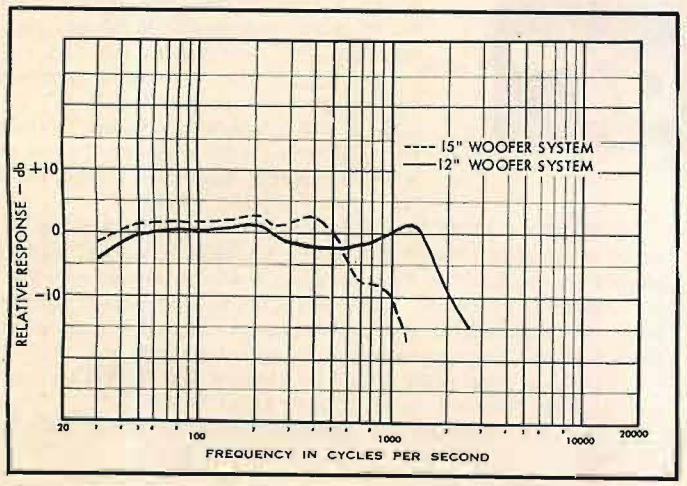


Fig. 3. Comparative frequency response of 12- and 15-inch woofer systems.

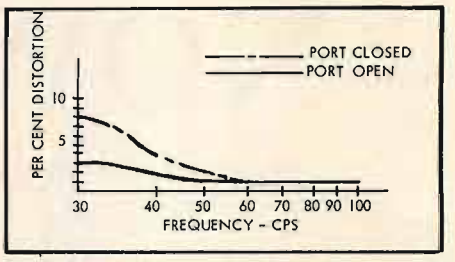


Fig. 4. Distortion of 12-inch woofer with port open and closed.

high frequencies beyond audibility. A "program distortion" filter is provided, with a switch, which rolls off the high-frequency response slightly for use when listening to program material that is not perfectly clean. The cabinet size of this model is only $25 \times 14 \times 14\frac{1}{2}$ in. Available for either lowboy or highboy (vertical) positioning, these speaker systems are ideal for stereo installations where available space is small. They fit conveniently into bookshelves.

Model S-11 is a more elaborate, 3-way system based on a 15-inch woofer, which has more extended bass range, higher efficiency, and still lower distortion than the S-10 system. A crossover at 500 cps transfers power to an 8-in. Diffusicone speaker tightly sealed in back to prevent its being driven by the high pressures developed inside the main cabinet at low

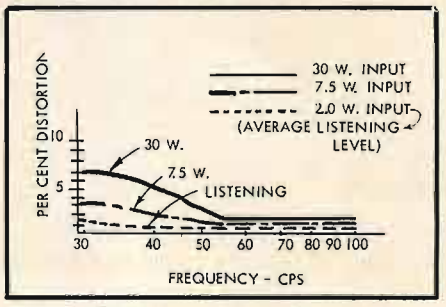


Fig. 5. Distortion of woofer at various power levels.

frequencies. At 2000 cps another transition takes place, to the tweeter. A "Presence" control is provided, comprising an L-pad on the mid-frequency speaker, and a "Brilliance" switch provides a roll-off on the tweeter when desired. A wide range of balance adjustment is thus available. The cabinet for this model is also available for either horizontal or vertical mounting. This unit is $26\frac{7}{8}$ in. high, $19\frac{1}{2}$ in. wide, and $17\frac{1}{2}$ in. deep.

The components of both speaker systems are available as kits, with complete instructions for installation and specifications for cabinets of various sizes.

Listening tests as well as theoretical considerations have shown that, for ideal stereo performance, the two channels should be identical in frequency response, at least in the range from several hundred cycles upward. This condition is met by University components, which are held within 1 db in production, for a given model. Æ

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Convert Your Collaro to Stereo

You can convert your Collaro easily to stereo without rewiring the arm.

STANLEY G. NEUFELD

As happens so often in a dynamic field such as high fidelity, new developments occur within the industry with astonishing rapidity. The latest of these are, of course, stereo cartridges and discs.

One of the problems to consider in any new development is the question of obsolescence. Fortunately, you can easily adapt your present Collaro changer to stereo in a matter of minutes. (To complete your stereo system you will then need a second speaker and amplifier).

All Collaro models over the past few years have been wired with three leads (two wires plus a shield) thus sparing you the problem of rewiring your arm. The only change, therefore, is to add an additional audio lead to plug into your second channel. This lead can easily be assembled with a length of shielded wire and a phono plug, or it can be purchased already assembled at any high fidelity store.

The following steps apply to all Collaro models. While there have been minor mechanical differences in the various models, the connecting lugs are all similar.

1. Turn the changer on its side with the muting switch towards the top. Your present audio lead connects directly to this switch. You will note that this switch terminates with three pairs of lugs. One pair of lugs contains a red lead from the tone arm, plus the "hot" wire from the present audio lead. The second pair of lugs contains the blue lead from the tone arm and the shield of the audio lead. The third pair of lugs is the ground connection and has both the shields of the tone arm wire and the audio lead. Note that the audio lead shield is connected to both the second and third sets of lugs. (See *Fig.* 1.)

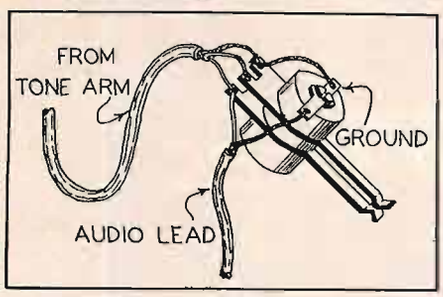


Fig. 1. Terminal wiring as used on late model Collaro changers.

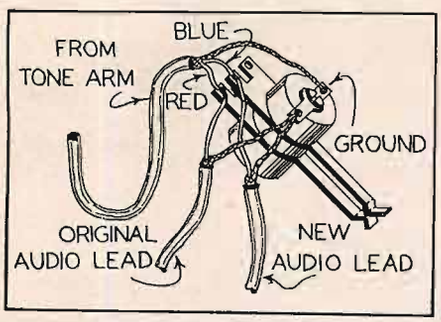


Fig. 2. After rewiring, terminal arrangement is as shown here, with additional audio lead for stereo use.

2. Disconnect the audio lead shield from the second pair of lugs (the one that also has the blue wire connected to it) making sure that this shield remains connected, however, to the third set of lugs.

3. Connect the "hot" wire of your new audio lead to the same lug from which you have just removed the shield in step two.

4. Connect the shield of the new audio lead to the third pair of lugs that contains the shields of the other audio lead.

5. Dress the new audio lead through the same hold-down clamp as the original audio lead.



Fig. 3. Wiring to underside of late-model units showing connections to Electro-Voice stereo cartridge.

This completes the wiring to be done at the bottom of the changer, which should now appear as in *Fig.* 2. There is no additional wiring (except the actual cartridge mounting) on the TC340 Conquest and the TC-540 Continental models. Both of these units contain the one-piece counterbalanced arm and you need only connect the pin jacks supplied with the stereo cartridge to complete the job (*Fig.* 3). You will find it much easier to mount the cartridge if you remove the cartridge mounting plate from the front of the arm. This is done by removing the chrome plated screw on the top front of the arm.

Older Models

The RC-440 Coronation and all older models such as the RC456 and RC-54 contain plug-in heads. With these models you will have an additional wire to connect. As these plug-in heads contain only two pins, it will be necessary to connect a "jumper" lead, and in order not to negate the convenience of the plug-in head, the "jumper" will be wired with a pin jack so it can be easily removed when the head is unplugged. The following steps apply:

1. Remove plug-in head shell and unscrew chrome plated screw at top front of head shell to remove cartridge mounting plate. Solder pin jacks supplied with cartridge on each of two wires in head shell and connect to "hot" pins on stereo cartridge. Mount the cartridge on mounting plate and screw entire assembly back into head shell.

2. Set changer on its side with the arms pointing straight up. The arm can now be allowed to fall back exposing the bottom for easiest working position. Solder one end of a four-inch length of wire to unterminated shield wire in arm. On the other end solder the third pin jack and connect to common pin on cartridge (*Fig.* 4). Certain stereo cartridges have four pins, two of which should be tied together to form one common connection. In order to unplug the head shell you will have to pull off the common pin jack and then unplug the head.

This completes the conversion for all models. Instructions given with the cartridge will indicate which pins are for the right and left channels. If your two stereo leads happen to be the same color and size, you can put a dab of nail polish on one of the phono jacks to indicate right or left channel. If the instructions indicate a different stylus force than the monophonic cartridge you were using, be sure to change it to the specified value. On the TC-340 and TC-540 the stylus-force adjustment is the second screw from the top back of the arm. To decrease the force of the arm, turn this screw counterclockwise. All other models have this force adjustment on the bottom of the arm in the form of a spring attached to a sliding arm. Increasing the tension of this spring by moving the slide decreases the stylus force. If this is to be your first excursion into stereo, then you are in for a great deal of enjoyment.

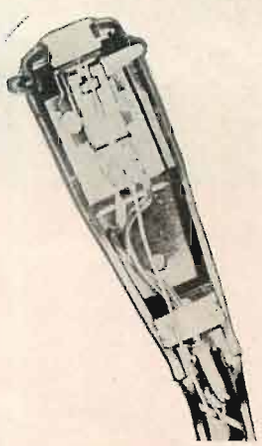


Fig. 4. When using with older plug-in heads, an additional lead must be carried past the "joint" and plugged directly onto the cartridge pin.

minates with three pairs of lugs. One pair of lugs contains a red lead from the tone

TC-540 Continental models. Both of these units contain the one-piece counterbalanced

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FOR THE STEREOPHONIC AGE!!!

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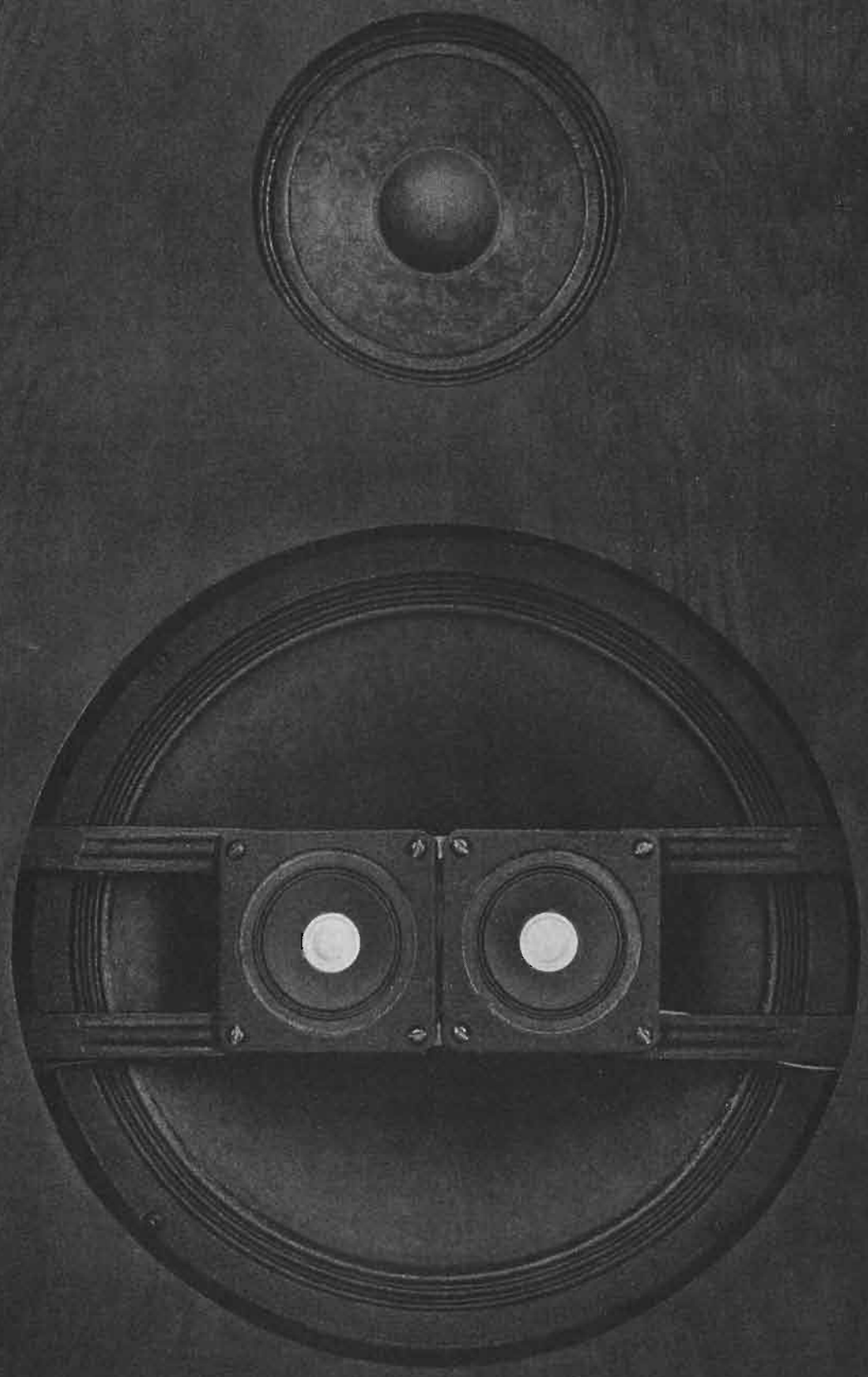
High fidelity speakers using cones formed by uniting the techniques of today's modern science with the techniques used in the manufacture of Japanese paper — techniques that have been fostered and handed down from generation to generation for centuries and centuries, and coupled with the dexterity of the Japanese people that has already been proven in such precision industries as the camera industry or the watch industry — PIONEER's line of products are already being appraised highly throughout the world as the leader of Japan's audio industry. Be sure to use PIONEER high fidelity speakers in converting your system to stereo that is now sweeping the audio world.

HIGH RANGE UNITS			MID RANGE UNIT	LOW RANGES
pioneer				**Woofers Equipped with Unique and Powerful Magnet Structure and Air-Pressed Cones Containing Glass wool**
The World's First Tweeter with 360° Dispersion	**The Tweeter Already Renowned on the U.S. Market**		**Diaphragm type Squawker using 8-section Multi-Cellular Horn**	12-inch and 15-inch woofers equipped with powerful magnet structures of idealistic design and cones made of a mixture of glass wool fibers and special vegetable fibers, formed by the air-press process.
Equipped with a diaphragm type driver unit, this tweeter provides identical frequency response anywhere on its circumference. Moreover, the cut-off frequency of the horn being quite low, the tweeter can be used satisfactorily even in two-way systems.	Equipped with a diaphragm type driver unit and a circular opening horn. Crossover frequency of 4,000 cps or more. For use as high frequency unit in three-way systems.	Uses identical driver unit as the PT-2, but has a rectangular opening horn. Crossover frequency of 2,800 cps or more. For use as high frequency unit in two-way systems.	A mid-range unit that boasts flawless sensitivity, directional characteristics and tonal quality, equipped with a wooden multi-cellular horn, each finished precisely by hand, and a diaphragm type driver unit possessing a powerful heavy-duty magnet structure.	
V.C. 8 or 16 ohms, F. Range 1,700-16,000 cps, Crossover Frequency over 2,800 cps, Max. Power 20 watts, Sensitivity 105 db/W	V.C. 8 or 16 ohms, F. Range 2,200-16,000 cps, Crossover Frequency over 4,000 cps, Max. Power 20 watts, Sensitivity 104 db/W	V.C. 8 or 16 ohms, F. Range 1,700-16,000 cps, Crossover Frequency over 2,800 cps, Max. Power 20 watts, Sensitivity 102 db/W.	V.C. 8 or 16 ohms, F. Range 300-5,000 cps, Crossover Frequency over 600 cps, Max. Power 20 watts, Sensitivity 110 db/W	**PW-15C** V. C. 16 ohms F. Range 30-4,000 cps Max. Power 30 watts Sensitivity 107 db/W
				
PT-01	**PT-2**	**PT-3**	**MH-300**	**PW-12C** V.C. 16 ohms F. Range 30-4,000 cps Max. Power 20 watts Sensitivity 105 db/W
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Hearing, the Determining Factor for High-Fidelity Transmission*

HARVEY FLETCHER

In three parts—Part 2

FROM THE ARCHIVES OF BELL TELEPHONE LABORATORIES

This is perhaps the first authoritative study of the requirements for ideal systems for the transmission of speech and music. Much of our present-day knowledge and practice stems from this article, which presents conclusions derived from measurements of hearing on more than 500,000 people during the World's Fairs in 1939 and 1940.

Sivian, Dunn, and White[5,6] reported measurements on sound levels created by various types of musical instruments and also by various kinds of speech. If we compare the loudness of a narrow band of thermal noise with that of a pure tone having the same intensity, the two will be judged to have equal loudness if the width of the transmitted frequency band of noise is limited to a critical value[7] called the critical bandwidth. For this reason the data reported by Sivian, Dunn, and White have been reduced to intensity levels which would have been obtained if the frequency bandwidths used in the filters had been equal to the critical bandwidths. Such levels which remain steady for ¼ second or more are directly comparable with levels of pure tones, and consequently their position in the chart of *Fig.* 3 determined. However, when an orchestra is playing or a person is speaking, the intensity levels received by a listener are varying rapidly. Our studies on hearing have indicated that the ear integrates such varying sounds over about ¼-second intervals. For example, the integrated sound energy in a critical band over a ¼-second interval will sound as loud as a pure tone in the same frequency band which produces the same sound energy in each ¼-second interval. The data on music and speech were taken in ⅛-second intervals, the former being only peak values, while the latter were both peak and root-mean-square values. For speech the maximum root-mean-square values for ¼-second and for ⅛-second intervals were found to be approximately the same and about 7 decibels below the 5 per cent values and about 10 decibels below the maximum peak values, being less for the low- and greater for the high-frequency ranges.

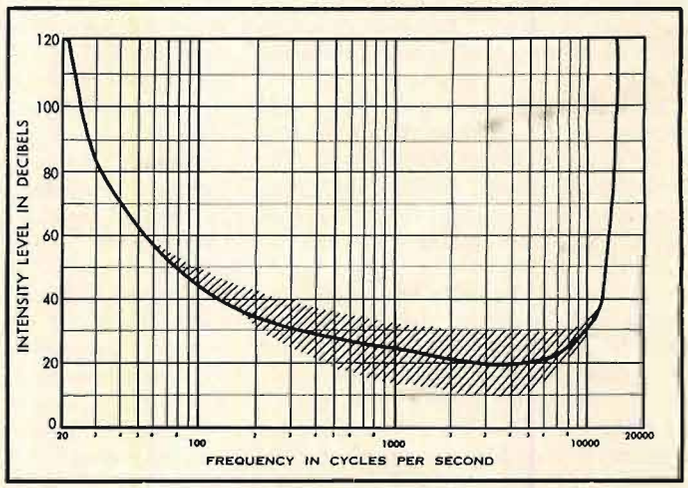


Fig. 3. Hearing limits for pure tones—typical listener in typical residential room noise.

For these reasons the data in the Sivian, Dunn, and White papers were reduced as follows. The maximum root-mean-square values for speech in ⅛-second intervals were corrected to a 20-foot distance and for critical bandwidths. The 5 per cent peak values for music were likewise corrected and then reduced by 7 decibels, with the hope that the final values would be at least approximately equal to maximum root-mean-square values that would obtain in ¼-second intervals in critical bands. There is some uncertainty in this procedure but probably not greater than that due to the sampling of the music. The values thus obtained are shown in Table 1.

In the first row in this table the mid-frequency of the critical band is given. In the second row the frequency limits of the bandpass filter used in taking the original data are given. In the next twenty rows opposite the name of each sound source are given maximum root-mean-square levels for ¼-second intervals which exist in a critical band having the mid-frequency given at the top of the table. Since the data were obtained by averaging, the critical band may be located anywhere in the filter band indicated in the second row. It is important to remember this when drawing conclusions from the data.

For example, consider the bass drum when it is played as a solo instrument. In a band 60 cps wide in the frequency region between 1000 to 1400 cps it produces maximum root-mean-square levels at 20 feet distant from it of 65 decibels. Similarly, the clarinet produces maximum root-mean-square levels, at the same distance and in a critical band of 400-cps width in the frequency region between 5600 and 8000, which reach 36 decibels.

In the last column the maximum root-

[5] L. J. Sivian, H. K. Dunn, and S. D. White, "Absolute amplitudes and spectra of certain musical instruments and orchestras," *J. Acous. Soc. Am.*, vol. 2, pp. 330–371; January, 1931.

[6] H. K. Dunn and S. D. White, "Statistical measurements on conversational speech," *J. Acous. Soc. Am.*, vol. 11, pp. 278–288; January, 1940.

[7] Harvey Fletcher, "Auditory patterns," *Rev. Mod. Phys.*, vol. 12, pp. 47–65; January, 1940, figure 16.

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TABLE I

MAXIMUM ROOT-MEAN-SQUARE LEVELS IN CRITICAL BANDS AND IN ¼-SECOND INTERVALS AT A DISTANCE OF 20 FEET FROM THE SOUND SOURCE

Mid-Frequency of Critical Band	45	95	190	375	600	850	1200	1700	2400	3400	4800	6800	10,000	All Bands
Frequency Limits of Filter	20 to 62.5	62.5 to 125	125 to 250	250 to 500	500 to 700	700 to 1000	1000 to 1400	1400 to 2000	2000 to 2800	2800 to 4000	4000 to 5600	5600 to 8000	8000 to ∞	
Organ, Loud	*107*	93	90	—	—	—	—	—	—	—	—	67	65	104
Bass Drum	*99*	97	92	87	77	72	65	64	64	57	51	38	(30)	103
Cymbals	54	57	64	73	68	59	61	66	72	71	79	78	*80*	105
Snare Drum	61	65	*79*	85	71	74	67	68	71	67	68	67	64	98
Large Orchestra	72	75	80	*82*	75	73	73	72	76	66	62	65	67	97
Trombone	51	(39)	62	64	*67*	64	62	64	63	55	60	64	(29)	94
Organ—Average	81	67	78	*82*	70	64	68	60	58	47	43	48	59	91
Tuba	72	73	*76*	76	65	60	51	39	(27)	(23)	(20)	(27)	(12)	87
Trumpet	—	—	56	65	*68*	65	64	61	55	45	41	50	(19)	84
Bass Saxophone	63	65	67	*76*	60	64	43	49	50	43	37	33	(16)	84
Piano	56	(40)	67	*73*	64	63	55	52	47	34	(21)	(12)	(15)	82
Bass Viol	77	*79*	73	59	46	48	37	39	35	(26)	(26)	(23)	(18)	82
French Horn	—	(31)	61	*67*	58	48	39	46	34	(22)	(15)	(11)	(10)	77
Clarinet	—	(32)	55	*57*	46	54	44	55	46	45	44	(26)	(18)	77
Speech—Declamatory	—	*70*	65	62	56	52	51	48	47	48	32	36	(30)	75
Piccolo	—	—	—	(21)	37	53	55	62	*62*	42	37	39	(29)	74
Triangle	—	(31)	(21)	(11)	(18)	36	(14)	44	52	44	50	61	*52*	73
Flute	—	—	—	—	56	*59*	52	43	36	(28)	(25)	(28)	—	69
Speech—Men Conversational	—	46	46	*49*	44	40	38	34	31	32	(22)	(23)	(12)	60
Speech—Women Conversational	—	—	47	46	42	38	35	35	(27)	(25)	(25)	(26)	(19)	58
Minimum Audible Level in Rooms with Noise	70	45–50	35–45	25–35	20–35	18–32	15–30	15–30	15–30	15–30	18–30	22–30	33	
Standard Audible Limit	55	39	24	11	3	0	0	−2	−7	−8	−5	4	9	

mean-square levels of the unfiltered sound are given. The transmission system must produce such levels at a distance of 20 feet if it is to recreate the sound.

It will be noticed that the sound sources are arranged in the descending order of total intensity produced. The loud organ produces the greatest intensity, ten times as great as a trumpet. About 100 loud voices are required to equal the intensity produced by a single trombone. The figure indicating the intensity level in the particular frequency band having the highest intensity level in a critical band is in *italics*. In Table II these frequency regions of maximum intensity are collected together. It is interesting to note that for speech, for an orchestra, for an organ, and for a piano the maximum intensity lies within the first octave above middle C. Also it will be noticed that no instrument has its maximum intensity above 1000 cps except the piccolo. The sounds from the cymbals and the triangle can hardly be called musical, but their maxima lie between 8000 and 15,000 cps.

The threshold levels in listening rooms with typical noise are given at the bottom of Table I. The two figures cover the range of room noise conditions. They were taken from *Fig.* 3. To assist the eye in seeing the audible range for each instrument all the intensity levels in the table falling in this range or lower are bracketed. The components represented by these bracketed numbers would not be audible to an average ear even if they were sounding alone. For comparison, threshold values for pure tones which have been adopted as standard are given in the last row. These correspond to values obtained in a very quiet room by young persons of acute hearing who have been trained to listen carefully. It was found in the survey mentioned above that only about 1 per cent of a typical group will obtain values as low as these. The masking values and levels above threshold used in this discussion are determined from these standard audible-limit values.

It will be seen that the snare drum, the cymbals, and the triangle have components above 8000 cps which are distinctly audible, while for the bass drum, bass viol, saxophone, tuba, trombone, trumpet, French horn, clarinet, and piccolo similar components are very near or below the threshold. Although no measurements were reported upon violins, our experience indicates that the elimination of frequencies above 8000 produces a detectable although very small change in the tone quality of the violin. It is interesting to note that components of the triangle below 700 cps are inaudible in the usual listening rooms.

The intensity levels taken from Table I are plotted for the bass drum, snare drum, cymbals, and a large orchestra. The resulting curves are shown in *Fig.* 4. The intersection of these curves with the threshold of audibility curves gives the frequency limits necessary for complete transmission of all audible components.

It will be seen that when the cymbals and bass drum are played as solo instruments, much higher intensity levels are produced than ordinarily used, at least in the two large orchestras which were tested. The drums and cymbals were at the back in the orchestra setup which may account for a 4- or 5-decibel difference; also, during the solo playing these instruments were purposely played as loud as possible. During the playing of the orchestra a considerably shorter period than 5 per cent of the time is used for such loud playing. However, one must expect occasionally to have levels as high as indicated for these instruments. Also it will be seen that for the orchestra as a whole the pitch range of audible components is from 40 to 14,000 cps, although for some instruments an 8000 cps upper limit is adequate.

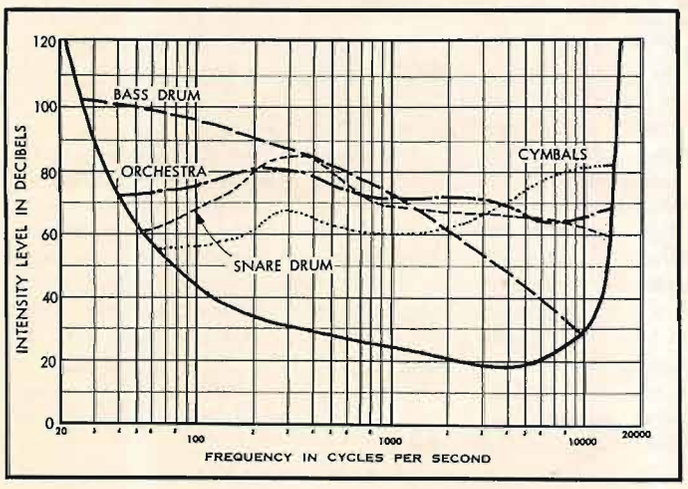


Fig. 4. Intensity levels in critical frequency bands created by orchestral instruments.

Masking Level

It has been found experimentally that the masking level of pure tones due to haphazard noise is equal to the intensity level of the noise in a critical

The threshold levels in listening rooms bass viol, saxophone, tuba, trombone, may account for a 4- or 5-decibel difference; also, during the solo playing these

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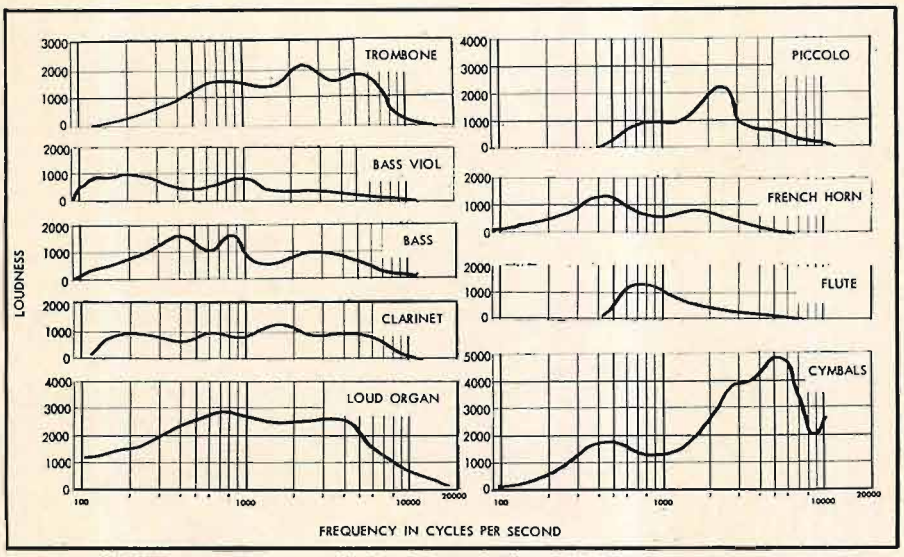


Fig. 5. Loudness per nerve patch versus frequency for musical instruments.

band. Consequently it is a fair approximation to assume that the numbers in Table I give also the masking levels in the presence of the various sounds indicated. The loudness produced by each of the instruments playing as solo instruments, the loudness of the orchestra as a whole, and also the loudness of speech was calculated by the methods previously outlined.[4] The results of these loudness calculations are given in *Figs.* 5, 6, and 7. The area under each curve is proportional to the loudness. The ordinate is proportional to the stimulation of the auditory nerves at the position in the cochlea corresponding to the frequency given by the abscissa. For example, for the 75-piece orchestra the ear is stimulated most at frequencies between 2000 and 3000 cps although the maximum intensities in the air occur in the frequency region of 375 cps. For the bass drum the maximum stimulation is around 400 cps, while for the snare drum it is between 2000 and 3000 cps. The cymbals produce an auditory stimulation which is greater than that produced by any other musical instrument.

Upper and Lower Limits

An examination of these loudness curves leads one to expect that for most instruments only small effects will be noticeable if frequencies above 10,000 cps or below 100 cps are eliminated during transmission, the exception being the organ, the cymbals, and the snare drum. For comparison the loudness curves for speech are plotted on the same plot with the orchestra curve. An estimated curve for a chorus of 100 voices is also shown. It is seen that the loudness of this chorus would balance approximately with the 75-piece orchestra. The areas under these curves were measured to determine the total peak loudness. The values thus obtained are tabulated in Table III in the first column.

The audible frequency range of these musical sounds was also determined by direct judgment tests. These results were reported by Snow.[5] The data from this paper are also included in the table. It will be seen that these values of audible pitch range agree well with what one would expect from the loudness plots. These plots indicate in a general way the degradation to be expected as one departs from the ideal requirements of frequency range. In Table III these results are arranged according to the total loudness levels produced. It is seen that the cymbals are the loudest and the bass viol is the weakest of the musical instruments. It would take about 100 bass viols to create a peak loudness equal to one pair of cymbals. It is interesting to note that the French horn produces about the same loudness as declamatory speech, which is estimated to be about the same as for a singing voice. For comparison the maximum peak intensity levels are also shown in this table in column 2.

When one tries to put down the maximum and minimum peak pressure levels necessary to transmit completely without distortion the sounds coming from an orchestra, one finds the matter rather complicated. It obviously will depend upon the size of the orchestra, how the instruments are played, and the selection being rendered. The peak pressure value of 107 decibels given in Table III is the average of four selections rendered by the Roxy Theater orchestra. The measured values from the four selections were +0.8, −1.0, −2.0, and +2.3 compared to 107 decibels. So it is seen that the maximum peak pressure exceeded 109 decibels intensity level. The peak pressure for the bass drum when played loudest was found to be 112 decibels. It is then concluded that for the Roxy 75-piece orchestra the maximum levels at 20 feet away from the orchestra (average distance to instruments) are somewhere between 109 and 112 decibels.

TABLE II

Frequency Region of Maximum Power	Instrument
20 to 62.5	Loud Organ—Bass Drum
62.5 to 125	Bass Viol—Declamatory Speech (Male)
125 to 250	Snare Drum—Tuba
250 to 500	Orchestra—Organ—Saxophone—Piano—French Horn—Clarinet and Speech
500 to 700	Trombone and Trumpet
700 to 1000	Flute
1000 to 1400	—
1400 to 2000	—
2000 to 2800	Piccolo
2800 to 4000	—
4000 to 5600	—
5600 to 8000	—
8000 to 15000	Cymbals—Triangle

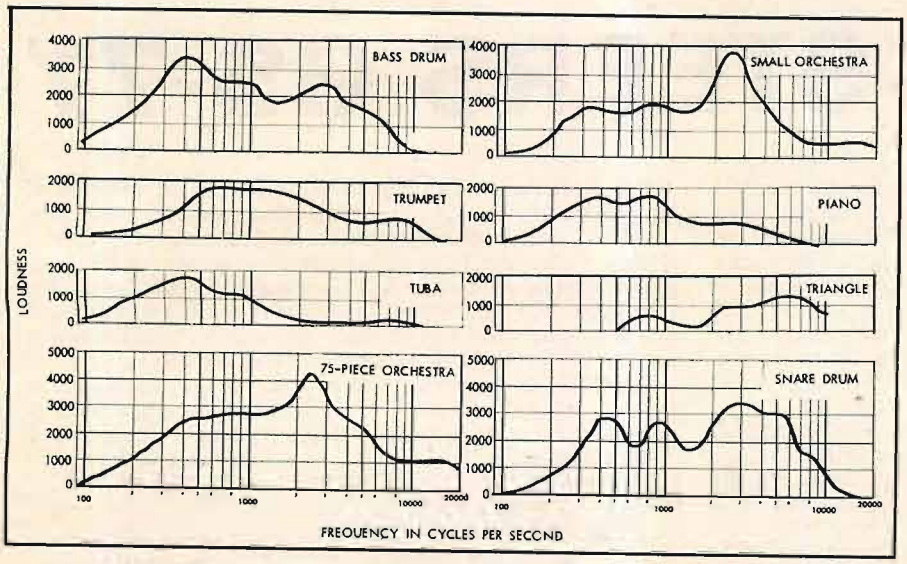
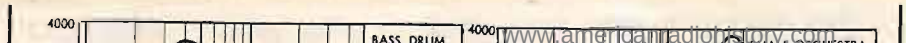


Fig. 6. Loudness per nerve patch versus frequency for musical instruments.

[5] W. B. Snow, "Audible frequency ranges of music, speech and noise," *J. Acous. Soc. Am.*, vol. 3, pp. 155–166; July, 1931.



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TABLE III

Musical Instrument	Peak Loudness Level	Peak Intensity Level	Pitch Range of Tone	Pitch Range of Noise
	decibels			
Chorus—100 voices	113	107	—	—
Orchestra—75 pieces	111	107	35–14,000	—
Cymbals	111	112	300–14,000	—
Snare drum	110	108	80–15,000	—
Loud organ	109	113	—	—
18-piece orchestra	108	100	—	—
Bass drum	107	112	50– 5,500	1,500– 5,500
Trombone	105	105	80– 8,000	—
Trumpet	101	93	160– 9,500	—
Organ average	99	102	—	—
Bass saxophone	98	92	55– 9,000	8,500–14,000
Piano	97	91	70– 6,500	—
Piccolo	97	84	520–10,000	10,000–15,000
Clarinet	95	86	140–10,000	10,000–14,000
Tuba	94	96	42– 7,000	4,000– 7,500
Triangle	92	82	—	—
Speech (declamatory)	92	86	—	—
French horn	90	86	87– 6,000	6,000– 8,100
Flute	90	81	250– 9,000	9,000–15,000
Bass viol	89	91	40– 8,000	5,000– 9,500
Speech—conversational				
Men	79	71	100– 8,500	—
Women	76	67	150–10,000	—
Footsteps	—	—	80–14,000	—
Key jingling	—	—	700–15,000	—
Hand clapping	—	—	100–15,000	—
Oboe	—	—	250–15,000	—
Bass clarinet	—	—	80–12,000	15,000

Typical Levels

Recently during a recording session a level recorder was used to make a record during a three-hour period while the Philadelphia Orchestra was playing the following selections in the Academy of Music auditorium:

Pictures at an Exhibition Moussorgsky
Blue Danube ..... Strauss
Night on a Bald Mountain Moussorgsky
Tales from the Vienna Woods ..... Strauss
Brünnhilde's Immolation from die Götterdämmerung ..... Wagner
Afternoon of a Faun ..... Debussy
Fire Bird ..... Stravinsky
Toccata and Fugue in DBach Minor .....
Moonlight ..... Debussy
Tristan and Isolde ..... Wagner

The level recorder was capable of following changes in levels at the rate of 200 decibels per second. The highest recorded level was near the end of the selection "Fire Bird." At the top of *Fig.* 8 is shown a reproduction of the track made by the level recorder at this time. The differences in decibels shown on the scale are accurate but the absolute values are arbitrary. It is seen that for the maximum level a value of 84 decibels was recorded. Its position is indicated by the arrow. The peak lasts less than 1/10 second. The strip of record shown in the middle shows the levels at the end of this loud passage. Although the level stays very high it never again reaches within 5 decibels of this highest peak. This was also true for all of the other selections played. The lowest level was reached at the conclusion of the selection "Moonlight," the record of which is shown at the bottom of *Fig.* 7. The minimum level is at 5 decibels on this arbitrary scale. The maximum range of levels as recorded by this instrument is seen to be 79 decibels. However, except for the single crash in "Fire Bird" the level range never exceeded 74 decibels but it frequently approached this value. It is probable that this maximum level was due to very loud playing of the bass drum. Unfortunately the level recorder was not calibrated for absolute levels. If, however, we identify the high peak level with the figure of 112 decibels given above, then the range is from 33 to 112 decibels, which fits in as a reasonable range, (See *Fig.* 3.)

Peak Values

Now if peak values of intensity were recorded the range would be even greater. Comparison of such levels with those obtained on a level recorder indicates that the peaks may reach 5- or 10-decibel higher levels than those recorded. On the other hand, a standard sound-level meter or volume indicator such as is ordinarily used in monitoring circuits may indicate a level range 5 or 10 decibels lower than that indicated by the level recorder. It is seen then that when speaking of level changes taking place in radio programs it is important to know the type of instrument which is used to obtain the data. The volume indicator is most frequently used. Such measured values are referred to as volume levels.

For a pure tone the level-recorder value or the volume-level value differs from the peak value by only 3 decibels. For other sounds the differences between these three measurements depend upon the character of the sound and may be as much as 20 decibels. Then in terms of volume levels, the maximum range for these orchestral selections is about 70 decibels and for all of the material except the one crash in the "Fire Bird" it is nearer 65 decibels.

Measurements[9] on speech power have indicated that when speaking with a soft voice the *"th"* sound carries about 1/100 microwatt of power, while for declamatory speech the *"a"* sound in "all" may reach a peak power of 5000 microwatts. This range is 56 decibels. When dealing with only one speaker this rarely exceeds 40 decibels. If a system had a range of 56 decibels from overload point to noise level, speech of all kinds could be faithfully transmitted. Here again the reader is cautioned because the long root-mean-square average for speech is usually about 20 decibels below the peak value. For this reason readings on a volume indicator when a single person is talking may not indicate a volume range of more than 20 or 25 decibels. The values given in Table I are averages of voices from six men and five women

[9] Harvey Fletcher, "Speech and Hearing," D. Van Nostrand Company, New York, N. Y., 1929, p. 75.

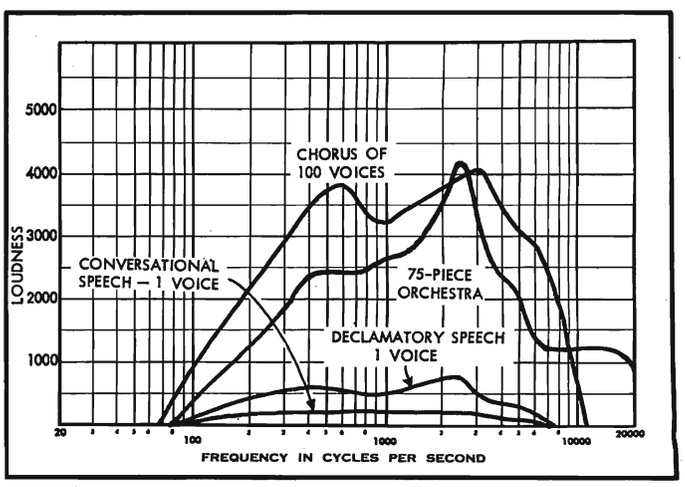


Fig. 7. Loudness per nerve patch versus frequency for a chorus.

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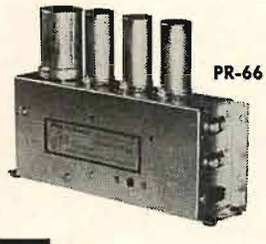
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reading from stories containing a large proportion of conversation.

Noises are so varied in character that it is difficult to make any generalizations. Their intensities and frequencies cover the entire audible range. Footsteps, key jingling, sword clashing, hand clapping, etc., involve audible frequencies from 80 to 15,000 cps.

The question now arises, if some of the audible frequencies are suppressed, what will happen to the quality of the reproduced music or speech? In the paper by Snow,[8] some judgment tests were reported for music which enable us to deduce some conclusions concerning this. With a group of observers, two conditions were asked to be judged. One was reproducing the orchestra with a system transmitting approximately uniformly everything between 40 and 15 000 cps. In the second condition, filters were introduced to cut off the various portions of the frequency range. The observers were asked to judge what per cent reduction in the quality was produced by the elimination of part of the pitch range. The values in Table IV were taken from the curve of Fig. 6 of Snow's paper and show the results of these judgment tests. For example, cutting off all frequencies above 6500 cps degrades the quality the same as cutting off all frequencies below 100 cps, in both cases reducing it from 100 to 85 per cent. It will be noticed that the results are arranged so that the effect upon judged quality is the same for the high-pass filter indicated in column 2 and the low-pass filter indicated in column 3. For these samples of music and for this group of observers eliminating frequencies above 5600 cps reduces the quality the same as eliminating frequencies below 120 cps, both producing a 20 per cent reduction in judged quality.

TABLE IV

MUSIC—JUDGED QUALITY

Judged Quality	High-Pass Filter Cutoff	Low-Pass Filter Cutoff
100	40	15,000
97	70	12,000
93	80	9,000
90	90	7,800
85	100	6,500
80	120	5,600
70	140	4,800
60	180	4,000
50	220	3,600
40	270	3,000
30	325	2,500
20	500	1,700
10	850	850

These data are taken from a curve based on judgment tests of eight engineers listening to an 18-piece orchestra playing the selections "The Beautiful Blue Danube" and "In the Village." If a different orchestra and different kind of music were used there is no doubt that a somewhat different curve would be found. Before one could consider such a curve as typical, more testing of various kinds of music would be necessary. It would be desirable to find such typical curves for the different kinds of orchestras used in broadcasting. It should be emphasized that the experimental points upon which these curves are based are very scattered above 8000 cps, indicating a wide difference of opinion among the judges, but below this frequency there is a very definite decrease in quality as the upper limiting frequency is lowered. Also, the observed points indicate that there is considerable uncertainty below 60 cps. There is no doubt that these figures would be different if we were considering music from a dance orchestra, from a large or small chorus, or from individual vocal or instrumental artists.

Effect of Reducing Range

What will happen to the quality of the music if we reduce the intensity level range from the ideal indicated in *Fig.* 4? If we desire to listen to music at the same level as produced in a concert hall, then the upper limit may be lowered 10 decibels to an intensity level of 110 decibels. If the lower limit is raised above that in *Fig.* 3, then parts of the very soft passages may be lost and the listener becomes conscious of noise from the transmission system. I do not know of any judgment tests to evaluate the deterioration of musical quality due to decreasing the upper limit or increasing the lower limit. A curve showing such a relation for various kinds of music would be useful for engineering transmission and recording systems.

Considerable work has been done on the deterioration of speech due to departing from the ideal of *Fig.* 3. The measurements on conversational speech given in Table I show that there are no audible components below 125 or above 4800 cps. This is for a distance of 20 feet between speaker and listener. If this distance is reduced to 2½ feet all the values in Table I must be increased 18 decibels. The audible frequency range is then from 62 to 8000 for men and from 125 to above 8000 for women. For declamatory speech or conversational speech reproduced at a high level, components above 8000 will be distinctly audible. As we reduce the limits from the ideal, what happens to the quality of the reproduced speech? Most of the work done on this problem has been in connection with the development of telephone systems. For this purpose the important characteristic to maintain is the intelligibility of the speech. Several different criteria[10] have been set up for measuring this intelligibility but the one most widely used is called the articulation. Lists of meaningless syllables made up from the fundamental sounds of speech are constructed. A speaker pronounces them into the system to be tested. The listener writes what he thinks was spoken. The per cent of the written syllables which are interpreted

TABLE V

SPEECH—ARTICULATION

Articulation	High-Pass Filter Cutoff	Low-Pass Filter-Cutoff
per cent		
98	40	15,000
98	100	12,000
98	250	7,000
96	570	5,000
94	720	3,900
90	960	3,100
80	1,500	2,300
70	1,920	1,970
60	2,300	1,700
50	2,600	1,500

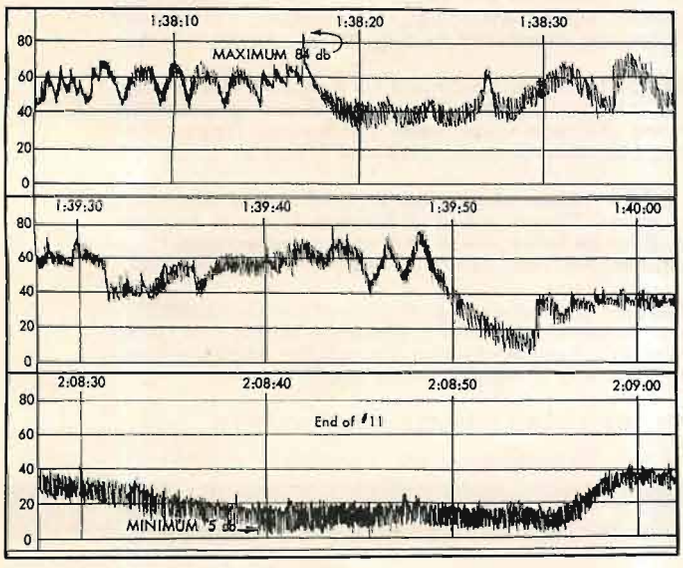


Fig. 8. Readings of a level indicator.

[10] Harvey Fletcher and J. C. Steinberg, "Articulation testing methods," *Bell Sys. Tech. Jour.*, vol. 8, pp. 806–854; October, 1929.

of the reproduced speech? Most of the

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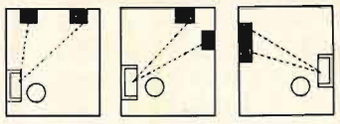
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The DS-100 dual stereo unit, in the popular lowboy, is the answer to the buyer's demand for a complete stereo reproducer in one cabinet. This handsomely styled loudspeaker system provides two completely independent 3-way speaker systems with 12" Flexair woofers (total of 6 speakers) which can be used together for superior spread source monophonic sound, as well as stereo. The two Stereo Directors, each having an 8 inch mid-channel and compression driver h-f unit, allow flexibility in cabinet placement with maximum effectiveness in aiming the sound to the favored listening area. Crossover frequencies 600 and 4000 cycles. 32" H., 52" W., 18¼" D. Available in Walnut, Tawny Ash and Mahogany **Net Price.....369.50**

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A pair of these Director assemblies are used in the DS-100 Dual 3-way System (illustrated above), a single assembly in the SS-100, mounted inside on the shelf above the Flexair woofer enclosure. Chassis easily rotated without moving cabinet, has an 8" m-f unit, compression-driver tweeter, network and control. All frequencies above 600 cycles are reproduced by the Stereo Director assembly. Complete system is also available in kit form.

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Mounts m-f and h-f units of KT-33 to make Stereo Director assembly as used in SS-100 reproducers. Includes panel, base, assembly hardware, and complete instructions.

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IT IS FAIRLY WELL established that a single-channel amplifier for a high-quality monophonic system should have upward of 20 watts for good performance without the possibility of "breaking up" on peak signals. However, when two channels are employed in a stereo system it seems quite likely that the minimum for each is somewhere around 10 watts. One of the possible drawbacks to a stereo system is the increase in space demanded for actually housing the amplifiers—to say nothing of the speakers themselves—so it was felt that an amplifier could be designed that was adequate for most uses, small in size, and big in performance. The amplifier to be described seems to fulfil these requirements very well.

Tube Selection

Selection of tubes in the 10- to 20-watt range is limited—if one wishes to keep size and power requirements to a minimum. The 6V6 would be adequate from the standpoint of power output, but this tube is notoriously poor from the standpoint of distortion. 6L6's and 5881's are not too large physically for a reasonably small unit, but the current drain—in the vicinity of 60 ma per tube—demands a 250-mil transformer. Larger tubes are out of the question, and the smaller 6AQ5 is too much like the 6V6 to warrant much consideration. This leaves only the EL84—but this is a very good solution, for two of these tubes with a 300-volt power supply are easily capable of a 15-watt output. The 6360—a dual tetrode—is capable of putting out 10 watts, but the screens are common so the efficiency and low distortion of the Ultra-Linear circuit may not be used. Consequently, the EL34—a European tube available from either Amperex or Mullard—was selected.

For the amplifier circuit, the Philips Technical Library book, "Valves for A.F. Amplifiers," was consulted, and a good start was found in the article "High-Fidelity Amplifier with Two Tubes EL84 in Push-Pull." This circuit employs an EL86 as a pentode first stage, followed by an ECC83 (12AX7) as a "long-tailed pair" phase splitter, and the EL84's in push pull. To reduce the gain to a more practical value for a basic amplifier, as well as to reduce the total number of tubes, the EF86 pentode was replaced by one half of an ECC83, and the remainder of the circuit followed fairly closely. With this arrangement, the first stage of each of the two channels employs half of one double triode, so that one "tube" serves both channels. From that point on, both channels are completely separate, except for the common power supply.

The phase-splitting stage is cathode coupled, with the input signal being fed direct to one grid at the same d.c. potential as the plate of the first stage, and with a decoupling resistor to the second grid which is bypassed for a.c. to ground, yet maintained at the same d.c. potential as the signal grid. The plate currents for both sections of the tube flow through a large cathode resistor, and since one grid is maintained at an a.c. ground potential while a signal is introduced to the other grid, plate current variation across this resistor provides an effective drive to the second section. The circuit has low distortion, and when carefully constructed so that the capacitances of the two plate circuits are kept to low and practically equal values, the over-all balance is excellent. To ensure good balance in practice, the plate-load resistors must *not* be exactly equal—the Philips book recommends balancing to approximately 5 per cent by selecting from 10-per cent resistors, with the larger of the two being used as R_p in the schematic, *Fig.* 2.

For proper operation with the plate voltage selected, the grids of the phase splitter should be maintained at a d.c. voltage of approximately +90, and by selection of a plate-load resistor value for the first triode, together with bias resistor, the voltage drop across the former may be made to provide this value. The direct coupling between these two tubes results in a zero phase shift at low frequencies and contributes to its stability.

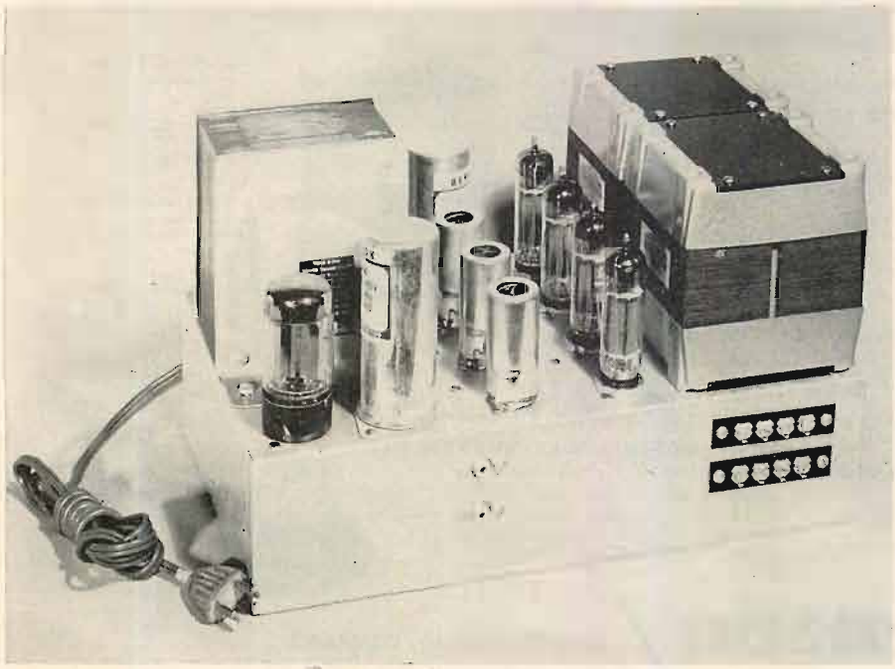


Fig. 1. Combining two 15-watt amplifiers onto one chassis results in a stereo "package" which compares favorably with most any amplifier available.



circuits are kept to low and practically equal values, the over-all balance is excellent. To ensure good balance in practice,

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With the AX20 there's no shuttling back and forth between two different instruments (you can even tuck your present amplifier out of sight); no adapter box to complicate matters. This one unit – the AX20 – controls the power to both amplifiers. It also controls treble, bass, volume, contour, balancing and equalization for both.

The AX20, in brushed copper and black, is strikingly handsome in appearance and outstanding in its performance characteristics. The amplifier delivers 20 watts of hum-free, distortion-free power (40 watt peaks). An exclusive new high gain phase inverter utilizing both positive and negative feedback drives the output tubes with minimum phase shift and excellent stability. As a result, the power amplifier has instantaneous recovery time resulting in uniquely clean and faithful transient response. The AX20 actually produces more clean useful power than conventional 30 watt amplifiers.

The preamplifier is a dual stereo device incorporating ganged bass and treble tone controls, loudness control, contour control, rumble filter, balance control, mode switch, speaker selector and function switches. Selectable equalization is provided for records and tape (7½ and 3¾ IPS). The second preamplifier delivers ½-volt output at low impedance.

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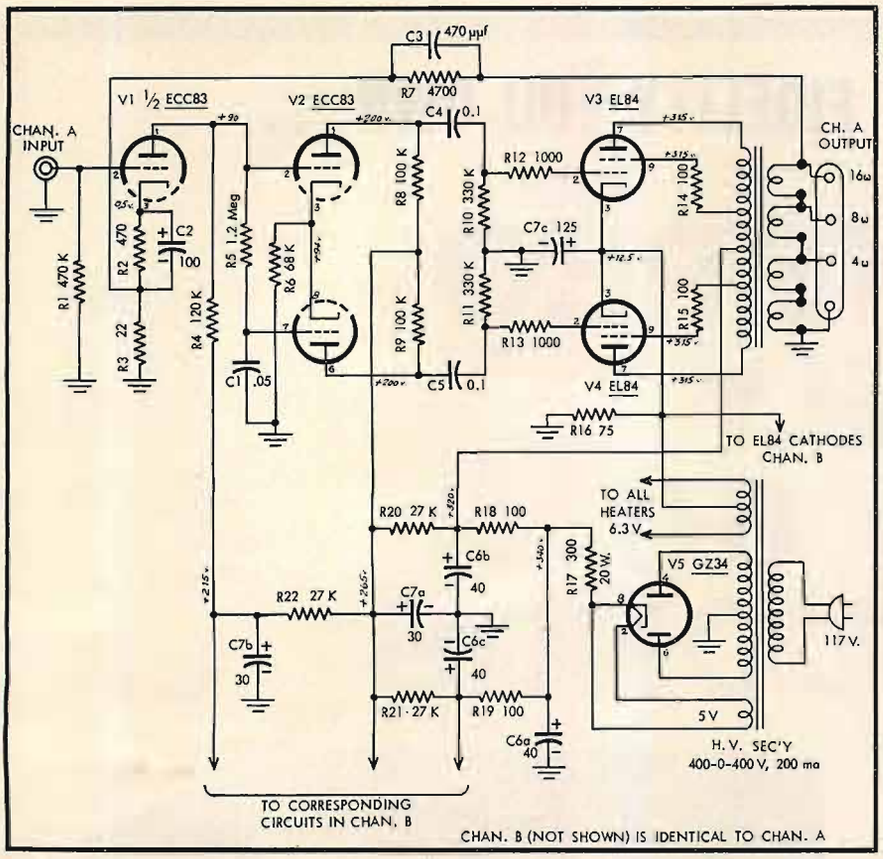


Fig. 2. Schematic of the two-channel amplifier. The "B" channel is not shown, but is identical with the "A" channel, and one power supply serves for both.

Output Transformer

Quality in any amplifier is very largely dependent on the output transformer, and while there are many smaller transformers than the ones selected that would permit the construction of a smaller unit, it is believed that there is no substitute for plenty of iron and copper, and since quality was the first consideration and over-all size of the amplifier was second, the new Partridge P-5000 series was chosen. With 10 db of feedback, these transformers are rated at 20 watts at 30 cps for less than 1 per cent distortion, or 35 watts at 50 cps. Since the tubes are capable of only about 15 watts, this was considered more than adequate to ensure good performance. Leakage inductance from primary to secondary is specified as 5 mh, which is the same as from one-half of the primary to the other. Shunt inductance of the primary is high, and rated at 450 H at a 4-watt output at 50 cps. Thus good low-frequency performance could be expected. The units are constructed with cast aluminum frames, and are very rugged in appearance, as may be seen in *Fig.* 1. The secondaries are wound in four separate sections, permitting the use of series connection for a total of 16 ohms output, combinations of series and parallel connections for 4 and 8 ohms, and with all four windings in parallel the output impedance of 1 ohm.

Common Power Supply

Since both channels are putting out essentially the same signal—a less severe requirement than would be encountered if both had entirely separate signals—a common power supply is indicated. The power transformer selected for the job has somewhat higher secondary voltage than necessary, but this permits a high value of current-limiting resistor between the rectifier tube and the first filter capacitor, reducing peak current drain through the rectifier and contributing to cool operation of the transformer. Separate filtering is provided for the two output stages, with common filtering being provided for the two preceding stages. Since both halves of the amplifier work at identical voltages, performance of the two channels is very nearly identical also.

One of the principal objects of this design was to provide the utmost in reliability so that one could build the amplifier, put it in service, and forget it entirely. So far it has proved to have this degree of reliability, and it runs cool, with all components well within their ratings.

Construction

The layout is fairly obvious from *Fig.* 1. The four EL84's are seen next to the transformers, while the three ECC83's are in the shielded sockets. So as to provide identical physical layout for the phase splitter and output stages of the two channels, the first and third tubes are the phase splitters, while the center ECC83 is used for the two first stages. All the heaters are biased positively by the amount of bias on the output stages —approximately 12.5 volts—by the simple expedient of connecting the center tap of the 6.3-volt winding to the cathodes directly. All chassis connections are made at the input jacks to avoid any possibility of ground loops, and each grounded circuit is run to these jacks separately. R_{17} is connected directly from the cathode of the GZ34 rectifier to the first filter capacitor section, and R_{18} and R_{19} are connected directly across the capacitor. The junction of R_{20}, R_{21}, and R_{22} is a tie point, from which R_8 and R_9 go to V_2 plates. A wire leads from this tie point to a second one adjacent to the second-channel phase splitter to accommodate the plate resistors for this stage. A third tie point adjacent to V_1 serves to connect R_4 and its B-channel equivalent to the first stages. R_2, R_3, R_7, C_2, and C_3 are mounted on four double tie points located between the two transformers under the chassis.

Since it was expected that the amplifier would be switched on and off from a control unit, no switch was provided on its chassis. No balance controls are needed for this circuit, and R_8 and R_9 were selected to a 5-per cent difference. The amplifier does not seem to be at all critical in construction, and no trouble was encountered in operation from the moment it was first turned on.

The values shown in the feedback circuit, R_7 and C_3, are for use with the 16-ohm output connection. For other output impedances, divide the resistor value by $\sqrt{16/Z}$, where Z is the new output impedance, and multiply the capacitor value by the same figure. Thus for the transformer specified, the resistor values should be 3600, 2400, and 1200 ohms, respectively, for output impedances of 8, 4, and 2 ohms. Capacitor values should be 620, 910, and 1800 µµf. respectively, for the same impedances. It would be better, however, to actually choose the capacitor value by the use of a square wave and a 'scope, if these instruments are available.

Performance

Using the 2-per cent IM distortion point for rating the amplifier, this unit would be called a 17-watt amplifier. Harmonic distortion is well under 0.5 per cent at this point, and both sides of a sine wave begin to break up symmetrically at the 17 watts.

Frequency response is within 1 db from 17 cps to 85 kc, with the power output dropping 3 db at 12 and 64,000 cps. Adjustment of feedback for an optimum square wave at 10 kc reduced the very-high-frequency output slightly—with a

35 watts at 50 cps. Since the tubes are capable of only about 15 watts, this was considered more than adequate to ensure

Face filtering is provided for the two output stages, with common filtering being provided for the two preceding stages.

values should be 620, 910, and 1800 µµf. respectively, for the same impedances. It would be better, however, to actually

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smaller capacitor at C_3 the half-power point was raised to over 90 kc, but in the interest of better square-wave response and greater stability the given value of C_3 was chosen.

The amplifier reaches its rated output at an input signal of 0.1 volts. This is relatively sensitive, and a voltage divider at the input would serve to decrease the sensitivity so that a 1-volt input, for example, would drive the amplifier to its normal maximum output. However, since stereo pickups have lower outputs than the monophonic counterparts, the additional sensitivity may be needed.

In listening quality the amplifier compares favorably—within its power capability—with several larger and more elaborate units. And in a small or average listening room, don't ever doubt that 15 watts can be loud. It might not be nearly enough for an auditorium, but few of us have listening rooms comparable to Carnegie Hall in size. Two 15-watt channels put out as much power as one 30-watt amplifier, and practically anyone will admit that 30 watts is nearly always adequate. Æ

Parts List

(Two each are required for all designated parts except those which are common to both channels. These are preceded in the list by asterisks.)

C_1	.05 μf, 400 v., paper
C_2	100 μf, 3-volt, electrolytic
C_3	470 μμf, 500 v., mica
C_4, C_5	0.1 μf, 600 v., paper
*$C_{6a, b, c}$	40-40-40/450, electrolytic
*$C_{7a, b, c}$	30-30/450, 125/25, electrolytic
R_1	470 K, ½ watt
R_2	470, ½ watt
R_3	22, ½ watt
R_4	120 K, 1 watt
R_5	1.2 meg, ½ watt
R_6	68 K, 1 watt
R_7	4700, ½ watt
R_8, R_9	100 K, 1 watt
R_{10}, R_{11}	330 K, ½ watt
R_{12}, R_{13}	1000, ½ watt
R_{14}, R_{15}	100, 1 watt
*R_{16}	75, 10 watts
*R_{17}	300, 20 watts
*R_{18}, R_{19}	100, 5 watts, wirewound
*R_{20}, R_{21}, R_{22}	27 K, 1 watt
T_1	Partridge P5201, plate-to-plate load 9000 to 12,000 ohms; secondary, four equal 1-ohm windings.
*T_2	Power transformer: 400-0-400 v. at 200 ma; 6.3 v. CT at 5 a; 5 v. at 3 a. Triad R-21 or equivalent

Miscellaneous

1	7 × 12 × 3 chassis, aluminum
4	Noval sockets
3	Noval sockets with shields
1	Octal socket
2	Phono jacks
2	4-terminal strips
1	Power cord
1	Grommet for power cord
4	EL34's; 2 ECC83's; 1 GZ34.
	Assorted tie points, hardware, etc.



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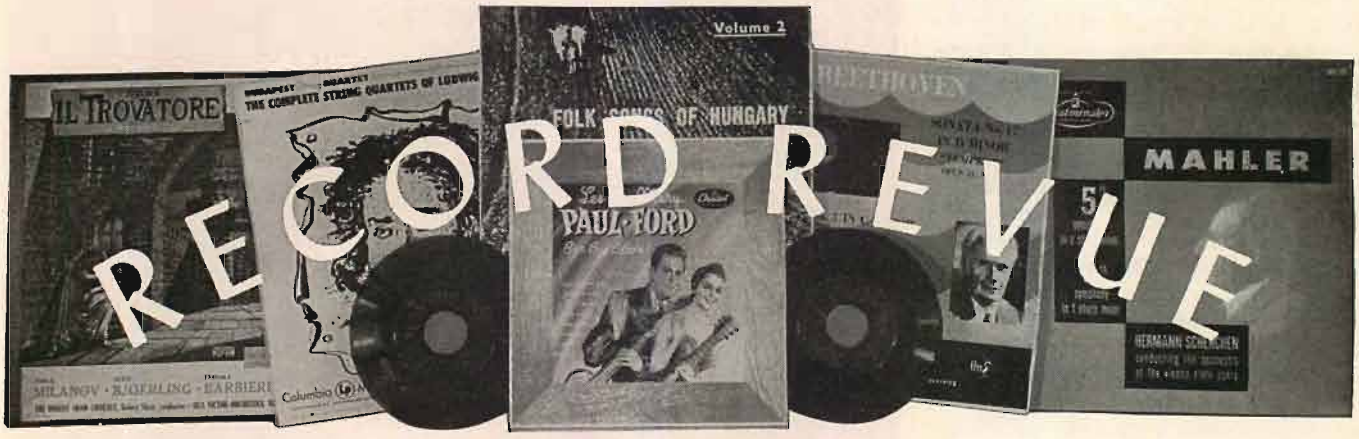
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EDWARD TATNALL CANBY*

1. FIRST DISC-STEREO

Note: In spite of much promotion and general excitement, very few actual, real, purchaseable stereo discs had reached market by early summer. This was strictly to be expected, and the normal time-lag between high expectations and sober production. The smaller companies were rushing in with "firsts" in stereo discs, where the biggies did not dare to tread, so soon. RCA Victor's "June" list wasn't heard from until long after July 4. The others hadn't issued a peep though all of us knew of the dammed-up masses of stereo material waiting to be launched.

Here are a few of the earlier discs, the first that came through legitimately in normal channels, without special wangling of advance copies. They are mostly small-company. Nothing from the big outfits, except the single advance RCA Victor, a lulu. My impression, as of this month: stereo disc has a great future, but its immediate present is a bit on the inevitable dismal side. In theory all is hi-fi and everything is distortionless. In practice, things are somewhat in a mess.

By next month there ought to be some good stuff—good in practice as well as theory. And before you know it, there'll be plenty to keep us all busy from morn 'til night. Don't forget those first months of the LP record itself, ten years ago. Pretty dismal. We're bound to experience the same thing in stereo, for awhile. It shouldn't last long, though.

E. T. C.

Hi-Fi Fiedler. (Rossini: Wm. Tell Overture; Rimsky-Korsakoff: Le Coq d'Or. Tchaikowsky: Marche Slav.) Boston Pops, Fiedler. **RCA Victor LSC 2100** (stereo)

Want to reassure yourself about stereo disc? Try this—if you can get it.

The recording has been reviewed before in its monophonic standard form. It has been out awhile on stereo tape, too (two reels, only one of which is given this title) and I suppose eventually it'll be launched in Number Four, the tape cartridge. RCA has wisely chosen to bring out its stereo discs with the same catalogue numbers as the standard disc version—in this case, the original LM 2100 came out a year or so ago. Of the original RCA "June" stereo disc release, some 20 records, this was the only one I had set eyes and ears upon by the early part of July. RCA's publicity was a bit premature, evidently.

You may take this one as the optimum stereo disc for the opening season and an excellent standard of reference against which to compare all comers, pending more records of this sort. The RCA sound is the best available at the moment of writing, when much other stereo sound is disturbingly full of metallic edges and assorted fuzzinesses; RCA's stereo know-how for big orchestra is unbeatable, after a good many years of experiment and experience. Lastly, the musical warhorses on this disc are played with the typical sprightly, zestful alertness and good taste that are usually heard in Boston Pops recordings. For a stereo opener, you can't do better.

Strauss Sparkles in Hi-Fi. Vienna Philharmusica, Hagen. **Urania USD 1003** (stereo).

The new Urania company, while re-circulating many of the old Urania catalogue items (worthwhile but often of doubtful fi), is promoting some fancy sound quality in its newly recorded material. This one is unusually good for an early-period stereo release. The sound is about as clean as it comes today (I'm making no comparisons yet with equivalent top-quality monophonic cutting!) and the music is interesting.

These Johann Strauss items are termed "unusual" on the cover, which is precisely accurate; they are mostly lesser known bits of typical Strauss tunefulness—instead of "Blue Danube" and "Vienna Woods" we have the "Bei uns z'Hause" waltz ("At Home") and something called the "Elektrophor-Polka", slightly dizzily translated as "Explosions Polka." Also the "Where the Lemon Trees Bloom" waltz and the "Kiss Waltz." You can see what I mean. It's all Johann Strauss, though, and nicely played in Viennese style by the unlikely Philharmusica orchestra, whose name somebody thought up in an awful hurry, I guess. Like a Framburger, or a Hot Dogfurter.

The stereo is huge and big, in an armory-type hall, with the instruments somewhat too close to the mikes for my taste—they sit in your lap, which ain't comfortable when you're trying to do a mental waltz or a make-believe polka. Impressive sound, just the same.

Portrait of Pee-Wee. (Jazz Septet). **Counterpoint CPST 562** (stereo).

Before I say more, I must object to Counterpoint's front-cover claim—"This is a Counterpoint Compatible Stereo Disc. May be played on any LP phonograph or Stereophonic Disc Playback Equipment." Sure, it may and it can, and Counterpoint (formerly Esoteric) says it has tried out its discs on all sorts of ordinary LP equipment with no observable damage. Maybe, maybe. Could be. Might be. But I am not persuaded, by any means, that to claim compatibility all-out, in this fashion, is good policy for stereo. It brings us much too uncomfortably close to the good old compatible "all groove" needle, that plays both 78's and microgrooves! Front-cover or no, I suggest playing this and all other Counterpoint stereo discs on *stereo* equipment. Period.

(Some other companies are making the same policy-claim, I gather. Audio Fidelity? You understand that this has nothing to do with the record itself, which is cut pretty much as are others. Just a question of semantics, of the use of the English language to simplify a complicated situation. To claim compatibility thus unqualified is to over-simplify, I say.)

* * *

Jazz isn't supposed to be my field but, as usual, if somebody sends it to me, I play it. This is good jazz stereo to my ear, with the sharp separation to right and left that is already becoming more or less standard in the non-classical field, yet with a degree of blending and natural-sounding liveness that pulls the stereo "picture" together in an easy and restful way.

Too many stereos are faked and forced and blatantly unnatural. We may, eventually, get to appreciate "hi-fi" effects in stereo of a sort that are basically unique and unrelated to any imagined "original"; but right now, at the beginning, our ears are apt to insist on at least a moderate degree of normal-seeming perspective, as of a room or hall. A vast concert sound is, at present, incompatible with musical instruments that seem to swing and sway in space a few feet in front of your ears or, as above, sit in your lap. Even jazz can use naturalness of room perspective. We have it in this disc.

The Counterpoint sound quality, as far as I can determine at this point, is good but not as good as it probably will be later on. Well-miked stereo always helps to obscure distortion, if any, and that is what happens here. I liked this stereo disc and so will you, especially if you are a Pee-Wee fan.

Vivaldi: 4 Bassoon Concertos. Virginio Bianchi, bassoon; Gli Accademici di Milano, Santi. **Stereovox ST-PL 1-.740.** (stereo).

Vox is creating a bit of semantic hash for us by classifying its stereo disc output under "S" instead of "V" in our indexes—and spelling the new name in various artistic ways, with script and the like, such as "Stereo-VOX," or maybe "Stereo VOX." Won't bother most listeners, I suppose, if the discs are OK. It annoys my cataloguing assistant.

The Vox musical output is nothing if not thorough and, to date, the policy of a lot of one kind of specialty has paid off, in prestige as well as cash. One big Vox album had 18 flute concertos by Vivaldi; the four bassoon concertos are a much lighter dosage.

The music is pleasantly lumpy Vivaldi, recorded fairly close with a good spread to the smallish string group, as between stereo speakers, and a somewhat heavy sound, inclined towards the bass end. The bassoon is comfortably close and slightly indefinite as to location, which is OK. The playing is technically expert but rather too metrical for my

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of the LP record itself, ten years ago. Pretty dismal. We're bound to experience
Bloom" waltz and the "Kiss Waltz." You can see what I mean. It's all Johann Strauss,
you, especially if you are a Pee-Wee fan.



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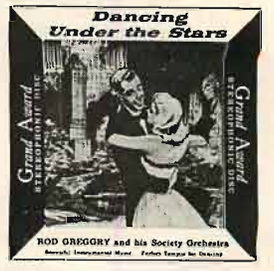
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taste; you'll beat time to it until you wish it would loosen up just a trifle here and there.

Taken one or two at a session (a side, maybe), these can be very pleasing. Small doses go down nicely; big ones stick in the craw. (Vivaldi, the composer, didn't ever intend that you should listen to four or five complete concerti in a row. They were simply published in a lump, for convenience in the handling and cataloguing, and they are recorded on disc with precisely the same intention.)

Stereo Record Sampler. Stereovox VST 1

This is a preview of things to come—or was at the time I heard it. The variety is excruciating, from the preceding Vivaldi bassoon music to the races at Lime Rock, Conn., the sound of which I hear "live" when the wind is right from my own front porch in Connecticut (about 7 miles away). For some reason there are included a music box and the inside of a jet plane whispering quietly at 700-plus miles an hour, not to mention the sonic barrier being busted wide open. (This sound, of course, peaks on the record at precisely the same level as the loudest tones of the single bassoon.)

That and more, on the first side. Real sampler. The second side goes all-out for a single musical sequence which has me puzzled—the dances from "The Bartered Bride" of Smetana, with the Bamberg Symphony under Hollreiser. Puzzled because the music is played in a vast, confusing liveness and the stereo effect, if any, is inaudible to me.

A horrid thought even occurred to my wicked mind—that this was merely a pseudo-stereo record, both tracks derived from a single original, the second track ingeniously doctored to give a sense of side-to-side space to the whole . . . but anyhow, the stereo isn't every effective. The sound is lumpy, bassy, as well as lost in the too-big echo, and the playing itself is lumpy too. These dancers must have had plenty of bacon on them. A kettle drum, near the beginning, is whammed like the crack of doom, as though a signal for us to grit our teeth and begin to suffer! Nope, not the best demonstration I've ever heard.

Follow the Drinking Gourd. Michel Larue, Alex Foster, the Drinking Gourds.
Counterpoint CPST 560 (stereo).

In spite of much to-do in the notes about the ethnic importance of negro slave music and so on—very true—the content of this record is somewhat arty and sophisticated and a far cry from slave music! I can best describe it, I guess, as in the Josh White area, though not half as easy-going and straightforward as White. There's a bit of voodoo and work song, some vaguely Latin-American tap-tapping, primitive drums here and there, plus singing and casual conversation over blues background.

The frank jazz stuff is the best, I'd say. Forget the ethnic and slave angle, and just listen to the electric guitar (anyhow, it sounds electric . . .) and the semi-croon. Not bad.

This is a clean-cut example of stereo extremes in the miking. Channel A is so completley isolated from Channel B in some parts of the music that if you listen to one track you hear the accompaniment alone, to the other and you get only the singing voice—with almost no "cross-talk" at all. Odd effect, bolstered by a bit of over-all echo-chamber (it sounds so, anyhow) in the rear. You can test your equipment very nicely.

Quality is fairly good, but with that slightly metallic sound which I'm getting to be all too familiar with in these early stereo discs. Seems to be inevitable as a starter, though (as can be guessed) all the specs from start to finish on records like this indicate perfection, minus distortion. Reminds me of the old weather cartoon—Weather Man looking out of his window and saying, "But it CAN'T be raining." . . .

Destination Moon (excerpt); Champagne Music. . . .
Omega Disc OSLX-1 (stereo 7-inch).

I just mention this little sampler, with a couple of minutes on each side, to say that, of its sort, it is surprisingly good and the complete recordings on disc and tape are probably the same. One side is informal pops, hotel orchestra style, and both are cut clean, with excellent stereo effect in each type of medium. About the best stereo I've heard on disc, technically speaking.

2. STEREO TAPE—NON-CARTRIDGE

Note: After my last month's AUDIO ETC enthusiasm for RCA's cartridge stereo, you may have thought that stereo-on-the-reel, two-track, was dead. Not at all—not yet. Lots more is coming out and the stereo cartridge, at this writing, hasn't given so much as a cheep or a peep in public since its flamboyant (and premature?) announcement back in May. It'll be along, but there's no hurry.

I think it important to point out that of all the forms of stereo sound available now, two-track stereo tape is the only one that has reached real stability and listening perfection. It takes a year or two for any new system to shake down to a reasonable reliability in all its aspects. It takes *us* a year or so, actually, to shake ourselves down to the point where we know what we have, where we understand our equipment's temperament and that of the recordings it plays.

These last months, after so long, I *have* really at last begun to enjoy stereo music for its full worth, via the numbers of tapes I've been receiving. Would that I could do justice to more than a part of them! Too many other things press for attention. But here are some of those I've played and absorbed, mostly with very great pleasure.

If you are set up for this type of tape stereo and can afford to continue buying on-the-reel tapes, by all means do so. It will be many months before disc stereo can reach the present high state of stability and reliability that we've achieved in stereo tape. The same goes for stereo tape cartridge, when it gets under way. I'm all for both of these *potentially*. But right now, I'll plug for ordinary stereo tape as the only reliable, perfected stereo on hand at the moment. It'll be that way for awhile more, you may be sure.

Beethoven: Symphony #2; Egmont Overture. Graz Philharmonic, Caridis.
Livingston 4003 K (stereo tape).

This is one of the rare independent classical tapes not available on standard disc, and it's an unexpectedly good tape, both technically and musically.

The orchestra is not first-rate, but the Graz players (Austria) are good musicians and well up on the Beethoven tradition. The performance is thoroughly pleasing and in excellent taste. So is the stereo.

Handel: Israel in Egypt. Combined choruses Univ. of Utah; Utah Symphony, soloists, Abravanel.
Westminister SWB 803, 9008 (two reels stereo tape).

This monumental Handel performance is out on stanadard disc if you want to save money. The performance is currently much the best on records, though there is more that could be done for a really top rate version of this great and dramatic oratorio, describing the plagues in Egypt and the Israelite exodus via the bottom of the Red Sea. The spirit of this performance, at least, is rightly dramatic and fast-moving, where the earlier British versions are painfully stodgy and dull. But the choruses mumble the text as they sing instead of saying it out with all its excitement, and the solo singers (relatively minor importance) are so-so. Still—the huge drama gets over.

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tric . . .) and the semi-croon. Not bad.
This is a clean-cut example of stereo extremes in the miking. Channel A is so com-
an unexpectedly good tape, both technically and musically.
The orchestra is not first-rate, but the Graz

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I'm not enthusiastic about the stereo effect. It has a vast sweep for the chorus (a double chorus, singing almost throughout the work) and for parts, at least, of the orchestra, and in this the stereo version does a lot for the immense, grandeur of the piece. But the soloists are rudely placed practically in your lap, in the left and right speakers, and some instruments of the orchestra are similarly falsified as to position for a "hi-fi" effect that confuses the imagined scene.

Stereo is very tricky in these respects. Hi-fi close-up miking can do startlingly false things in many situations. There's nothing wrong with close-up recording—so long as it is consistent with the over-all mental picture being projected of the complete musical scene. It isn't, here.

Chadwick: Symphonic Sketches. Eastman-Rochester Symphony, Hanson.
Mercury MDS5-24 (stereo tape).

Who's Chadwick? A delightfully good humored old composer from Boston, of the turn of the century, one of our own musical leaders and long head of the New England Conservatory of Music in Boston. He wrote big, extrovert, bouncing overtures and such (lots more, too) that are uninhibitedly imitative of European music, as was all of ours in the late years of the nineteenth century. Very dated, this music, as we hear it now, but good stuff for listening even so, with an unescapable American twang in spite of the 100 per cent European Romantic idiom. Of this suite, "Jubilee" is fairly often played; the other items are new for most of us—but it's about time we heard them.

Mercury's three-track technique, as described in AUDIO, ETC awhile back, allows for an over-all close-up "hi-fi" view of the orchestra without noticeable doubling, or split in the middle. It works, and this is a good example. But for me it is somehow a disappointing sort of stereo, lacking the dramatic big-hall sound that makes Capitol and RCA orchestral stereo so exciting in musical effect. Matter of taste; the instruments, one and all, are impeccably clear and sharp in detail here and the sound is excellent in quality.

Chausson: Symphony in B Flat. Detroit Symphony, Paray.
Mercury MDS5-26 (stereo tape).

My favorite bouncing French conductor, Paul Paray of the Detroit, in one of those nice, long-winded French symphonies that now sound so pleasantly old-fashioned. Paray makes a great deal of it, as a dutiful Frenchman should (and as he can so well), and the stuff makes pleasant listening. Again, the Mercury stereo technique is as described above.

Wagner: Dawn and Siegfried's Rhine Journey; Siegfried Idyll. Detroit Symphony, Paray.
Mercury MAS5-20 (stereo tape).

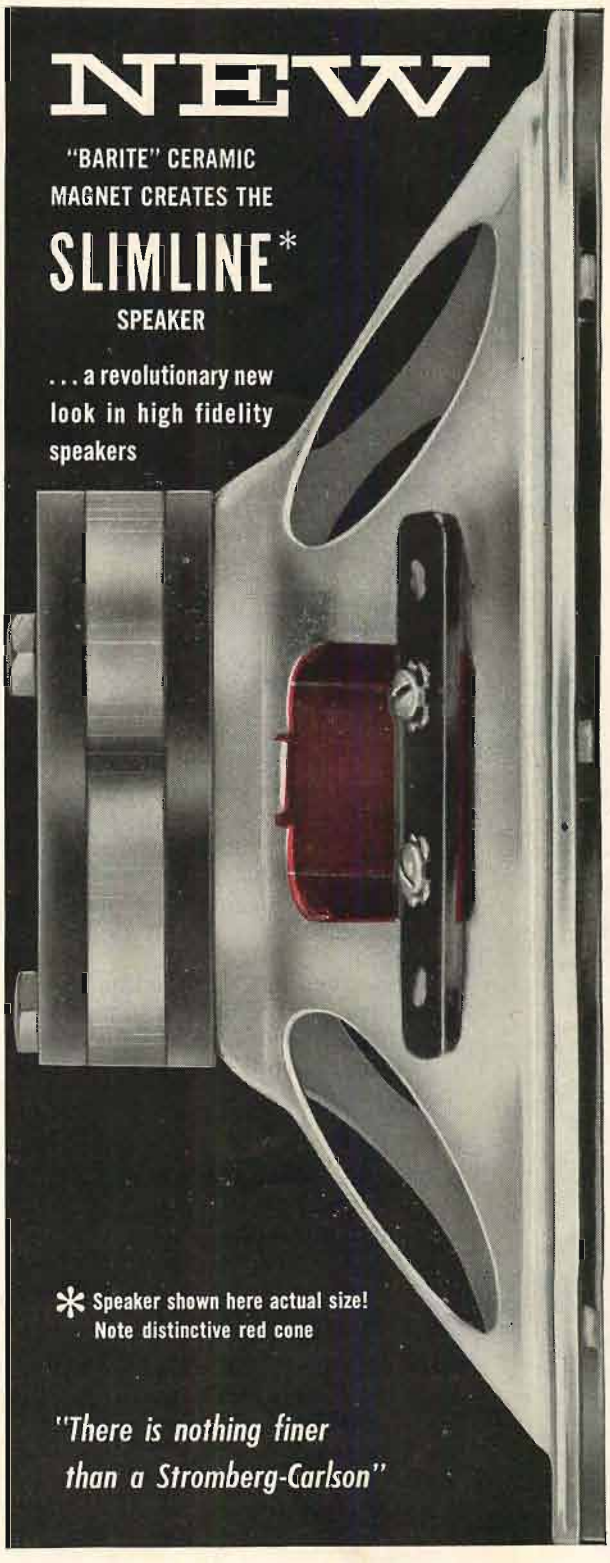
. . . And here he is again, doing wonderfully French things with the heavyweight German music, which somehow comes out sounding like "Carmen." The French, as you know, detest heaviness in music, especially in their musical arch-enemy, Wagner. So if you have ever thought of the great German as a too-weighty, Teutonic monster, you'll find this record an agreeable surprise.

Of course it takes superb musicianssip to dress up Wagner in French style. Paray has it. I am amused at his bouncy eccentricities, but I respect his musicianship throughout, in whatever he plays. So will you. Mercury's stereo technique is good for the Paray Wagner, lightening it up, bringing out all sorts of unexpected inner details that are normally lost in the (intended) general blur of sound. Interesting and plenty hi in fi.

Prokofieff: Suite from "Love for Three Oranges". London Symphony, Dorati.
Mercury MWS5-18 (stereo tape).

Clean up some more Mercury items, while I'm at it. This is a shorty and a beaut of a stereo. The music is brilliant, acid early-twenties (with the familiar March included

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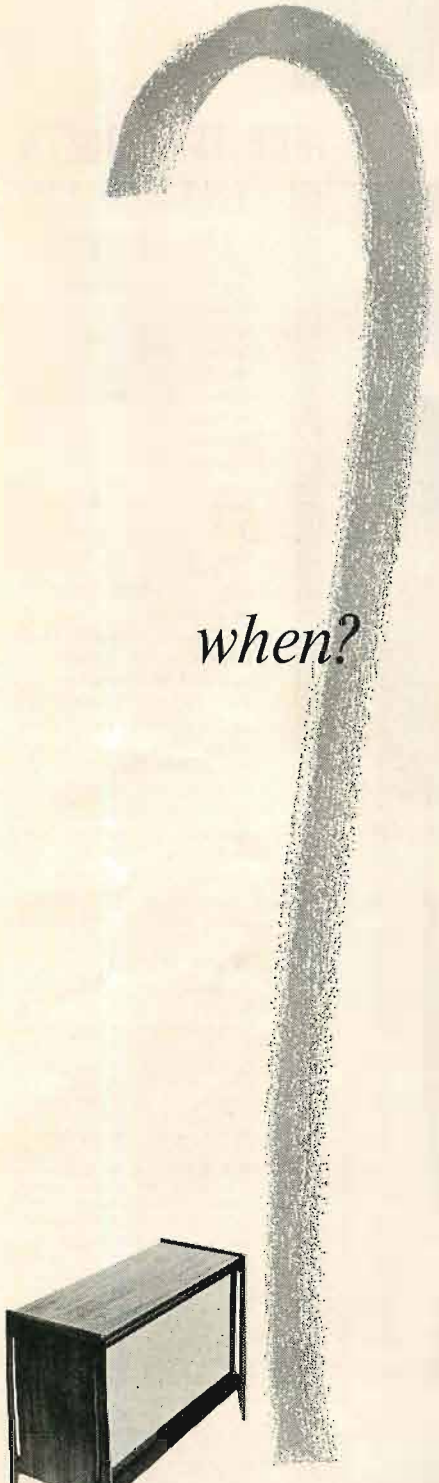
POWER-HANDLING CAPACITY: 18 watts peak. EFFECTIVE FREQUENCY RANGE: 30 to 17,000 cps for 10:1 average loudness range re. 32 sones (90 phons). 52 to 12,000 cps for 5:1 average loudness range re. 32 sones (90 phons). I. M. DISTORTION: 200 cps and 7,000 cps at 2.8 volts, 1:1 ratio, an instantaneous power input of 4 watts: 3.9%. POWER RESPONSE: Within the effective frequency range of from 30 to 17,000 cps, the integrated power response (PWL) is flat within 4 db from 62 to 6400 cps. DISPERSION: 100°—Test Signal, constant amplitude noise band, 1 kc to 20 kc. The intensity at the outer limits of the 100 degree solid angle is within 10 db of the intensity on axis. FREE AIR RESONANCE: 80 cps, ±5 cps. MAXIMUM FLUX DENSITY IN MAGNET STRUCTURE: 17,000 gauss. FLUX DENSITY IN AIR GAP: 10,000 gauss. TOTAL FLUX IN AIR GAP: 29,700 lines. NOMINAL IMPEDANCE: 8 ohms. DIMENSIONS: Diameter—8 3/32"; Depth—3 1/16"; Weight—2 lbs. PRICE: $24.95 (Zone 1).

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Mercury MAS5-20 (stereo tape).

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Test Signal, constant amplitude noise band, 1 kc to



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The total specifications are impressive, but they are also long and complex. So we have included just a few which we think everyone will find interesting. Of course, if you would like the complete specifications, drop us a line and we'll send them along.

Specifications:
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Servo-Speaker Amplifier System.

Contains 3 woofers in a patented computer-designed enclosure, 2 coaxial-coplanar mid-range and tweeter units . . . seven speakers in all. It mounts six fully transistored power amplifiers, each preceded by its own low level crossover network. Frequency response is down zero db at 40 cycles and 3 db at 20,000 cycles. Power output is 2 acoustical watts in the average room . . . about 75 watts of audio output into the speakers. At normal room listening levels, distortion will be less than 0.15% in the *output sound*, not in that dummy load resistor that no one can hear. Input impedance is 100,000 ohms. One volt required for full power output. Dimensions: 44" wide x 30" high x 18" deep. Available in select hand rubbed walnut, teak or limba. Prices from $595.00.

Model 136A Monaural
Servo-Speaker Amplifier System.

Contains 3 woofers, 1 coaxial-coplanar mid-range and tweeter assembly . . . five speakers in all. It employs 3 transformerless direct coupled transistor amplifiers and crossovers. Frequency response is the same as Model 372A above. Maximum power output is one acoustical watt . . . 36 electrical watts. Distortion is less than 0.15% at normal listening levels. Input impedance is 200,000 ohms. 1 volt required for full power output. Dimensions: 30" wide x 30" high x 18" deep. Available in select hand rubbed walnut, teak or limba. Prices from $395.00.

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ant's *Pawn Ticket* in his best jazz effort in some time.

Ernestine Anderson won some notice on records in her own country, before departing on a tour of Sweden in 1956. There she became a hit and was asked to stay on as a headliner. The recording which reintroduces her more mature and practiced voice to American listeners was made there with a capable orchestra headed by Harry Arnold. Her choice of selections lists the too seldom heard *Experiments* by Cole Porter, and Ellington's *Day Dream*.

London: Its Sounds And People
Capitol T10150

The pealing bells of Westminister Abbey provide a sunny introduction to this portrait in sound, a sequel to sketches of France and Holland. A succeeding flight of Canberra jet planes disperses any remnants of fog lingering along the Thames, and the city is shown in its most summery hues. There are the welcoming roars of animals at Whipsnade Zoo, nightingales and cuckoos on their native heath, buskers, street musicians, Marble Arch orators, a public house visit, and bargaining with Church Street vendors. Thunder accompanies the inevitable shower, quickly replaced by the unleashed voices of children excused from school. Sports fans enjoy a choice of boxing, football and racing cars. Then there is the music of a purring Rolls Royce and a Festival Hall rehearsal. Reggie Brooks is the suitably restrained narrator and Rex Updegraft edited the tapes.

Paul Clayton: Unholy Matrimony
Elektra 147

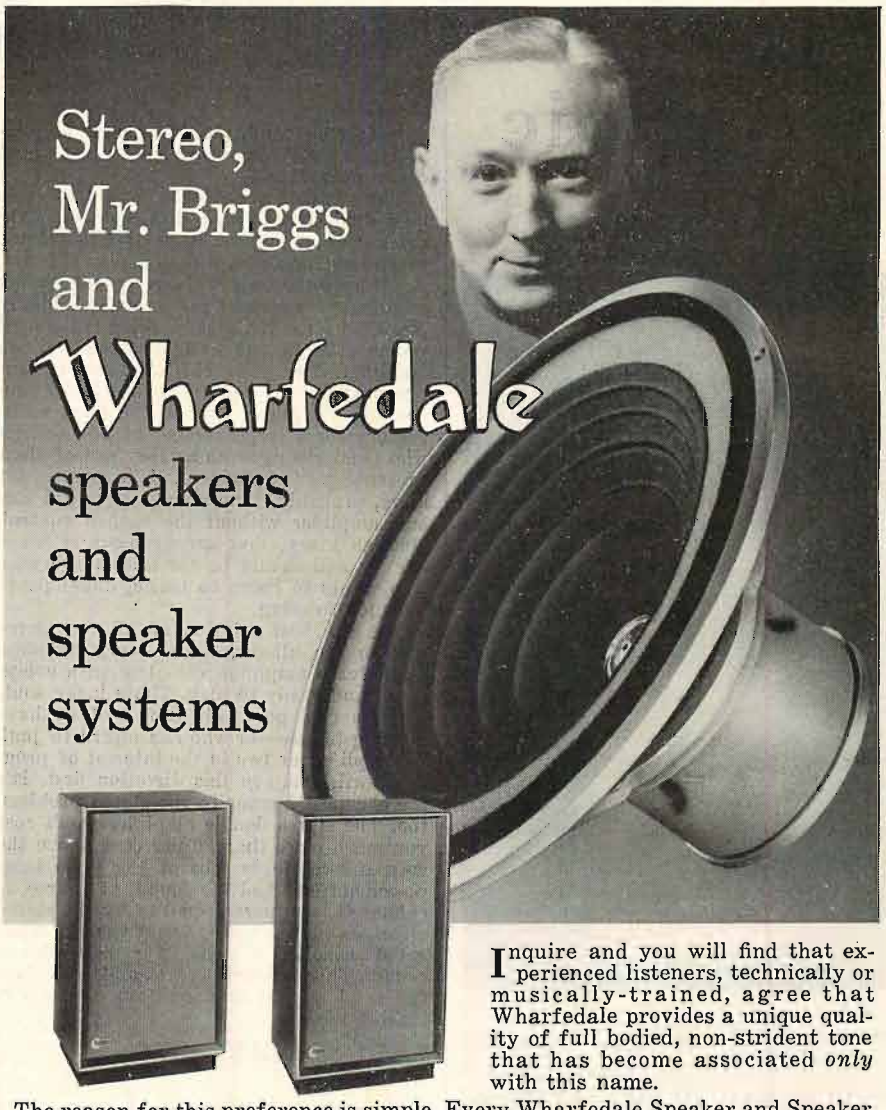
The Kingston Trio
Capitol T996

Both albums proclaim the joys of bachelorhood, with folksinger Paul Clayton relating eighteen reasons for avoiding the married state. In a sequel to Elektra's "Dalliance" series, he sings of *The Farmer's Nagging Wife, The Dumb Wife,* and *Mother-In-Law Song.* Some of his collection is ancient, some modern as *Life on the Installment Plan,* but little of it as familiar as *I Wish I Was Single Again.* The "Scruggs style" banjo and cithern of Bob Yellin supports Clayton's guitar in the accompaniments.

The Kinston Trio, too young a group to have encountered the trials of matrimony, celebrates the delights of the open road on *Fast Freight, Bay of Mexico, Saro Jane,* and other traditional tunes arranged by its leader Dave Guard. In their travels, the boys have filled engagements at San Francisco's "the hungry i" and Chicago's "Mr. Kelley's," and their sound musicianship and skilled vocals will take them further. The other members are Bob Shane and Nick Reynolds, who plays conga drums to augment the guitars of his companions. Their spirits are infectious and their sea chanteys and calypsos invoke a wanderlust.

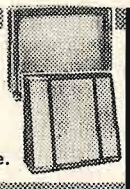
Barron Smith: Wurlitzer Theater Organ
Urania UX108

For the second volume in its series "Breaking the Sound Barrier", Urania turns to the sounds of the Wurlitzer theater organ and the gaiety of Offenbach operettas. A graduate of the Curtis Institute of Music, Barron Smith is organist at the Hollywood Presbyterian Church, a post he held for the past seven years, when not furthering his concert career in this country and abroad. He has also appeared with the Roger Wagner Chorale, and extends his admiration for the stage to include the overtures from the Broadway musicals *Kismet* and *Plain and Fancy.* The engineers chose a seat comfortably forward in the orchestra rows and it is easy to imagine the curtain going up on the can-can girls of *La Vie Parisienne,* or *Orpheus in the Underworld.* Smith follows the lightening shifts of mood in *Bluebeard* and *Tales of Hoffman,* saving the *Sabre Galop* from *The Grand Duchesse of Gerolstein* for a rousing finale. He keeps his opera light, but not too frothy, in an excellent recording. AE



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2 Speaker System
based on the full range, remarkably balanced W/10/FSB speaker

In this Wharfedale Speaker System the W/10/FSB speaker and tweeter are integrated with an enclosure, incorporating the new, patented Acoustic-Filter design. It produces a majestic sound, most unusual for such a compact system. Particularly suitable for stereo listening in an average room. **$144.50**



WAF/2
2 Speaker System
designed around the celebrated Super 12/FS/AL full-range speaker

Here is the Wharfedale System that was designed specifically to insure full performance of the very wide range Super 12/FS/AL speaker and Super 3 tweeter. For this reason the WAF/2 system is recommended for maximum stereo effect. It is handsomely styled and incorporates the Briggs' Acoustic-Filter. **$199.00**

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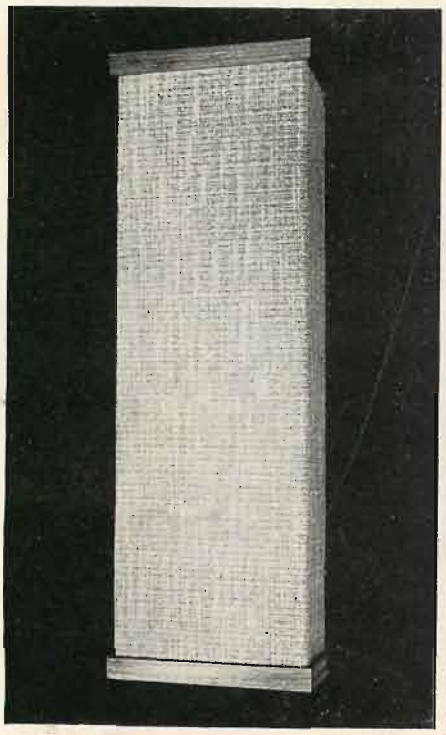
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AUDIO ETC

(*from page 14*)

amps are on hand, the dual power amplification is a far easier problem in just about every respect.

The simplest such device would seem to be a dual stereo preamplifier-control, without power amplifiers. Hook to two outside amplifiers, preferably duplicates. (If not, you'll have the usual balance troubles when you change modes of operation.) A highly practical form of the same thing is the dual preamplifier-control unit with one built-in amplifier. Use your old amplifier (minus preamp) for the other. This species of conversion, I'd guess, will be the most satisfactory for a large number of hi-fi owners who must use as much as they can of their present good equipment. It'll cost a bit more, probably, than simply buying a second amplifier without the unified control. But, as I say, that arrangement is taboo for me and should be for almost everyone who wants to listen to music, unhampered by knob-twisting.

But the best solution of all for stereo hi-fi is the all-out, brand new, one-piece dual stereo amplifier, complete with everything and ready to play. Those lucky souls who haven't got their hi-fi and so have nothing to lose—or who can afford to junk an amplifier or two in the interest of progress—will jump in this direction first. It's the cheapest answer to the stereo problem, too. The stereo double amplifier won't cost you much more than 20 per cent above the cost of two single jobs of the same total power output. And the sound, of course, is enhanced in apparent quality by the stereo effect, as well as by the use of the two separated speaker systems for monophonic sound. This is where we should look first for good stereo, then, and it's where I'm looking next.

2. 50–60 WATT KITS

A. EICO

I'm a sissy. Well, anyhow, I chose not to build two excellent kits that were offered for my inspection to choice—in kit form or ready-wired at the factory. I'm not much of a construction artist, but I think it can safely be blamed on lack of time, what with so much of this and that in audio and music. I took them both ready-made. So for a good while now I've been working alternately with the Eico and Dynakit big-watt jobs—both of them at once in the stereo demonstration alluded to above.

My engineer assistant, who does more or less what he wants to with my equipment, has noted on his "OK" tag attached to the Eico HF52 50-watter this cryptically revealing statement, presumably after his own testing: "Response at 49 watts from less than 18 cycles to 80 Kc ± 1 db." If so, I can only say that the amplifier sound confirms such an observation, as far as my ear can tell. . . . which isn't anywhere near *that* far.

I've found the Eico an almost model example of the large one-piece amplifier, complete on a single chassis. It is old-fashioned and hearty in looks, with tubes, condensers, (whoa, I mean capacitors), bulky transformers, jutting upwards on top, minus cage. (There is a cage, but I don't have it.) It has a row of large knobs, easy to get hold of, and the lettering, black on matte gold, is unusually large and quite legible—a feature that I bless daily.

I do *not* like equipment with such illegible lettering that I have to get down on my hands and knees with a magnifying glass, or shift the lamp back and forth to get the reflection just right, before I can read the useful information. Too much otherwise handsome stuff is thus marked. Not Eico.

One of the first things I noted with pleasure on this amplifier was the positive, 100 per cent shorted-out switching on the selector control. There isn't a trace of leakage from one position to the next and the "feel" of the selector, as well as the other controls, is solid and long-lasting. Nothing has come loose yet, implying that feeling is believing. A solidly built amplifier, this, and I suppose that if you build it from the kit you'll get the same results.

At full volume position, this amplifier produces only a mild rustling noise—no audible hum. That's good. Hum is my biggest bugbear in amplifiers, since I seem to detect it in practically every one I use, specifications or no. I am deeply grateful to any amplifier maker who can guarantee me *humless* music at all practicable volume levels. What? *Every* amplifier should do that? Why, certainly. But darned few actually do it in practice. Especially after a year or so of use. In this sort of thing, hearing is believing. I've heard, and I'm deeply cynical in regard to quoted specifications. Take that from an old and seasoned music listener.

(That reminds me of the very odd sensation I had, in Europe, the first time I heard an amplifier operating on European current. The line was 50 cps, instead of 60, and the hum was minor third lower in musical pitch than ours—roughly a G-sharp instead of the near-B-natural of 60-cps hum. I don't have absolute pitch, but this difference was very pronounced—like the difference between a tenor hum and a baritone hum.)

There isn't much I can say about inputs and the like on the Eico 50-watt because the one that I received was missing its rear lettering. Nine RCA-type phono-plug sockets and not an identification on any of them. I found the essentials by the feel system—magnetic phono, high-level for radio, etc. There is a tape output (off to one side) and the front panel indicates the usual complement of other inputs, exactly those which are most necessary. I approve heartily of the five equalization positions (though I like, these days, to see RIAA at the top, centered) and recommend them as a present standard. COL—the old original LP curve. LON, a complementary curve with *less* roll-off than RIAA, where the COL curve has greater roll-off, both matching whole groups of earlier LP records. These three, COL, RIAA and LON, cover the LP situation very nicely, with occasional aid from a tone control. The other two are AM 78, for U.S. discs with high turnover (800), such as the old RCA Victors (even into the LP era, if I am right), and EUR 78, for the European ones with low (300) turnover and the upper end more or less flat. These five are all you need for present use, unless you are an inveterate gadgetizer who prefers equalizing to listening to music. Eico has 'em, all five.

There isn't much more I can say usefully about an amplifier of this sort except to observe that it has faithfully served me for a year, almost, with nary a slip and no trouble—though the company apologized for forgetting to put on the base plate and thus the insides have been cruelly exposed, in my various movings-about.

I add only one item, subject to your checking. The input sensitivity on this Eico is not very *high. It takes a lot* to drive the main amplifier to all of its rated 50 watts. I see a note on the abovementioned tag that

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in this recording) and is ideal for the Mercury close-up stereo treatment. Nothing "Romantic" here! Dorati is a hard, driving conductor and the music takes to his batou remarkably well.

Brahms: Variations on a Theme by Haydn. London Symphony, Dorati.
Mercury MVS5-25 (stereo tape).

. . . But here we have something else again. All of the hard, unphrased, ugly qualities that Dorati can produce are concentrated in this outwardly note-perfect, inwardly cold and unfeeling performance. Sorry—but this piece is too good aud warm to be played this way without riling the likes of me, and probably you, too.

Tchaikowsky: Swan Lake. Ballet Theatre Orch., Levine.
Capitol ZF-66. (stereo tape).

A splendid ballet sound on this one, in Capitol's reliable and excellent orchestral stereo, huge and live with the instruments beautifully natural iu a fairly distant balance. RCA Victor has a somewhat more taut and disciplined version of this music, but this one has a fine ballet feeling to it and good warmth, where warmth is needed.

I don't know whether this is the complete ballet or not—but there's an awful lot of music on the tape, which is long-play type.

(Note that Capitol uses a form of high-output tape, dark red in color. If you erase it, you'll find that it won't record properly on machiues biased for standard oxide tape. It plays beautifully, as is.)

Tchaikowsky: Capriccio Italien. Graz Philharmonic, Cerny.
Livingston 1016 C (stereo tape).

This is the same outfit as in the Beethoven tape reviewed elsewhere and the effect is similarly gratifying, allowing for the fact that Tchaikowsky demands a bigger, more virtuoso orchestra than Beethoven. It could be a bit more impressive and better in the discipline, but the general effect is musical enough and the stereo is excellent.

Stravinsky: Petrouchka; Firebird (Suites). Berlin Philharmonic, Stokowsky.
Capitol ZF-49 (stereo tape).

Capitol has had wonderful success with its Stokowsky line. This dual recording, of the big two early Stravinsky works, takes me back with euormous pleasure to Stokowsky's earlier days and his always masterful and dramatic treatment of these scores. (Stokowsky made the first complete 78 version of the whole of "Petrouchka," before the war, and it was one of my favorite recordings for years.)

The Capitol stereo technique is astonishingly consistent, from Hollywood to Houston (Stoky's present orchestra) and to Berlin. The sound is superb, no less—in a huge but clear liveness, the orchestra at a reasonable stage distance and marvellously well balanced from right to left, the individual solo instruments as clean and sharp as a whistle yet part of the total ensemble and utterly natural in placement. A top stereo, this. A long one, too.

Gounod: Faust Ballet Music. Vienna State Opera Orch., Aliberti.
Westminster SWB 7058 (stereo tape).

The Viennese orchestra under the Italian (?) conductor gives a straightforward and lively performance of the familiar French ballet music, in reasonable hi-fi stereo, the instruments as with other Westminsters rather close-up aud tending to float indeterminately iu space iu front of the concert stage. Odd, but not nesessarily unpleasant in effect.

Saint-Saëns: Symphony #3 (with Organ). A. Schreiner; Utah Symphony, Abravanel.
Westminster SWB 8030 (stereo tape).

The big sound of this Utah performance and the organist, the man who plays in the Salt Lake City Tabernacle, suggest that maybe the music was performed in that famous spot, though Westminster doesn't say so. I wouldn't know, but the Tabernacle is sort of tied up with Columbia Records, so the omission is understandable.

As in most recent records of this familiar symphony, the organ here is mostly inaudible and you won't need to bother to look for big, fat hi-fi low tones. (Remember the old Columbia version, with the low tones on it?) The performance is, shall I say, entirely satisfactory, if not exactly earth-shaking. The big-liveness acoustics help to blend the sound into a quite pleasing over-all balance. AE

HEARING

(*from page 52*)

correctly is called the articulation. A large amount of such testing has been done at the Bell Telephone Laboratories and elsewhere. The results for a listener receiving the speech at optimum intensity are shown in Table V. It represents the average results of several crews, each having several speakers and listeners. The articulation is given in the first column, the cutoff of the high-pass filter in the second, and the cutoff of the low-pass filter in the third column.

It is interesting to note that for this optimum intensity the articulation is reduced the same amount by eliminating frequencies above 5000 cps as by eliminating frequencies below 570 cps. It is seen that no detectable loss in articulation results until the lower cutoff is raised to 250 cps, or until the upper one is lowered to 7000 cps. The articulation drops from 98 to 96 as the upper cutoff is lowered from 7000 to 5000 or the lower cutoff raised from 250 to 570. It is surprising to note that cutting off at 3100 at the upper limit produces the same loss in articulation as cutting off at 960 at the lower limit. If we cut the frequency range into two parts at 1950, each half will transmit speech with an articulation of about 70 per cent.

If the criterion of the quality of the reproduced speech is taken as the artistic qualities of the voice, we know from our experience with such filtered systems and also from loudness plots of *Fig.* 7 that the lower-frequency regions turn out to be much more important than indicated by the results shown in Table V.

(*To be concluded*)

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Antonio Tain: Paso Doble!
World Wide 20004

One of the more substantial of the many developments in a swift-moving field is transported from the laboratory to the living room with these releases, which also signal the stereo debut of two companies on discs. World Wide is the name chosen by Savoy to label its new offshoot and begin a program of expansion. The Elektra sampler contains excerpts from four of their five initial offerings and is venturesome in its varied choice of material. All were mastered by use of the new Fairchild stereo cutter and allied equipment in the Hackensack studio of Rudy Van Gelder, who had a hand in its conception and closely followed its progress through successive stages to put it to the first commercial test.

It began during a series of conversations with his friend Rein Narma, head of production and chief engineer at Fairchild and a fellow New Jersey resident, shortly after the events of the last New York High Fidelity Show. The demonstrations of the methods of cutting stereo discs were given searching consideration and it was agreed that the 45/45 system offered great possibilities.

"My enthusiasm for the theoretical is always related to the everyday needs of the practicing engineer," said Van Gelder, "and we were both well aware at the time of the difficulties the system would present in day to day operation on a tight schedule. In providing an answer to a few of my objections, Rein revealed some of his ideas for executing a cutter that would be dependable and easy to control. I make no secret of my regard for him as the most brilliant audio design engineer in the country. I soon left off thinking up questions and began persuading him to make something good. About the first of the year, he had permission from his superiors to go ahead and his staff was at work on the project."

There was much research and several prototypes were constructed before Van Gelder was able to remove one from the laboratory and install it in his studio late in April. It lacks the finished appearance of a production model and improvements are still being made. It will be manufactured and sold as an integrated system, including rack-mounted amplifiers and controls. Switches will permit it to be operated monophonically, but Van Gelder has not disrupted his regular equipment to investigate this feature yet.

"There is still a lot to be learned about stereo records," said Van Gelder, "and original research and a fresh approach are going to play their part for some time to come. Because it gives me complete control over how I make a record, the Fairchild system solves many of my problems. I can cut a better groove now than most current cartridges will reproduce, but noise will always be a worry. Representatives from General Electric were out to hear the first lacquer tests. They brought a prototype of their stereo pickup and I have great hopes for it."

The first technical description prepared by Fairchild ran to six pages and has been revised since. Much too briefly, some of its high points are an effective unification of the cutting stylus and armature in one piece, making mechanical linkage unnecessary, and a new damping material of silicone grease. Two electrically independent coils are wound at right angles to each other on one armature, consisting of a single cross-shaped light metal alloy piece machined from a single piece of solid metal. An attached ring houses the stylus chuck, also in a single piece to remove superfluous resonances and ensure rigidity in all directions.

"I have sent test material to all the processing plants used by my clients," Van Gelder continued, "and the reactions are extremely favorable. So far, these are the only stereo records released not mastered by a Westrex cutter. It is still early in the game and I believe the Columbia engineers, along with some English companies and one or two on the continent, may come up with something of their own. I feel the Fairchild will find a place in many studios."

Until the company announced production of the cutter, Van Gelder had to parry queries regarding his plans for stereo. "It was a period of embarrassment," he said, "and not a few unkind remarks. I was glad when I could start my clients on their catalogues early in May. The dates for World Wide were held the same month and for the first time I didn't even run a monophonic tape. The supervisor, Ozzie Cadena, was interested only in good stereo. He selected the musicians and had Billy Ver Planck make the arrangements with this in mind."

None of the companies stress monophonic playback in the advance publicity. When asked to express his views on compatibility, Van Gelder continued, "I find that my clients hestitate to state in their sales literature that a stereo record can be played on a monophonic phonograph, even when the resulting sound is satisfactory. The reasons for this are many. Some of them stem from the reams of inaccurate publicity about stereo records, the desire of the client to sell "pure" stereo with no compromise, or the knowledge that the term must be qualified when the original tapes prove suitable only for good stereo. The last reason seems to be a deciding factor, with the conclusion: 'Let's not call it compatible even though it sounds good.' Nevertheless, I feel that our records play very well on many monophonic machines."

As to the future of stereo, Van Gelder had a few parting thoughts, "The pseudo-technical articles in the public press attempting to explain stereo seem to have created the impression that the effect is two different sounds coming from two separate speakers. Consequently, many people, some in the record business, are judging the records by the difference between the left and right channels and nothing else. I feel this approach to be completely wrong. It is the sort of nonsense that can only lead to a dead end, particularly for music.

"I have spent years trying to make musicians sound like they are playing together, not against each other. I find it most embarrassing to see anyone stick his head between two blaring speakers in an attempt to discover 'Who's on the left and who's on the right'. There is nothing like stereo for making an exciting experience of a moving sound, though I should point out that it is the easiest thing to fake from a monophonic original. Stereo must advance from the cow crossing the living room and left-right separation stage. The stereophonic recording of music is an art far removed from these effects."

Elektra supports its claim as originator of the sampler idea by wrapping up a dozen selections in the form of a travelogue and pricing it to represent the best value in stereo to date. According to Jac Holzman, who directs the company in association with engineer Leonard Ripley, previous samplers have more than paid their way and this one is planned to serve a dual purpose. "We wanted before to make it easier for the listener to meet new artists," he said, "but now we are in the same position as the public in finding our way in a new medium. In spite of nearly three years of experience with stereo tapes, we realize the new discs mean our techniques must be reviewed and a new marketing potential explored. As a first step in that direction, this record has accomplished a lot in a short time.

"If stereo had remained in the laboratory for another six months, some of these questions might have been dealt with less openly. But none of the majors seems to be leading the way, as Columbia did when promoting the LP. We consider it a stroke of luck to work with the people at our pressing plant, Dave Foxman and Horace Grenell of Abbey, and Van Gelder. Livingston Audio Products also cooperated and provided the tapes for three bands."

Many of the artists will be familiar to followers of the label, as some items are available monophonically. They include Sabicas, Theodore Bikel, Marilyn Child, Glenn Yarbrough, Tom Kines, Cynthia Gooding, and the Oranim Zabar Israeli troupe. Those scheduled in the first release are the New York Jazz Quartet, Trinidad Steel Band, and clarinetist Ken Davern and his Salty Dogs. Also two tapes from Livingston featuring the New Deutschmeister Band, and Edi Csoka and his Hungarian Gypsy ensemble. Due to Van Gelder's early reticence regarding the new cutter, the Westrex system is credited on the liner.

"The response is good and reorders came

(*Continued on page 69*)

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

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(*from page 64*)

in before the first shipments were made," Holzman revealed. "As we feel our monophonic product is superior in most cases, we are not pushing the aspect of compatibility. However, advance copies were sent to our artists and people close to the company, along with a mimeographed sheet of questions. Liners and labels were omitted and there was no indication of the nature of the discs. No one was the wiser and only about one person in ten noticed the faults that worried us most. Monophonically, the banjo is too loud on the Ken Davern track and the background noise is too high on another. We expected the Trinidad Steel Band to give trouble and placed it on an inner band for the severest test. It drew favorable comments.

"We followed up with another set of queries to a larger group on the stereo qualities," Holzman concluded, "though it is too early for conclusive returns. We are trying to decide just how much of our catalogue will benefit from stereo and whether it is desired by the people who buy our folk items. We may try some new things or reserve it for sessions which warrant it."

Billy Ver Planck, formerly a trombonist in the bands of Charlie Spivak, Sonny Dunham, and the brothers Dorsey, won his spurs as arranger and composer on two albums for Savoy. The first lives up to the title "Dancing Jazz" on Savoy MG12101, and his current set is called "Jazz for Playgirls" (MG 12121), a designation which fails to disconcert Bill Harris, Phil Woods, Joe Wilder, Eddie Costa, and Sheldon Powell from intense solo flights on a swinging performance of mainstream jazz. His scores give evidence that his working tools include a thorough knowledge of jazz history and he uses it to forge ahead on a direct path, avoiding wandering byways. They warrant his choice as conductor of World Wide's initial sessions.

For his first stereo effort, he calls on a Basie-styled rhythm section and bends it to his needs in devising a superb setting for Coleman Hawkins. It is an effective answer to the often asked question of how the veteran master of the tenor sax would sound in the Basie band for he is joined by Marshall Royal, Frank Wess, Frank Foster and Charlie Fowlkes, all practiced members of its reed section. They give him the warm, understanding support he has missed since leaving Fletcher Henderson nearly twenty-five years ago. He is glowingly expressive on *I've Grown Accustomed To Your Face, Thanks for the Memory,* and *There Is Nothing Like A Dame.* The bouncy *Ooga-Dooga* and *An Evening at Papa Joe's* offer more of a challenge and the way he meets it demands an encore.

The rhythm section, with Nat Pierce in his accustomed role of Basie at the piano, has an integrated sound, due largely to the guitar of Freddie Green. One blessing of stereo may be the welcome return of this instrument to its rightful place on more recordings. Eddie Jones plays bass and Bobby Donaldson is on drums. When played monophonically, this is one instance where the slight unbalance of the stereo setup is an advantage. The same amount of presence on a series of saxophone solos, with no relieving brass, can be very wearing. Instead, there is the pleasant sense of depth of a live performance.

I was prepared to call it the best stereo recording I had yet encountered, when the arrival of the demonstration of *ffss* snatched the words from my typewriter. London stakes a firm claim on the classical honors, and it is enough praise to report that a direct comparison of the sound on the jazz items is favorable to both parties. It is reassuring to know that another period of wishing many American jazz musicians were recorded in England is not ahead.

In sharp contrast to his voicing of reeds, Ver Planck's second stereo LP makes use of his ability to write vital lines for a free-wheeling septet. His melodies are catchy, and the solos of Joe Wilder, on trumpet, and trombonist Bill Harris are the sort you will return to again and again. The baritone sax of Pepper Adams is in its element in stereo, and is balanced by the tenor sax of Bobby Jaspar. Their version of *Royal Garden Blues* is fresh testimony of the adaptibility of such tunes to stereo. Pianist Eddie Costa heads the rhythm section of George Duvivier on bass, and drummer Art Taylor. When played monophonically the sound seems good, but only until it is heard in stereo.

Bearing the subtitle "Dance of the Bullfighters," the third World Wide release is one of the increasingly popular sonic expeditions to Mexico. Antonio Tain leads Los Banderillos in an exploration of native festivities on ten numbers. Shouts of *Ole!* reward the toreadors and add a sense of immediacy and exuberance to the colorful spectacle in the ring. It is most impressive for the quality of the recording and a careful control of the stereo effect. Unlike many stereo discs which aim mainly at directional separation of instruments, it can be used by those lacking tape facilities, and a suitable recorded tape, to position the two speakers. There is no discernible distortion between the two channels and they blend in agreeable realism, when properly equalized. It is another step forward for the stereo disc, and proof that it is rapidly moving out of the experimental stage both in and out of the laboratories.

A Journey Into Stereo Sound

London PS100

This demonstration record, with the new identifying symbol *ffss* and a royal blue label, seems destined for repeated play at every components shop and high fidelity show. Before this note appears in print, most audio fans will be made aware of at least a portion of its contents. The eighteen selections are an inclusive recital of stereo sound, bound together by a narrator who includes an unlisted exchange at table tennis. The expected trains, tap dancer, and racing cars are topped by the changing of the guard in the engrossing "Ceremony of the Keys." Ted Heath is heard with drums in the middle, and the reed and brass sections on either side. The Mantovani strings shimmer with all their luster. But the anticipatory lure of the album begins as Ernest Ansermet conducts the Orchestre de la Suisse Romande in rehearsal, followed by a moment from Stravinsky's *Rite of Spring.* Here is stereo in all its glory, and succeeding classical excerpts prove that the traditions of *ffrr* are being carried forward.

The Music Of New Orleans, Vol. I

Folkways FA2461

Recorded in the years between 1951 and 1958 by Samuel B. Charters, a California musician who has spent much time studying the music of the South and its progenitors, this volume is the first of a series of four devoted to the traditional sounds of New Orleans as heard in the city today. The current sides were taken down in the past two years and are divided between the picturesque street serenaders and the revelry of Mardi Gras. There are the cries of peddlers, a blind artist of the musical saw, and evangelist Sister Dora Alexander with her tambourine and the warning *Russia, Let God's Moon Alone,* composed the day after the launching of the first Sputnik. The performers were recorded in their own homes, except for a shoe shine boy dancing the complicated pattern of the *Hambone* at his stand. Frank Amica, an itinerant guitarist, shows a style attuned to the light classics, in contrast to Blind Snooks Eaglin's blues lament *Mean Old Frisco.*

Mardi Gras day begins with a visit to a tribe of Indians, whose lavish, rented costumes and painted faces make them colorful adjuncts to the carnival. Their description in song and story of the practices of their club is a souvenir collected by few tourists. A weary brass band, exhausted from an afternoon of marching, starts a lugubrious *Bourbon Street Parade,* then suddenly steps up the pace as lodge headquarters is sighted. The crowd noises of the torchlighted Momus parade and snatches of passing bands brings the day to a climactic close.

Portrait Of Pee Wee

Counterpoint 562

Due to his part in the "Seven Lively Arts" jazz program and his frequent appearances on the weekly WNTA televised jazz party, also broadcast on AM and FM radio on a second channel for stereo listening, the mischievous features of Charles Ellsworth Russell hold a fascination for many viewers in the New York area and the far reaches of the Armed Forces network. In the liner notes, Charles Edward Smith gives a word picture of his career and lasting position in jazz, touching on his link with Frank Teschmaker and his flair for the unpredictable. For his sound portrait in stereo, Nat Pierce fashions nine arrangements for a septet of trumpeter Ruby Braff, Bud Freeman on tenor sax, Vic Dickenson on trombone, Charles Potter on bass, and drummer Karl Kiffe. And the clarinetist applies the final shimmering hues on three quartet numbers, topped by his own beautifully-shaded *Pee Wee Blues.*

Like the musicians on this label's first stereo date with Juanita Hall, he survived the recording techniques of the 20's under the wing of Red Nichols, and takes the new dimension in stride. It is on a par with that disc, both as to sound and in the recalling of such favorites as *I Used To Love You, Out Of Nowhere, If I Had You,* and *World On A String.* There is no vocalist, of course, and someday a liner writer may tell of the fate of a bevy of Broadway thrushes, imposed on the band headed by Russell in a club once standing on the site of the parking lot opposite Jimmy Ryan's.

It is now fairly established that a small, relaxed jazz team is the ideal combination to help stereo discs through a period of growing pains. They have strength and durability, plus a sureness of timbre more adaptable to close-miking than most voices. The soloists are well separated, but the arrangements are skillfully planned to keep them integrated. For the quartet, Pierce changes channels to balance his piano against the clarinet. In monophonic playback, the clarinet is favored and the trumpet loses a little of its edge.

Eddie Condon Is Uptown Now!

M-G-M E 3651

Red Onion Jazz Band: Dance Off Both Your Shoes

Riverside RLP 12-260

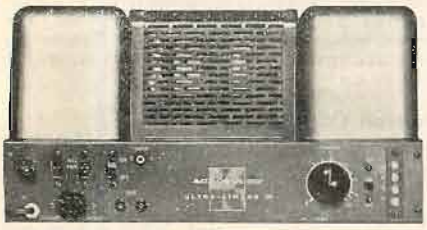
Apparently still dazed from the logistical operations involved in moving his club from Third to 56th Street, Eddie Condon let ten men into the studio for this date, complementing his septet with Billy Butterfield, Dick Cary, and Bud Freeman. Also on display is Rex Stewart, replacement for Wild Bill Davidson, and his vocal salute to the occasion is alone worth the price of admission. Included are Freeman's *Ginger Brown,* and *Newport News,* with a lingering look at the Village in *Third Street Blues.* Despite plush surroundings and the inflated personnel, it is the same old Condon crowd.

The Red Onion, headed by Drummer Bob Thompson, was one of the few traditionalist groups to make Manhattan a headquarters. It never forgot the dancer and its easy tempos remain ideal for that purpose. Joe Muranyi, cornet, and Jim Heanue, clarinet, are firmly rooted in New Orleans, and pianist Hank Ross studied with James P. Johnson. As part of a program of restoring Empirical sides, the LP presents first issues of *Beedle Um Bum, I'm Nobody's Baby, Mr. Jelly Lord,* and *Sobbin' Blues.*

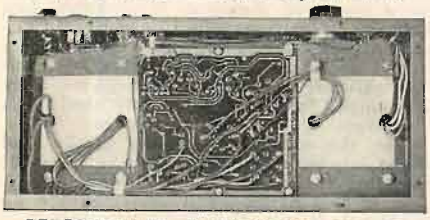
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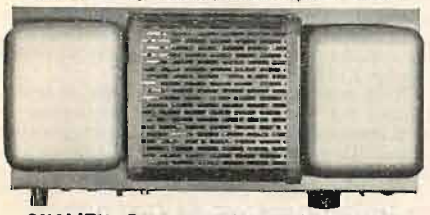
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Wheelin' And Dealin'
Prestige 7131

Charted by pianist Mal Waldron to showcase the distinct styles of a trio of leading tenormen, this date is further leavened by the contrasting flute work of Frank Wess, who outlines the theme in most cases before switching instruments to swap choruses with Paul Quinichette and John Coltrane. The title stems from two blues, *Wheelin'*, a fast Basie-inspired dazzler, and *Dealin'*, a plaintive minor-keyed opus characteristic of the composer. Included are *Robbins' Nest*, and Ellington's *Things Ain't What They Used To Be*.

It is a partial answer for those persons who have been waiting to hear how the potent force of Coltrane would mix in such company. His solos flow logically and fit into the over-all pattern, either as climactic accents or as solid structures for the others to build on. There can be no doubt of his individual jazz voice and the fortunes of recording may yet team him with Thelonious Monk for the space of a complete LP. Doug Watkins, bass, and Arthur Taylor, drums, fill out the rhythm section.

Benny Golson: The Modern Touch
Riverside RLP12-256

While building a reputation as composer and arranger during the past two years, Benny Golson did most of his writing for the Dizzy Gillespie band, until its untimely demise shortly after these sessions were held the week before last Christmas. From his post in the reed section, he worked out strongly melodic themes and imaginative ensemble passages to serve both the big band and gatherings of its members in small studio groups. His first LP as a leader is a departure from this context, as he writes for trumpeter Kenny Dorham, trombonist J. J. Johnson, bassist Paul Chambers, drummer Max Roach and pianist Wynton Kelly, the only other recent Gillespie alumnus. Unless he can find a place in one of the few large organizations, this diverting excursion will assume importance as the first step in a fresh stage in his development.

From now on Golson's career may be cast with units this size and his three originals are tighter and more complex than previous efforts. Designed to stimulate the soloists in the intimacy of a sextet, they bask in the warm glow of his lyric tenor sax playing, especially on *Blues on Down*. Gigi Gryce provides *Hymn to the Orient*, and *Reunion*. A show tune, *Namely You*, is from "Li'l Abner".

Bob Brookmeyer: Street Swingers
World Pacific PJ1239

Jimmy Giuffre 3: Trav'lin' Light
Atlantic 1282

Along with his formal entry into the orbit of the Jimmy Giuffre 3, Bob Brookmeyer is continuing to broadcast a strong signal on his own behalf. Neither in the music or his unassuming liner notes does the trombonist indicate a desire to dismiss the pulse of the rhythm section, as sounded here by Bill Crow on bass, and drummer Osie Johnson. And he turns to the piano to make it an engaging and sprightly part of his *Musicale Du Jour*, and the title tune. Guitarists Jimmy Raney and Jim Hall, who is also one-third of the Giuffre 3, alternate between lyrical lines and rhythmic comments, each contributing two originals. Hall's *Arrowhead* is most successful in its organization of American Indian themes and dances. The other compositions are generous in a valid use of blues, gospel, and country-western folk elements.

They are employed in the same refreshing manner that made the first album by the Giuffre 3 so effective, and in its second effort the leader continues to nurture the same areas on *The Swamp People, Green Country*, and *The Lonely Time*. He shifts from clarinet to tenor or baritone sax for rewarding interplay with Brookmeyer, but the trio suffers from the loss of bassist Ralph Pena. Giuffre's dismissal of the rhythm instruments here reaches the point of diminishing returns. However intriguing its initial appeal, when carried to this extent, it interferes with the functions of the horns. Besides, imaginations fertile enough to amplify his indicated pulse can also envision better solos on their own than he can play, making his experiments self-defeating in the end. But their influence can be a healthy one, as Brookmeyer demonstrates on both sets.

Red Garland: All Mornin' Long
Prestige 7130

The informality of this session extends the title track to fill one side of the record with the pre-dawn sounds of the sort of blues usually reserved for the last set of an inspired evening. Red Garland punches out the lines in firm, declarative statements on the keyboard before subsiding into an insistent prodding of the horns. Not that much is needed, for John Coltrane on tenor sax and trumpeter Donald Byrd welcome a chance to illuminate some of the eternal truths of the subject. They thrive in a setting which permits a free flow of ideas, unimpeded by anything other than an inherent sense of form and unmarred by technical exercises and meaningless outbursts. Bassist George Joyner is accomplished in his solos and Art Taylor drums in a manner to make the whole proceeding seem effortless.

The quintet is not a studio group, having played engagements during the leader's sabbatical from Miles Davis last fall. Byrd reworks the melody of *They Can't Take That Away From Me*, and a dynamic reading of Tadd Dameron's *Our Delight* provides a whirlwind finish.

Glen Gray: Sounds Of The Great Bands
Capitol W1022

Ted Heath: Al Jolson Classics
London 1776

Jackie Gleason: Riff Jazz
Capitol W1020

The swing era is still very much alive in these albums, all designed for dancing feet. Glen Gray recreates the original sounds and personality of sixteen big bands in hit arrangements. He casts Nick Fatool in the Gene Krupa role on *Symphony in Riffs*, and selects Gus Bivona for Artie Shaw's chorus on *Begin the Beguine*. Skeets Herfurt plays Jimmy Dorsey's *Contrasts*, and Plas Johnson is Charlie Barnet on *Cherokee*. But the honors are carried off by Ray Sherman, a pianist able to depict the divergent solos of Count Basie, Claude Thornhill, Earl Hines and Avery Parrish.

Ted Heath renews a dozen Al Jolson favorites with a fresh setting and a livelier pulse. His band is at its best on showtunes, and again the engineers perform the impossible in seeming to make this recording sound better than his last. The British leader may find himself dedicating an album to Jackie Gleason, for the rotund stylist adds ringing brass to his string section and hastens it on a musical journey up the Sawmill River Parkway and the Albany Post Road to the *Bird'n Bottle*, stopping midway for a snack at *Mary's Pizza Mart*. The soloists are Charlie Shavers, Hank Jones, Jimmy Cleveland and a surprisingly relaxed Charlie Ventura. A genial outing for any summer evening.

Dakota Station: In The Night
Capitol T1003

Ernestine Anderson: Hot Cargo!
Mercury MG20354

International boundary lines fall before the two promising jazz vocalists on this pair of LP's. As a reward for becoming a bestseller in her record debut, Dakota Staton is teamed with the George Shearing Quintet on six numbers, including *I Hear Music, I'm Left With The Blues In My Heart*, and the title tune. Her early success, as in the case of many young singers, stems partly from an appealing set of tricks. No matter how individual and identifying they seem now, she should begin to discard them before they become mannerisms and obscure her basic talent, which is considerable. But it is the former British subject who should be grateful for this date, for it allows him to loose his pianistic abilities on Horace Silver's *Senor Blues* and Ray Bry-

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reads "*10 Mv* for 50 w, out." In my own terminology, I find that most low-level cartridges drive this amplifier to reasonably high output with the volume about three-quarters turned up; but a really low signal input finds that there isn't much reserve left. So it was with the Fairchild XP-4 stereo cartridge, mentioned above. Could be an idiosyncrasy of this particular instrument—I haven't looked at the published specs.

Mark III

B. DYNAKIT

I don't really know what to say about the famed Mark III Dynakit, the other amplifier that was turned over to me already assembled. We all know that it rates among the very top amplifiers on the market in basic performance. I found no reason to think it deserves less praise, and it hasn't given me any sort of trouble so far, after a good many months use, including travel abuse. (I've nearly dropped the darned power unit on my toes a couple of times—it never fails to catch me unawares, it is so extraordinarily heavy!)

The Dynakit, of course, is in two units; I have both the power amplifier and the preamp unit. There's little to say about the power amplifier in use, other than to note its weight, its nice chrome bottom, and the utter silence which issues from the loudspeaker when the input is shorted out! No hum in this unit, as far as I can hear. The rest is an old story with many readers—this is a famous unit by now.

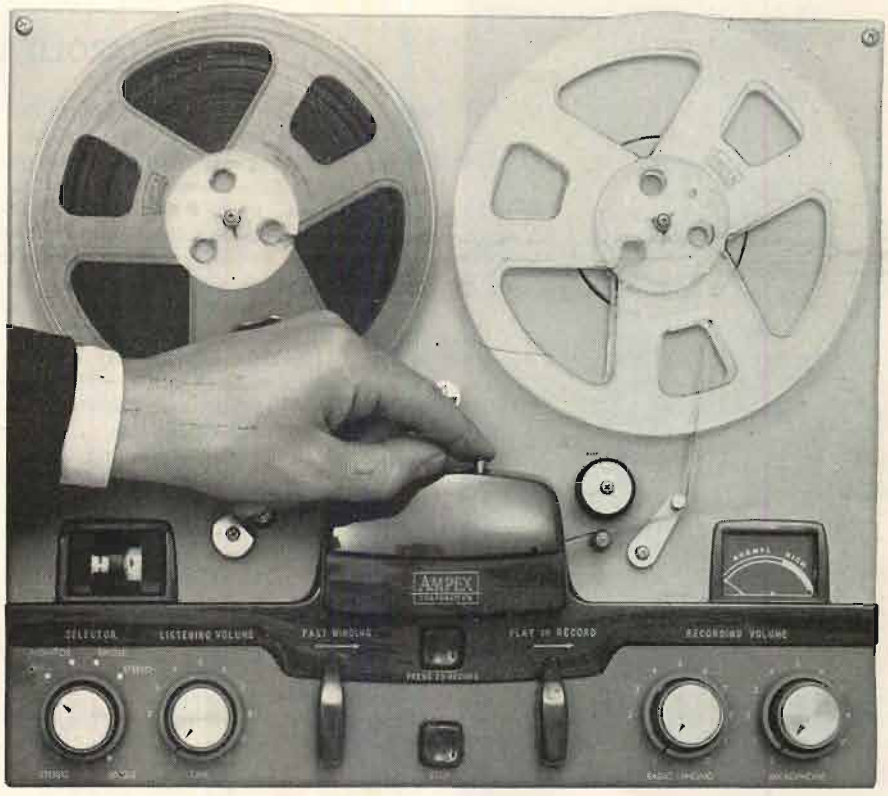
The preamp is widely known and a bit on the unusual side. It is one of the rare models that is not self-powered; it plugs into the main amp for its juice. That makes it small and plenty compact. But it also means a lot of cabling between the two units, and you can't space them apart more than the short cable length available. In use, you'll have three cables between the two sections, power cord for the power amp (which turns on with the preamp when plugged into it), power cable for the preamp tubes and the signal connection from preamp to main amp. A bit cluttered, if out in the open—and I always forget the signal connection when I hook the system up in a strange place. But I do like the thin-line shape of the preamp unit. Neat and convenient.

If I may be constructive, I suggest these mild disadvantages. First, there is a bit of noise in mine, more than is ideal. Being a kit, this one may suffer from individual ills. It isn't bad, but it is there—for my ear, anyhow. Second, I get annoyed at the odd space-saving indicator paste-on for connections, at the rear. It is a "picture" of the inputs, etc., and you look at it like a map, then go find the proper facility. True, there probably wasn't room for anything else in this very compact rear end. But does it have to be shiny gold metal—so that light reflects from it and the lettering is mostly invisible? A very minor point, but it can annoy, especially when you crane your neck over backwards to get a look at the rear of the unit, only to be greeted with bright golden flashes!

Due to the compact size, the control knobs are a bit on the small side, too. Not important, but this was one more incompatibility when I was using this preamp *along* with the Eico and its rather large control knobs for my stereo demonstration. A little volume knob on this unit, a big knob on the other, the settings different, the position on the panel different . . . no wonder I got mixed up once in awhile.

Don't take all this too seriously; the unit is the most economical of space, the most compact that I've run into so far and its general shape, performance and facilities are likely to please a lot of people Æ

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ABOUT MUSIC

Report from Pre-Festival Salzburg

HAROLD LAWRENCE*

THE CHIEF ATTRACTIONS of Salzburg during pre-Festival days are the city itself, which is rightly described as a "Baroque jewel," and its impressive natural setting. Looking down upon Salzburg from the mighty fortress of the archbishops, *Festung Hohensalzburg*, is like seeing the plan of a 17th–18th century town brought to life. Virtually all the buildings in the heart of the city date back to 1500–1750. The only apparent touches of modernity are the trams, electric cables, autos, and a few houses of more recent vintage scattered unobstrusively throughout the city.

Huddled in a valley, straddling the Salzach River, this once-powerful citadel of Catholic authority is surrounded on all sides by huge mountains ranging in size from the Gaisberg and Untersberg, to the taller, snow-tipped peaks of more distant elevations. The layout of the city is a contrast of narrow streets and majestic open squares.

Life in Salzburg is typical of scores of other old cities in Europe whose livelihood center around the tourist trade. The height of the season occurs towards the end of July when the Salzburg Music Festival goes into full swing. During the entire month of August, visitors have a wide choice of musical events each day, from opera to symphonic, chamber and liturgical music. Weather permitting, outdoor concerts are given in the Mirabell Gardens, and in other parts of this picturesque capital of upper Austria.

During this period, Salzburg is bursting at its baroque seams; restaurants are jammed, hotels solidly booked, streets crowded, and theaters and halls filled to capacity. Singers, conductors, instrumentalists, reporters, recording personnel from Philips and Radio Salzburg, high society and just plain tourists loudly exchange greetings and gossip in the Café Tomaselli and along the Getreidegasse while native Salzburgians who are not merchants go into hiding.

Visiting Mozart's birthplace in June, weeks before the rest of the musical world descends upon Salzburg en masse is a far more relaxing affair. Then, the city assumes a less harried expression. Those tourists who visit the city at that time are women from the neighbouring countryside in their colorful drndls and men in feathered hats and shorts. For the benefit of visitors who come to Salzburg in pre-Festival time, there is a "Spring Festival" consisting of a few scattered chamber music concerts and church performances. The visitors, however, need not fear missing any of these since they are hardly of the same calibre as those of Festival variety. A regular year-round feature of Salzburg's musical life, however, is the world-famous Marionette Theater.

Since its founding in 1913, the Salzburg Marionette Theater has built up a repertoire including six Mozart operas, Strauss's *Die Fledermaus*, and several ballets and plays. Bernhard Paumgartner, one of the leading organizers of the Salzburg festivals, lauded the "subtle, unworldly, theatrical art of the [Salzburg] marionettes with their strange, weightless, stylized movements and their supernatural gradations of color and sound." The Marionette Theater makes it possible, Dr. Paumgartner continues, for many of Mozart's works which are unsuited to the large stage "to be brought to full realization on the marionette stage."

Having read this glowing tribute to the artistic importance of the Salzburg Marionette Theater, it was with great anticipation that we looked forward to our first evening of puppet opera. Mozart's *The Magic Flute* was the scheduled performance. We were curious to learn whether a "live" cast or a recording was to be used. The answer was provided in the program booklet we purchased as we were ushered to our seats. The musical sound track was taken from a Radio Salzburg recording made in 1952 at the Festspielhaus with a distinguished group of singers and the Vienna Philharmonic.

From the very first notes of the Overture, it was immediately apparent that both the recording and the playback equipment were hopelessly inadequate. The original recording had obviously been made at stage level judging from the thumping sounds, and the off-focus, over-reverberant pickup. In addition, the audio system in the Marionette Theater reproduced this recording with all the clarity and presence of a portable phonograph of pre-LP vintage with a frequency response of 150–5000 cps and a substantial peak around 1000 cps. Following this sonic ordeal, the curtain rose on a tastefully designed miniature stage, and the action of the opera began.

What then ensued could only be described as a high-brow Punch and Judy show. The fearsome, fire-snorting dragon being clobbered to death by the three fairies, Papageno clattering noisily across the stage waving his plume-covered arms, the animals prancing harmlessly to the sound of the magic flute—all this was sure fire entertainment for the kiddies, but hardly the magical, subtle creation praised by Paumgartner. To be sure, a painstaking attention to detail went into this production; the construction of each puppet makes for an astonishing number of different movements. Each puppet has a special head joint which

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

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endows it with its own distinctive expressions. The puppeteers make every effort to render their wooden figures as lifelike as possible. Gestures and clever bodily movements partly compensate for the puppet's frozen face, the head joints are employed to simulate even the singer's characteristic toss of the head as he brings off a tricky phrase.

The final results, despite the skill and imagination of the puppeteers, emerge with somewhat less success than the lowly Punch and Judy show. Where the action calls for a comedy situation, the marionettes hit their stride. But Mozart's *The Magic Flute* abounds in lengthy arias of great musical beauty sung by fairly static figures. It is in these moments that one is painfully aware of both the inferior recording and the enormous discrepancy between the sound of the live artist breathing deeply and straining his body to produce tones of great power and the pitifully small, lifeless doll staring dumbly out over the footlights, moving his limbs and head in awkward, jerky movements. That the producers of the Marionette Theater were cognizant of this discrepancy was made plain by their wholesale abridgments of all arias in the opera.

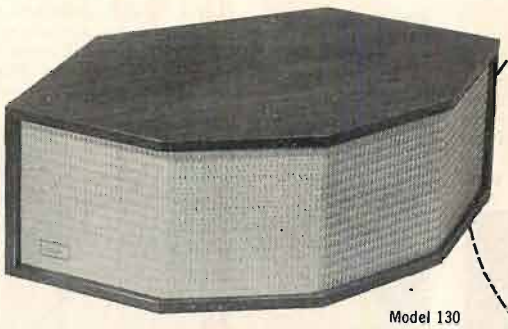
The puppet theater would no doubt be better served by completely live sound, rather than by recordings. Also, it might be wiser for puppeteers to restrict themselves more or less to works which were originally written for marionette performances. These include such works as Haydn's opera, *Philemon und Baucis* and Falla's *Master Peter's Puppet Show.* 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:

Sept. 5–7—Albany, N. Y.; DeWitt Clinton Hotel. (*RIGO*)
Sept. 19–21—Chicago, Ill.; Palmer House Hotel. (*International Sight & Sound Exposition*)
Sept. 19–21—Syracuse, N. Y.; Onandaga Hotel. (*RIGO*)
Sept. 26–28—Rochester, N. Y.; Sheraton Hotel. (*RIGO*)
Sept. 30–Oct. 4—New York; Trade Show Bldg. (*IHFM*)
Oct. 3–5—St. Louis, Mo.; Statler. (*RIGO*)
Oct. 10–12—Cincinnati, Ohio; Sheraton-Gibson. (*RIGO*)
Oct. 17–19—Detroit, Mich.; Statler. (*RIGO*)
Oct. 29–Nov. 1—Montreal, Canada; Windsor Hotel. (*Dominion High Fidelity Association*)
Nov. 7–9—Omaha, Neb.; Paxton. (*RIGO*)
Nov. 14–16—Kansas City, Mo.; Pickwick. (*RIGO*)
Nov. 21–23—Seattle, Wash.; New Washington. (*RIGO*)
Jan. 9–11—Minneapolis, Minn.; Dykman. (*RIGO*)
Jan. 30–Feb. 1—Indianapolis, Ind.; Antlers. (*RIGO*)
Mar. 6–8—Denver, Colo.; Cosmopolitan. (*RIGO*)
Mar. 20–22—Baltimore, Md.; Lord Baltimore. (*RIGO*)
Apr. 3–5—Pittsburgh, Pa.; Penn-Sheraton. (*RIGO*)
Apr. 10–12—Buffalo, N. Y.; Statler. (*RIGO*)

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Model 130

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The Audio League Report.
Authorized quotation No. 52

JansZen* DYNAMIC

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STEREO PRODUCTS REVIEW

LOUDSPEAKERS

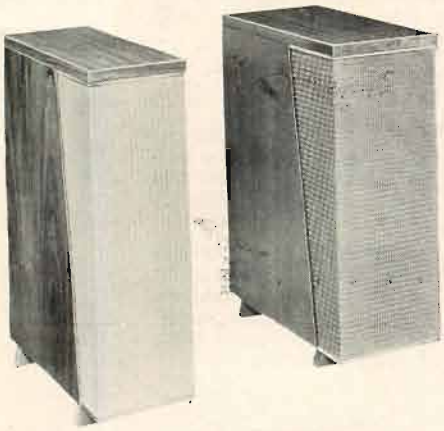
• Bozak Stereo Speaker System. Unique design of the Bozak B-304 "Stereo-Fantasy" blends the sound from stereo sources into a unified front similar to that of a concert hall, with individual instruments and voices in their proper positions within the larger bodies of sound.



There is no "hole in the middle," no beaming, and the stereo effect is evidenced over a wide listening area. Two complete, but separated, B302A speaker systems, each in its own infinite baffle, are directed outward through the ends of the B-304 cabinet. Hinged "directors" permit optimum use of room acoustics. Each B-302A system should be driven by an amplifier with at least 30 watts output. Frequency range of the Stereo-Fantasy is 40 to 16,000 cps. Bozak Sales Company, Darien, Conn.

H-9

• Electro-Voice "Stereon" Speaker System. Along with the well-known Series 20 stereo cartridges and "Power Points," E-V is introducing a number of other stereo accessories, including a control unit, a test record, and speaker systems. An example of the latter is the Stereon, a system engineered to solve the space problem by eliminating the need for a second large full-



range speaker. The Stereon is comprised of mid-bass, treble, and high-frequency drivers, and reproduces only the frequencies needed, according to Electro-Voice, for stereo, namely, those above 300 cps. When used in conjunction with a full-range speaker (such as was illustrated on the cover of the May, 1958, issue of AUDIO), the Stereon completes a stereo system of the highest order. The E-V stereo demonstration record contains six selections chosen from ABC-Paramount's first stereo releases. All were recorded using the E-V Variable-D cardioid microphone. Electro-Voice, Inc., Buchanan, Mich.

H-10

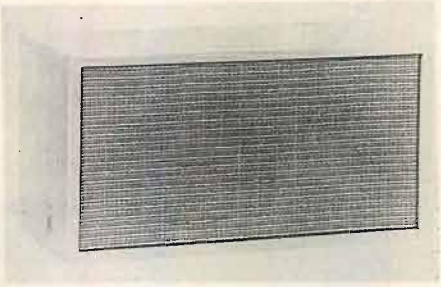
• Frazier "Stereo-Master" Speaker System. This system consists of two "Dixielander" folded-horn speakers with special mounting assembly for 30-deg. separation. Since the woofer horns and the tweeter horns have the same axis for each channel, separation is apparent for all musical instruments, including those in the high-frequency range. High efficiency of



the Stereo-Master permits the use of economical low-power amplifiers with excellent results. Comfortable living-room volume is obtained with as little as 0.25 watt feeding each channel. Tasteful design and hand-crafted furniture finish of the Stereo-Master will add to the decor of any listening room. Dimensions are 60"w x 32¾"h x 22"d. International Electronics Corporation, 2649 Brenner Drive, Dallas 20, Texas.

H-11

• General-Electric "Stereo" Bookshelf Speaker System. Where space is at a premium, this new G. E. introduction provides an excellent answer to the music

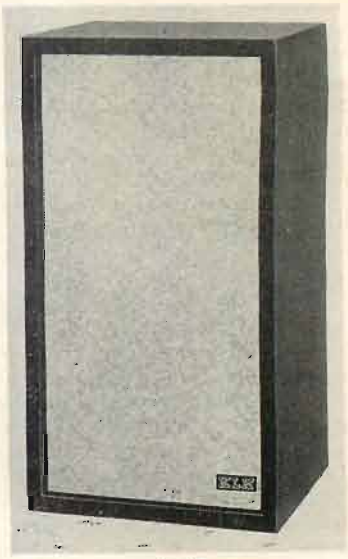


lover who must think in terms of compact speaker enclosures. Ideal for small-apartment stereo systems, the Stereo Classic measures only 9"h x 8⅜"d x 17⅝"l. Extended bass results from a newly-designed 6-in. woofer with high-compliance cone suspension in infinite baffle. The 2¾-in. tweeter is of the direct-radiating cone-type. The system is also offered as a kit without enclosure. General Electric Company, Specialty Electronic Components Dept., AS, W. Genesee St., Auburn, N.Y.

H-12

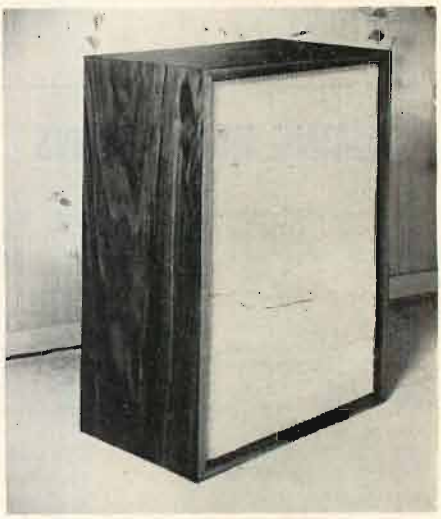
• KLH Model Six Speaker System. Notwithstanding its compactness, which suits it ideally for stereo use, this new KLH model is a full-range two-way speaker system capable of superb audio performance. Use of the patented acoustic suspension principle, together with special cones and suspensions developed by KLH, permits clean reproduction of very low frequencies and excellent transient characteristics. The tweeter is a small cone-type direct-radiator, also developed in the KLH laboratories. A built in LC crossover network has provision for increasing or decreasing the high-frequency level 3.0 db. Two Model Six's, properly placed, will give home stereo performance of the highest order. Dimensions are 23½"h x 12⅝"w-x 11⅞"d. KLH Research & Development Corporation, 30 Cross St., Cambridge, Mass.

H-13



KLH

• Tannoy "Belvedere" Speaker Enclosure. The Belvedere is a handsomely-finished and acoustically-correct cabinet engineered to complement Tannoy 12-in. dual concentric and direct-radiator speakers, providing an integrated sound source particu-



larly directed to stereophonic reproduction. The cabinet is a damped, dual-ported bass reflex, designed to give maximum performance for minimum size. Since all sides are finished it can be used either horizontally of vertically. Dimensions are 26" x 18" x 12"d. Available in walnut or mahogany. Tannoy (America) Ltd., Box 177, East Norwich, N.Y.

H-14

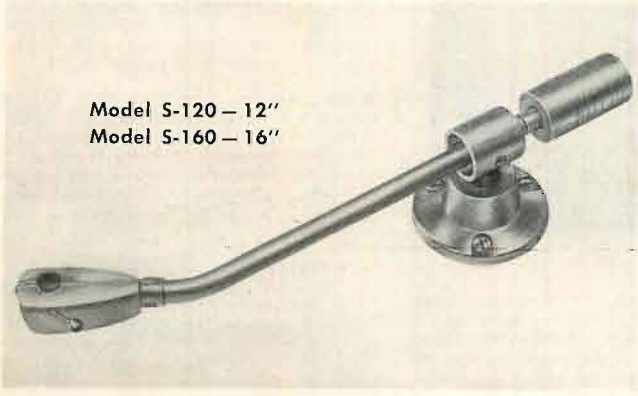
• United Speaker System. Compactness is combined with excellent performance in the Series X-100 speaker system, making the unit exceptionally well-suited for home stereo installation. Extended bass response and clean transients free from cone breakup result from critical resistance loading of frequencies below 200 cps. The X-100 incorporates two 12-in. United woofers with free-air resonance of 40 cps and a specially designed tweeter which offers high-frequency response to well beyond 18,000 cps. Power rating is 24 watts. Decorator-designed enclosures are constructed of ¾-in. plywood—glued, screwed, and braced internally to prevent cabinet resonances. Dimensions are 24" x 24" x 15½"d. United Speaker Sys-

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The latest high fidelity developments from Rek-O-Kut Co., Inc., 38-19 108th St., Corona 68, N. Y.

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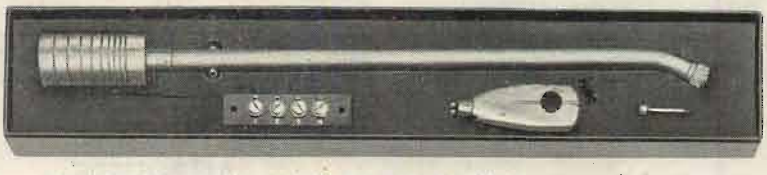
Model S-120 — 12"
Model S-160 — 16"

PRICES OF THE NEW STEREO-MONAURAL ARMS ARE: MODEL S-120, 12" ARM, $27.95; MODEL S-160, 16" ARM, $30.95.

The fabulous Rek-O-Kut Tonearm (the arm that outsold all others 9 to 1) now goes stereo! Here are some of the new basic features which make this tonearm a "must" in any fine stereo or monaural high fidelity system: 1. Mass of the shell increased... to lower the point of resonance. 2. Larger, heavier counterweight. 3. 4-conductor lead... to accommodate all 3 and 4-terminal stereo cartridges. 4. Four-prong shell for easy phasing of stereo cartridges. 5. Supplied with wires already connected to terminal strip.

In addition, the new S-120 and S-160 Stero-Monaural arms retain these exclusive engineering features of the famous A-120 and A-160 arms: friction-free micro-bearing pivot and adjustable Micrometer counterweight!

Stereo Conversion Kit Converts A-120, A-160 Monaural Tonearms For Stereo Reproduction!

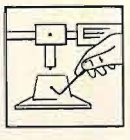


Model SC-12 — 12" — $17.95 net Model SC-16 — 16" — $19.95 net

Rek-O-Kut A-120 and A-160 Monaural Tonearms now can be easily and quickly converted for stereo with the new Rek-O-Kut Stereo Conversion Kit. The new kit saves Rek-O-Kut monaural tonearm owners a minimum of ten dollars, and includes all parts and two simple tools required for the conversion. The procedures are simple... the entire conversion can be made in ten minutes. No mechanical skill is needed, no tools, other than those furnished in the kit, are required.

The ease with which conversion can be made reflects the simplicity of the basic Rek-O-Kut Tonearm design. All parts are warranteed.

Conversion Made In 3 Simple Steps







The arm assembly is removed from the base by loosening a single set screw with wrench provided. Old arm and counterweight are removed from swivel by loosening two screws. New preassembled stereo arm and counterweight are inserted in swivel and 4-conductor lead is pulled through the bottom.

After re-assembly, leads are connected to the terminal block furnished in the kit.

SPECIAL FREE OFFER!

Popular Audax Stylus Balance Your Gift With Purchase Of Stereo Arm or Conversion Kit!

The free gift of a popular Audax Stylus Balance (regular value — $3.95), is now being offered by Rek-O-Kut to purchasers of either the new Stereo-Monaural Tonearm or Conversion Kit. This special premium is automatically included with both of these new products now available from your high fidelity dealer. The Audax Stylus Balance gift offer ends August 31st, 1958

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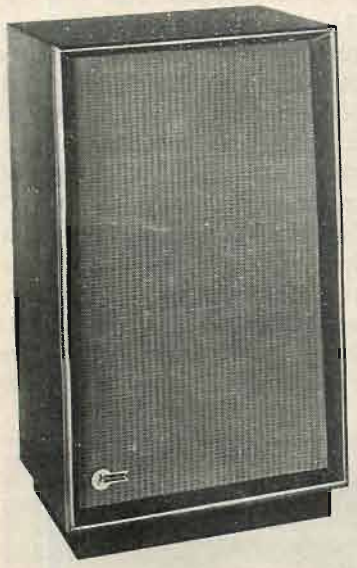
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Popular Audax Stylus Balance



tems, 192 William St., East Orange, N.J. **H-15**

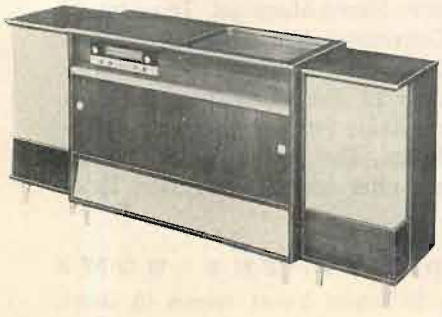
• **Wharfedale Speaker Systems For Stereo.** Keeping pace with the trend toward compact speaker systems especially well-adapted to the requirements of stereo in the home, Wharfedale is introducing two new ready-to-play models. The W/AF/1 contains a Wharfedale W10/FSB 10-in.



full-range speaker with matching tweeter and balance control. Dimensions are 30″h × 17″w × 12″d. The W/AF/2 system is similar in appearance, but somewhat larger in size, measuring 36⅜″h × 23″w × 15⅝″d. It incorporates a Wharfedale Super 12/FS/AL 12-in. full-range speaker plus a Super 3 tweeter with balance control. Enclosures for both systems were designed by G. A. Briggs, and incorporate a new patented "acoustic filter" which improves power handling capacity at low frequencies and reduces standing wave effects. Available finishes are mahogany, walnut, and blonde. British Industries Corporation, Port Washington, N.Y. **H-16**

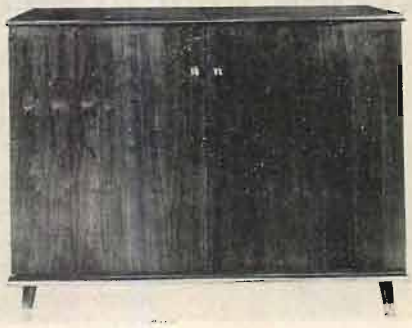
EQUIPMENT CABINETS

• **Heathkit Stereo Equipment Cabinet.** All parts of this superbly designed enclosure, which will contain an entire stereo music



system, are pre-cut and drilled for simple assembly. Styled to add elegance to surroundings, the cabinet is fashioned with gold and black panels, with trim and hardware chosen to emphasize the overall effect. Rich-toned grille cloth is flecked with gold and black. The center section of the enclosure has ample room for an AM-FM tuner, tape deck, stereo preamplifier, power amplifiers, record player, and record storage space. The end sections are speaker enclosures, which may be purchased separately if desired. Sliding doors provide convenient access to the player and record-storage compartments. Heath Company, 305 Territorial Road, Benton Harbor, Mich. **H-17**

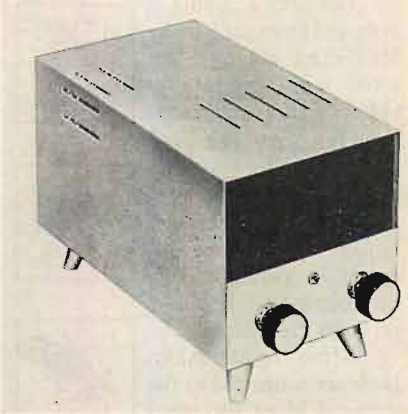
• **Wellcor High-Fidelity Enclosures.** Highlighting an extensive line of fine cabinetry equally suitable for stereo and monophonic music systems is the Model E1 equipment cabinet. A strikingly hand-



some furniture piece, it accommodates tuner, amplifier, and preamp (either shelf and/or panel mounted), changer or turntable with 16-in. transcription arm, and portable tape recorder mounted on slide-out shelf. Also included are two separate compartments fitted for disc and tape storage. Turntable compartment is top-loading with all-position lid support. Shock-resistant rubber-covered cleats are provided for the mounting board. Recessed precision-hinged doors are equipped with magnetic catches. Dimensions are 44″w × 28″h × 21″d, plus 4-in. self-leveling legs. Matching speaker enclosures are of equally impressive construction and finish. Wellcor, Inc., 1214 N. Wells St., Chicago 10, Ill. **H-18**

AMPLIFIERS

• **DB212 Stereo Control Center With Dual Amplifier.** The ST10A affords an economical means of converting an existing monophonic hi-fi system into a 2-channel stereo system. The unit contains two separate channels which are regulated



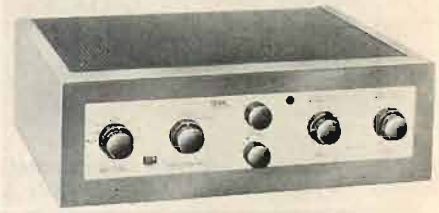
simultaneously by a single volume control. Channel 1 consists of a preamplifier, a 10-watt power amplifier, and a tone control. Channel 2 consists of a preamplifier for driving the high-level input of the amplifier in an existing installation. With the ST10A and your present music



system, only an additional speaker is necessary to enjoy true stereo sound.

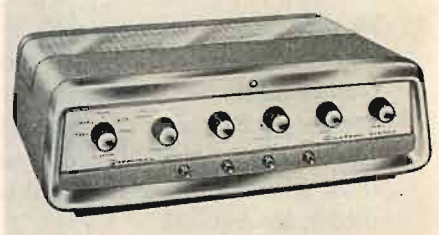
The DB212 control center and dual amplifier is a complete stereo amplifying system, including two 12-watt power amplifiers. Frequency response is 20 to 20,000 cps ± 1.0 db and harmonic distortion is 0.5 per cent at rated output. Bass and treble controls are peaked at 60 cps and 10 kc, respectively. In addition to conventional controls, the DB212 includes a speaker phasing switch, which may be used to eliminate the "hole in the middle" effect which occurs when speakers are operated out of phase. David Bogen Company, P. O. Box 500, Paramus, N. J. **H-19**

• **Eico Stereo Amplifier/Kit.** Available in either kit of fully-wired form, the Model HF81 stereo amplifier incorporates two 14-watt channels. Among its features are separate low-level inputs in each channel for magnetic cartridge, tape head, and microphone. High-level inputs are pro-



vided for AM tuner, FM tuner, FM multiplex, and two auxiliary signal sources. Ganged level and tone controls and separate balance control afford excellent stereo flexibility. Identical Williamson-type power amplifiers use EL84's in output stages. Tone control ranges are ± 15 db at 50 and 10,000 cps. Frequency response at 2.0 watts (1.0 watt each channel) is 10 cps to 100 kc within ± 0.5 db. Harmonic distortion is less than 1.0 per cent from 50 to 5000 cps at full rated output. Electronic Instrument Co., Inc., 33-00 Northern Blvd., Long Island City 1, N.Y. **H-20**

• **Grommes 24-Watt Stereo Amplifier.** Both economy and excellent performance are combined in the Grommes Model 24PG, a complete preamplifier and power amplifier on a single chassis. Two 12-watt channels convert to 24 watts of monophonic power when no stereo source is available. Fre-



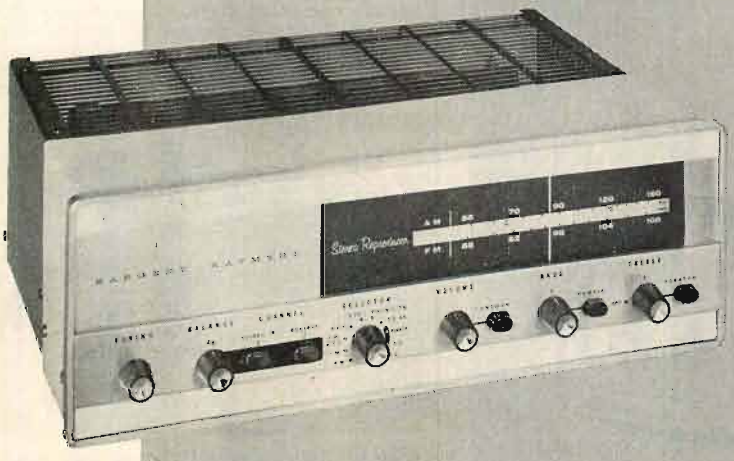
quency response is 20 to 20,000 cps within ± 0.5 db. Harmonic distortion is less than 1.0 per cent and intermodulation under 2.0 per cent at full rated output. All controls are ganged for ease of stereo operation. Ten inputs accommodate virtually any type of signal source. Along with all conventional adjustments, a channel-balance control permits variation of input to stereo speakers. Push-button switches are used for rumble and scratch filters, and to disable loudness control compensation.

new patented "acoustic filter" which im- combined in the Grommes Model 24PG, a

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2 NEW SARGENT-RAYMENT Stereo Reproducers

for advanced high fidelity installations



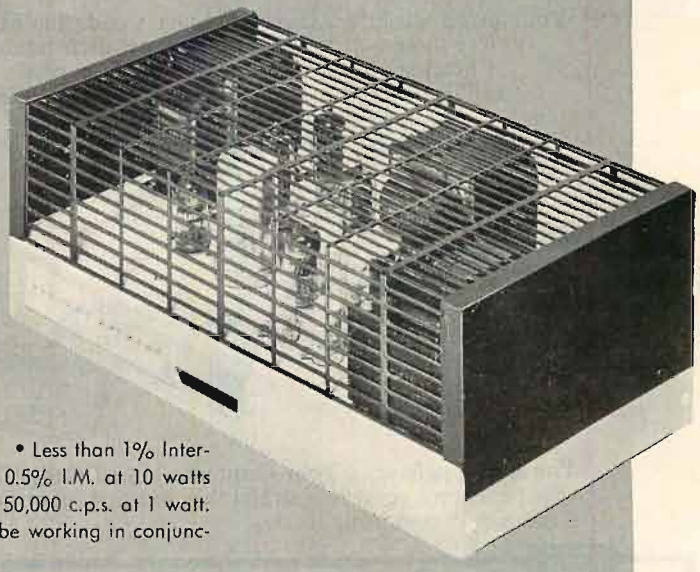
SR-380 FM-AM TUNER WITH STEREO PRE-AMP AND TONE CONTROL $189.60

This Hi-Fi instrument represents the full accomplishment of a challenging objective — the combining on one chassis of a dual channel professional stereo pre-amp and tone control with that of a Deluxe FM-AM Tuner.

Some of the outstanding features are:

• Stereo (dual) inputs for tape heads with 3 positions of equalization for 15 (NARTB), 7½, and 3¾ I.P.S., phono cartridge (both magnetic and ceramic), tape recorder, and aux. The FM position has a stereo channel input for use with the future FM multiplex transmission. It may now be used for stereo FM-FM or FM-AM by inserting another FM or AM source. • Extremely stable FM sensitivity of 3 uv for 20 db quieting, which is unaffected by a mismatched antenna. • Push-button operated rumble and scratch filters. • Stereo balance control. • Push-button type channel reverse and monaural-stereo switches. • Elimination of hum and heat due to absence of power supply.

SR-534 34 WATT BASIC STEREO AMPLIFIER $106.60



The SR-534 offers clear cut superiority in design, construction, endurance and, most important, performance. The design is that of two independently controlled and terminated 17 watt sections. Each section is capable of delivering power beyond usability in the average home installation with distortion characteristics found only in the most expensive basic amplifiers.

Some of the outstanding features are:

• 17 watts power output each section, 34 watts output for combined dual channel monaural use. • Less than 1% Intermodulation Distortion at rated output. Less than 0.5% I.M. at 10 watts output. • Frequency response of ±0.5 db 10 to 50,000 c.p.s. at 1 watt. • Ideal regulation with the new GZ34 rectifier tube working in conjunction with an extra large transformer.

SR

Write for complete brochure on all SR Stereo Reproducers.

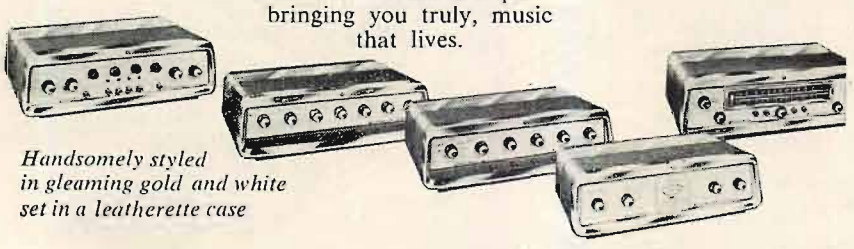
SARGENT-RAYMENT CO.

4926 East 12th Street, Oakland 1, California

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You turn a dial . . . and something wonderful happens! You're there . . . reliving the original performance, hearing the songs you love with a new brilliant clarity . . . hearing the depth of life in each musical passage. Grommes Stereo is stereophonic reproduction at it's finest . . . superb fidelity with a new realistic depth . . . bringing you truly, music that lives.



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You be the judge . . . Your Grommes High Fidelity Dealer will be happy to demonstrate this exciting new line of Grommes Stereo Amplifiers.

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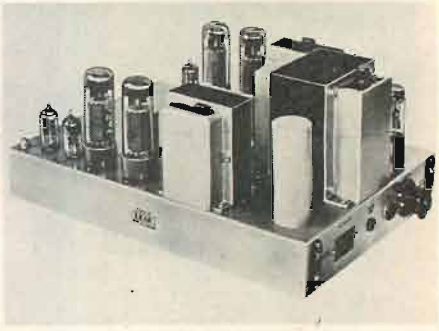
Precision Electronics, Inc., 9101 King St., Franklin Park, Ill. **H-21**

PREAMP-CONTROL UNITS

• Leak "Point One Stereo" Preamplifier and "Stereo 50" Power Amplifier. Every factor important in stereo has been taken into consideration in design of these new British-made units recently announced by



H. J. Leak and Co., Ltd. Five stereo inputs permit operation from virtually any type of signal source, including microphones. Bass and treble controls permit boost and cut of 16 db at 30 cps and 15 kc, respectively. Balance control allows for a differ-



ence of 6 db in sensitivity of loud-speakers. All controls are of the dual ganged type, operative on both channels simultaneously. Distortion of the "Point One Stereo" preamplifier is less than 0.1 per cent for 1.25 volt output. The "Stereo 50" power amplifier contains two 25-watt maximum output channels, each identical in gain within 0.5 db. Frequency response is within ± 0.5 db from 20 to 20,000 cps. British Industries Corporation, Port Washington, N.Y. **H-22**

• Pilot Stereo Preamplifier and Matching Power Amplifier. The Pilot Model SP-210 contains two identical preamplifiers with ganged controls for convenient stereophonic operation. Designed as a matched



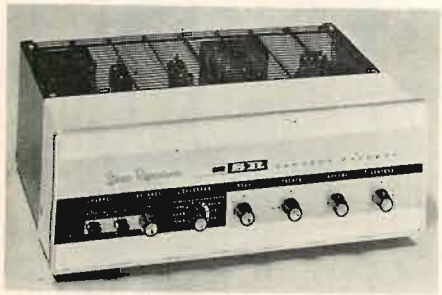
companion to Pilot stereo amplifiers, such as the Model SA-232 (illustrated), it derives its power from the basic amplifier with which it is used. Among controls is

with a new realistic depth

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an automatic equipment shut-off switch which operates when the final record on a changer has been played. The switch may be deactivated when desired. Six dual-channel inputs include provisions for microphones and tape heads. Feedback-type tone controls afford low distortion and permit low-impedance output. Frequency response is 20 to 20,000 cps within ±1.0 db and total distortion is 0.2 per cent at maximum sensitivity. The Model SA-232 basic amplifier is a dual-channel unit with continuous power output rating of 32 watts for both channels. Frequency response is 20 to 20,000 cps and total harmonic distortion is under 1.0 per cent. Hum level is 90 db below rated output. Pilot Radio Corporation, 37-06 36th St., Long Island City 1, N. Y. **H-23**

• **Sargent-Rayment Stereo Amplifier System.** The S-R Model 17-17 represents the combination on a single chassis of two professional-type preamplifiers, including tone controls, with a stereo power amplifier, each channel of which is rated at 17 watts. Type EL84 tubes are used in a



dual push-pull output circuit to deliver rated power with less than 1.5 per cent intermodulation. Harmonic distortion is well under 1.0 per cent. Controls are of the dual ganged type, affording ease and accuracy of stereo operation. Bass and treble controls afford up to 15 db boost at 40 and 15,000 cps, respectively, with less than 1.0 db rise at mid-frequency. An 8-position selector switch controls inputs and equalization for various tyes of recordings. Carbon deposited resistors are used in the preamp section of the 17-17 to ensure low noise. Sargent-Rayment Co., 4926 E. 12th St., Oakland 1, Calif. **H-24**

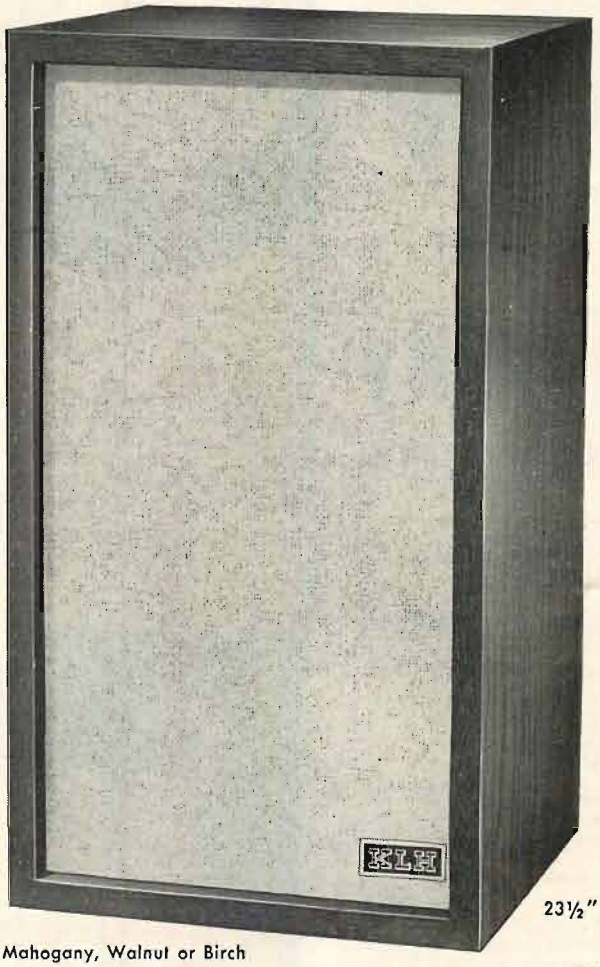
• **Stromberg-Carlson Stereo Amplifier.** Low-distortion Type EL84 tubes are used in the output stages of the ASR-433 amplifier, which incorporates two 12-watt channels which may be combined to deliver 24 watts when the unit is used monophonically. Frequency response is 20 to



20,000 cps within ±1.0 db. Inputs are provided for magnetic cartridge, crystal cartridge, tape head, tuner, and auxiliary devices. Independent volume and tone controls are provided for each channel, with a master volume control for adjusting the level of both channels simultaneously. Harmonic distortion is less than 1.5 per cent. A two-position switch affords RIAA equalization for records and NARTB equalization for tape. Stromberg-Carlson, Rochester 3, N.Y. **H-25**

• **Altec Master Stereo Control.** Development of an inexpensive master stereo concontrol for converting two monophonic amplifiers to stereo operation has been announced by Altec Lansing. The new Model S40 control unit is designed for use with Altec's well-known 344A monophonic amplifier. It provides master channel con-

a reassuring sign



The Model Six
Two-Way System
23½" x 12⅝" x 12¼".

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One of the most reassuring sights you can see on the face of a loudspeaker—*is the KLH trademark.* It represents that the product is one of a series of distinctly superior loudspeaker systems. These systems are evolved from a newly improved KLH formula for constructing speakers employing the acoustic suspension principle. At the laboratories of KLH, fine engineering experience does not stop at loudspeakers, but extends to exhaustive research and development in the fields of acoustics and sonics.

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THE D130 EXTENDED RANGE SPEAKER



THE 175DLH HIGH FREQUENCY ASSEMBLY



OR THE 075 HIGH FREQUENCY UNIT

--to get the best in high fidelity sound. And to get all of the rich, crisp, accurate, deep down bass generated by your D130, you must mount it in a carefully constructed, engineered acoustical enclosure. One of the most popular enclosures ever made, because of its compact dimensions and smooth, clean response, is the JBL Harkness Model C40—a back-loaded folded horn. Sound below 150 cps is radiated from the back of your D130 through the horn. Above 150 cps the speaker acts as a direct radiator. The six foot long, exponentially-flared horn path is ingeniously folded within sleek, low enclosure measuring only 38" wide. The horn is completely contained within the enclosure and is independent of room walls.

BUILD YOUR C40 FROM PRODUCTION PRINTS

Prove your woodworking skill and get the greatest thrill high fidelity can give you. Here is a project that will make use of your finest craftsmanship for the enjoyment of yourself and your family—a project you can show off to others with pride. Detailed production prints, complete with a list of parts, and step-by-step instructions have now been released by the factory. The set is yours for only three dollars.



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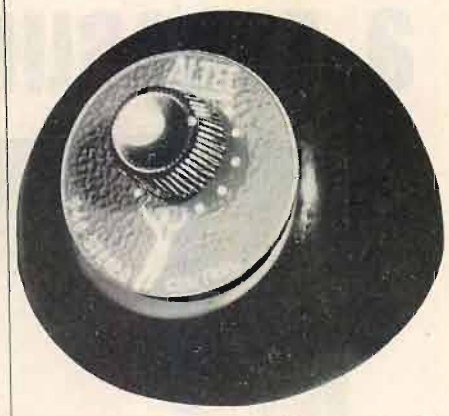
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3249 Casitas Ave., Los Angeles 39, Calif.

Gentlemen: _____ Enclosed find $3.00 for one set of Model C40 Production Prints.
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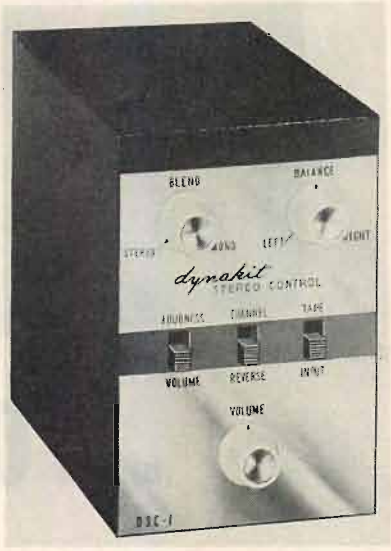
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trol for two 344A's which can be used together for 40-watt stereo. The S40 simply plugs into the 344A and enables the user



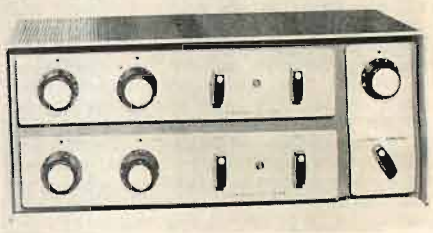
to convert to stereo by the simple addition of another 344A and a second speaker. Altec Lansing Corporation, Anaheim, Calif. **H-26**

• **Dynakit Stereo Control.** Complete stereo control facilities can be readily added to a pair of Dynakit preamplifiers with the new DSC-1 kit which can be assembled in less than one hour. In addition to the conventional dual volume control, the DSC-1 includes a balance control to equalize inter-channel levels, loudness compensation with a disabling switch, a channel reversing switch, and a dual tape monitor

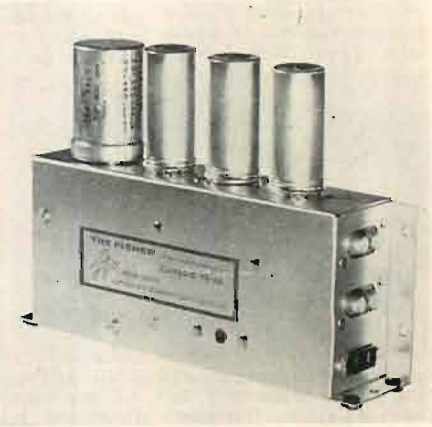


switch. A unique auxiliary adjustment is the "blend" control, which permits mixing the stereo channels in controllable proportion. It also allows the reproduction of stereo program sources through monophonic systems, so that stereo discs can be played monophonically without the need to change cartridge hookup. Dynaco, Inc., 617 N. 41st St., Philadelphia 4, Pa. **H-27**

• **Fairchild Stereo Components.** Every element of perfection is incorporated in the new Fairchild Model 248 stereo preamplifier and the 282 stereo arm. The preamp combines extreme simplicity of operation with accuracy of equalization and flexibility of control. The unit includes two completely independent preamplifiers, with individual bass, treble and level adjustments for each channel. Single-knob overall gain control preserves individual channel adjustments and balance. Mono-stereo switching electronically cancels vertical cartridge output for use with standard microgroove records. The 280 stereo arm embodies a number of refinements and improvements in the well-known 280 monophonic arm, making it especially suitable for stereo use. Fairchild Recording Equipment Corporation, 10-40 45th Ave., Long Island City 1, N. Y. **H-28**



• **Fisher Stereo Preamplifier-Equalizer.** Completely self-contained and self-powered on a single chassis, the PR-66 preamp-equalizer is designed for remote operation, hence has no controls. It provides necessary preamplification for low-level stereo cartridges, and equalization



for stereo records. With a simple modification, the PR-66 may be used as a preamplifier-equalizer for direct connection from stereo tape playback heads, or as a two-channel preamplifier for two microphones. The PR-66 contains two inputs for signal sources, and two outputs for connection to an audio control system. Fisher Radio Corporation, 21-21 44th Drive, Long Island City 1, N.Y. **H-29**

• **Knight Stereo/Monophonic Preamplifier.** Excellent quality is combined with low cost in this complete audio control center. Included in its features is a gain control for each channel plus a master control for adjusting both channels simultaneously. Full tape and record equalization



are included for monophonic use. Frequency response is 20 to 20,000 cps ±1.0 db. Controls include bass and treble, scratch filter, rumble filter, loudness switch, and mono-stereo and channel-reverse switch. All filaments are operated on d.c. to ensure minimum hum. Ten inputs are provided for virtually every type of signal source, including microphone. Allied Radio Corporation, 100 N. Western Ave., Chicago 80, Ill. **H-30**

• **McIntosh Stereo-Facility Preamplifier.** Identical in electrical and mechanical characteristics to the renowned Model C-8 Professional Audio Compensator, the Model C-8S is designed for use with any existing preamplifier to serve as a second-channel preamp and master control in stereo systems. It does not obsolete any other equipment, and has sufficient in-built flexibility for matching unbalanced

independent of room walls.

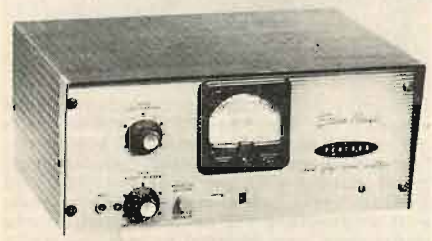
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stereo systems employing two dissimilar speaker systems. Basically the unit is a C-8 with the addition of three features: (1) a stereo mode selector—which switches between monophonic and stereo reproduction, selects either one of the two



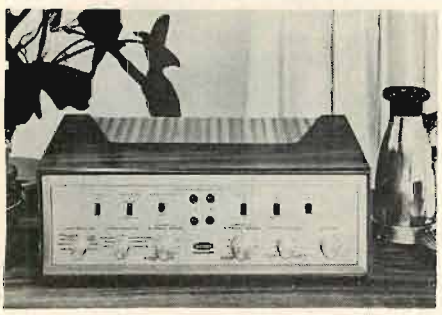
channels for monophonic use and feeds both amplifiers, or reverses the channels in stereo; (2) a stereo balance control; and (3) a ganged master volume control. McIntosh Laboratory, Inc., 4 Chambers St., Binghamton, N.Y. **H-31**

• **Pentron Stereo Play/Monophonic Record Preamplifier.** Although designed primarily for use with Pentron tape mechanisms, which it matches in appearance, the Model CA-24 may be used with equal effectiveness with any standard tape deck. Features include an illuminated recording-



level meter, safety interlock to prevent accidental erasure, record push button, and individual gain control for each channel. Automatic hum-balance control assures minimum noise level. Frequency resonse is 20 to 20,000 cps with exceedingly low distortion. Within the near future Pentron will introduce conversion kits for adapting existing Pentron tape recorders to stereo playback, as well as a number of new models which will handle both 4- and 2-track stereo and half-track monophonic recordings. The Pentron Corporation, Chicago 24, Ill. **H-32**

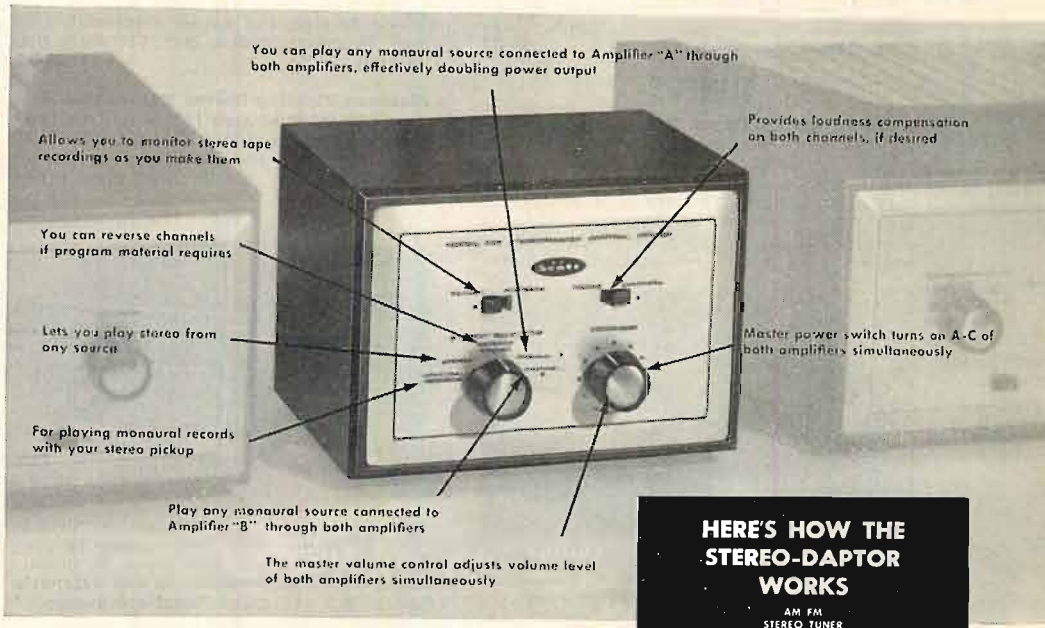
• **H. H. Scott Stereo Preamplifier.** Many features of the well-known Scott Model 121 monophonic preamplifier are inherent in the new Model 130 which is designed for stereo. Unique among features of the new model is its indicator-light control



panel. As the input-selector switch is turned, lights flash on to give visual indication of the mode of operation. Other front-panel controls include a pickup-selector switch for selection between two stereo cartridges, stereo tape monitor switch, scratch filter, rumble filter, phase reversal switch, loudness-volume switch stereo selector, separate bass and treble controls for both stereo channels, stereo

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NEW H. H. SCOTT STEREO-DAPTOR

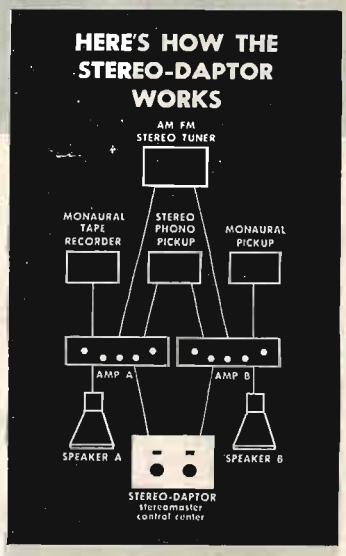
• Updates your *present* H. H. Scott System for Stereo records and tape.
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Just add the Stereo-Daptor and a new H. H. Scott amplifier to your present H. H. Scott system and you can play the new stereo records, stereo tape, stereo AM-FM or stereo from any source.

The Stereo-Daptor permits control of two separate amplifiers from a central point. A Master Volume Control adjusts the volume levels of both channels simultaneously. Special switching lets you play Stereo, Reverse Stereo, use your Stereo Pickup on Monaural Records, or play monaural program material through both amplifiers at the same time. This gives you the full power of both amplifiers. No internal changes are required when used with H. H. Scott amplifiers.

only $24.95*

IMPORTANT! Stereo-Daptor works with *All* current H. H. Scott amplifiers and most older models . . . with any system having separate pre-amplifier and power amplifier . . . and with complete amplifiers having tape monitor input and output provisions.



SPECIFICATIONS

H. H. Scott Stereo-Daptor
Stereomaster Control Center

Compatibility: Any amplifier in any of the groups shown below may be used with a second amplifier IN THE SAME GROUP for best results with the Stereo-Daptor.
Group I: 99-A,B,C,D; 210-F; 120-A; 120-B; 210-C.
Group II: 121-A,B,C; 210-D,E.
Group III: Any systems with separate preamplifiers and power amplifiers.
Group IV: Two identical complete amplifiers having tape monitoring input and output connections.

Controls: Master Volume: Loudness-Volume: Function Selector (with these positions — Stereo; Reverse Stereo; Monaural Records; Monaural Channel A; Monaural Channel B) Tape Monitor: Power off (on volume control).

Connecting Cables: Four two-foot shielded cables are supplied for all necessary connections. Maximum recommended cable length 3 feet.

Custom Installation: The Stereo-Daptor is easily custom mounted, and no special mounting escutcheons are required.

Price: $24.95* completely enclosed. Accessory cases extra

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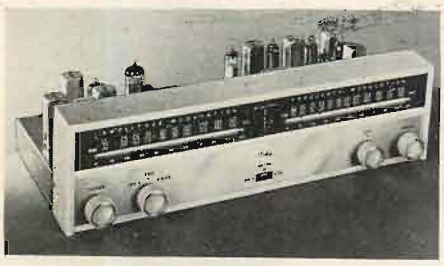
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balance control, and loudness control. Individual with the Model 130 is a phase reversal switch which permits reversing the phase of one channel 180 deg. with relation to the other. Maximum sensitivity of the unit is 1.5 mv, allowing it to be connected directly to stereo heads without use of an additional preamplifier. H. H. Scott, Inc., 111 Powdermill Road, Maynard, Mass. **H-33**

TUNERS

• **Arkay Stereo Tuner Kit.** Engineered for simultaneous reception of FM and AM broadcasts or for monophonic reception of either FM or AM, the Model ST-11 is actually two distinct tuners in a composite unit. The advanced engineering features contained in its design provide the custom builder with a self-powered stereo tuner



with remarkable flexibility of operation. Sensitivity of the FM section is 4.0 microvolts for 20 db quieting. Frequency response is uniform from 20 to 20,000 cps. AM sensitivity is 2.0 microvolts for 20-db signal-to-noise ratio. Variable bandwidth i-f stages permit adjustment of AM frequency response from 20 to 3500 cps in narrow-band position, to 8500 in wide-band position. Both sections have flywheel tuning with edge-lighted slide-rule scale. Large pictorial diagrams and an instruction manual written in non-technical terminology make construction of the ST-11 an easy chore for the average layman. Arkay Radio Kits Inc., 120 Cedar St., New York 6, N.Y. **H-34**

• **Harman-Kardon TP200 Stereo Tuner/Preamplifier and AX20 Dual Stereo Preamplifier with 20-Watt Power Amplifier.** Known as The Concerto, the TP200 incorporates a complete FM and AM tuner with dual stereo preamplifiers in a compact enclosure. AM and FM sections of



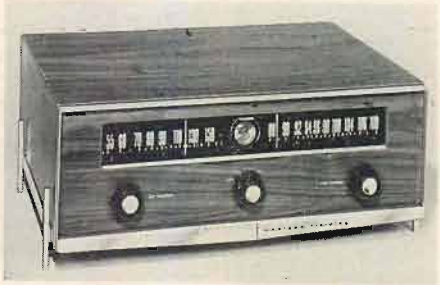
the unit are completely separate and can be tuned independently to receive stereo or monophonic broadcasts. A jack is provided for the addition of an FM multiplex adapter. Two tape outputs for driving a tape recorder are provided, independent of all controls.

The AX20 amplifier assembly, known as The Nocturne, offers an ideal means to



convert any existing monophonic system to complete stereo. One simple connection to the present basic amplifier does it all. The preamplifier section of the AX20 is a dual stereo device incorporating ganged bass and treble tone controls, loudness control, contour control, rumble filter, balance control, mode switch, speaker selector and function switches. The first preamplifier drives the AX20 power amplifier, while the second delivers 0.5-volt output for driving the owner's present amplifier. Harmon-Kardon, Inc., 520 Main St., Westbury, N.Y. **H-35**

• **Madison Fielding Stereo Tuner.** The M-F Series 330 incorporates two sensitive tuners on a single compact chassis. The tuners can be used individually for AM or FM reception, or can be used simultane-



ously to receive AM-FM stereo broadcasts. A special multiplex output is provided for use when this form of broadcasting becomes available in the listener's locality. An exclusive "dual-stereoscopic" tuning indicator permits visual center-of-channel tuning for both AM and FM signals simultaneously. Sensitivity of the FM section is 2.0 microvolts for 20 db quieting. Frequency response is uniform within 1.0 db from 20 to 20,000 cps. The AM section has 3.0-microvolt sensitivity and features a separate tuned r.f. stage for maximum selectivity. Madison Fielding Corporation, 5 Lorimer St., Brooklyn, N.Y. **H-36**

TAPE EQUIPMENT

• **Ampex 4-Track Stereo Unit.** Offering such unique features as a choice of 4-track or 2-track stereo playback, half- or full-track monophonic playback and half-track monophonic record, and automatic end-of-reel shut-off, the new Ampex Universal "A" (900 Series) is now being shipped to dealers throughout the country. A single lever, indicated by the arrow in the illus-



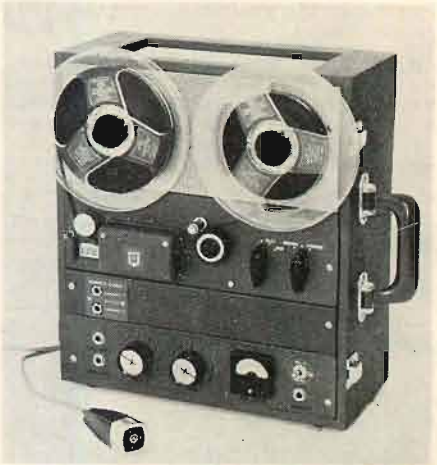
tration, on the head assembly is used to adjust the machine to the desired function. Tapes may be played or recorded at either 7.5 or 3.75 ips. Foreseeing the advent of 4-channel recording, Ampex engineers incorporated the necessary basic features into the original "A" Series design, including an adaptable head assembly and stable 3.75-ips tape speed. Advance engineered during the past year and waiting release of the new 4-track recorded tapes, the Universal "A" models are now being shipped in all Ampex consoles, modular units, portables, and unmounted tape decks. In addition, a simple conversion is available to bring the advantages of 4-track stereo to present Ampex owners, thus up-grading their "A" series recorders to keep abreast of this significant advance. Ampex Audio, Inc., 1020 Kifer Road, Sunnyvale, Calif. **H-37**

• **Portable Stereo "Magnemite."** Engineered to fill the need for a compact self-contained stereo tape recorder, this unit is available in three single-speed models which operate at 15, 7.5, or 3.75 ips. The 15- and 7.5-ips models meet primary and secondary NARTB standards, respectively.



High-gain record-playback amplifiers are powered by inexpensive flashlight cells and one B battery which last 100 hours. The spring-operated motor operates with flutter within ± 0.1 per cent over the full winding cycle. Independent gain adjustment is provided for each channel. Stereo headphones may be used to monitor while recording. Recordings can be made while the instrument is in motion or in any position. Housed in a weather-tight aluminum case which measures but 8¼" × 11" × 10", the Stereo Magnemite weighs only 17 lbs. Amplifier Corp. of America, 398 Broadway, New York 13, N.Y. **H-38**

• **Roberts Stereo Reproducer/Monophonic Recorder.** The featured attraction in this new Roberts Model 90-S professional-type recorder is a wide-range stacked stereo



head which permits playback flat within ± 2.0 from 40 to 15,000 cps. The drive mechanism is powered by a hysteresis synchronous motor which holds wow and flutter well within professional standards. A two-speed unit, the 90-S may be operated at 7.5 or 3.75 ips in either horizontal or vertical position. An illuminated VU meter and an index counter facilitate recording and location of desired program material on a spool of tape. Timing ac-

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curacy is 0.2 per cent. Roberts Electronics Inc., 1028 N. La Brea Ave., Los Angeles, Calif. **H-39**

● **Stancil-Hoffman Portable Stereo "Minitape."** This recorder, which is a self-contained battery-operated unit, has virtually all of the features of large line-operated machines. Housed in a drawn aluminum case 9" x 12" x 5" and weighing 13 lbs., it is available in a choice of 7.5 or 3.75 ips



tape speeds. A battery charge will power the Minitape for two hours and it may be either remotely or locally controlled. It will operate in motion so that recordings can be made even on roller coasters, in moving trains, and under similar demanding situations. Stacked recording and playback heads are used with separate amplifiers to permit stereo monitoring simultaneously with recording. Both amplifiers use transistors throughout. Recordings made on the Minitape may be reproduced on any standard playback equipment. A single nickel cadmium battery powers the amplifiers and the well-regulated motor. Accessories include cigarette-lighter charging attachment, automatic battery charger, and other items broadening the use of the Minitape. The Stancil-Hoffman Corporation, 921 N. Highland Ave., Hollywood 38, Calif. **H-40**

● **Tandberg Stereo Conversion Equipment.** Owners and buyers of Tandberg Model 3-S (for stereo) tape recorders will find the uses for their equipment greatly expanded with announcement of the new Model 241 stereo-record preamplifier which permits stereophonic recording, and the Model 529 4-track stereo head. The 241 is a plug-in device which can be disconnected and

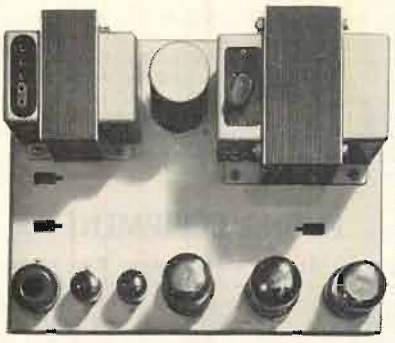


stored when not in use, thus not affecting the operating convenience of the recorder. The 259, in addition to handling the new 4-track stereo, will play present half-track stereo and monophonic tapes as well. Recent improvements which have been made in the Model 3-S (illustrated) include: a bass switch which provides 12 db of bass boost at 70 cps, and an automatic tape stop which shuts off the machine at the end of a reel. Reeves Equipment Corp., 10 E. 52nd St., New York 22, N.Y. **H-41**

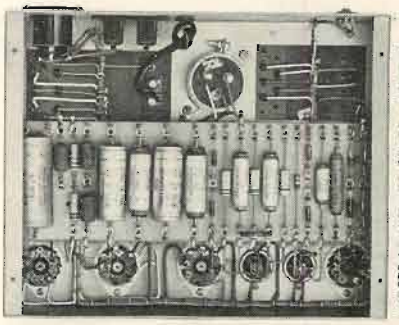
Point One to consider for Stereo

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Only Leak "Point One" Amplifiers keep distortion to 1/10th of 1% AT FULL RATED POWER!



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Therefore, Leak "Point One" Amplifiers can guarantee truly realistic, satisfying stereo reproduction!

HERE'S HOW YOU CAN APPLY THESE GREAT REMOTE CONTROL POWER AMPLIFIERS TO YOUR STEREO OR MONAURAL HIGH FIDELITY SYSTEM:

IF YOU ARE STARTING YOUR HIGH-FIDELITY SYSTEM	**A PAIR OF LEAK AMPLIFIERS FOR MONAURAL NOW, STEREO WHEN YOU'RE READY.** For example, two 25-watt Leak amplifiers equal a 50-watt single channel system, 25-watt double channel stereo. This is your most flexible type of high-fidelity system today.
IF YOU NOW HAVE ONE AMPLIFIER	**AS A SECOND POWER AMPLIFIER TO CONVERT TO STEREO.** If you have an amplifier now, just add a Leak power amplifier (and suitable preamp) and enjoy the realism, clarity and dimension which stereo promises but can only deliver through an amplifier of such quality.
IF YOU HAVE A STEREO (BINAURAL) TUNER	**AS A PAIR OF AMPLIFIERS FOR STEREO SIMULCAST.** Used in connection with your stereophonic tuner, Leak power amplifiers (with suitable preamp) deliver the full quality of stereo radio at its very best. Built around professional components, Leak amplifiers assure you outstanding performance for years.
IF YOU ARE INTERESTED IN STEREO TAPE	**FOR STEREO TAPE RECORDING AND PLAYBACK.** One Leak power amplifier now for single channel, another now or later for stereo. This is an excellent way to insure the performance which a fine tape recorder can give you. (You'll often find the preamp is already built into the tape recorder).
IF YOU ARE A PROFESSIONAL AUDIO ENGINEER	**FOR SIMULTANEOUS COMMERCIAL TRANSMISSION.** Since 1945, Leak amplifiers have been the choice of the BBC and other professional users all over the world. This preference for Leak engineering is as valid today for stereo use as it was when Harold Leak presented the first audio amplifier with 0.1% distortion.

The Leak line is surprisingly moderate in cost. Three Leak Power Amplifiers to choose from:
■ TL/12 Plus, 12-Watts, $89 ■ TL/25 Plus, 25-Watts, $109.50 ■ TL/50 Plus, 50-Watts, $149
and two Leak Preamplifiers:
■ "Point One Plus" $55 ■ "Varislope III" $79

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Arkay Stereo Dual Channel Control Center SP-6



The first and only unit of its kind! Precision engineered for all stereo needs—present and future. Completely self-powered, sensitive dual preamps with dual inputs and outputs; cathode followers. For use with stereo or monaural tape decks, phonos, tuners (incl. multiplex) etc. Exclusive engineering principles provide unparalleled flexibility, i.e. control compensates for amplifier differences, reverse position, hi, lo filters etc. 8 inputs, 4 outputs. Must be seen! $62.95
SAVE! Easy-to-build kit $39.95

Arkay Stereo Dual Channel Preamp 25 Watt Amp SA-25



Attached to your present power amp and presto!—you've got the finest stereo system. Channel 1—25 watt amp freq. resp. ±2 db @ 20 watts, 20-20,000 cycles; sens. tape phono —4mv for 20 watts; tuner aux—.3mv for 25 watts. Controls: volume, bass treble, lo and hi filters; equal for all labels plus NARTB tape head. Channel 2—same sensitivity. $89.95
SAVE! Easy-to-build kit $59.95

Arkay Stereo AM-FM Tuner ST-L1



Here's an exceptional, self-powered AC operated stereo-binaural tuner of unsurpassed sensitivity and flexibility of operation. May be used for simultaneous (stereo) AM and FM broadcasts or monaural FM or AM. Outputs of both sections independent, each containing dual cathode followers and level adjustment. Sens: FM—4 μv for 20 db quieting ½ db. 20-20,000 cps. AM—2 μv for 20 db/sn 20-8500 cps.; wide and narrow band AM. AFC etc. $74.50
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See and Hear LIVING SOUND STEREO by ARKAY

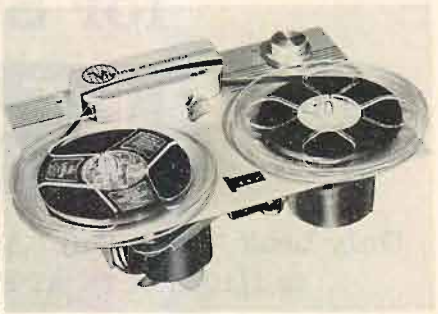
FREE! Reg. 35¢ Book "Let's Talk About STEREO"—available at your dealer's . . . yours for the asking. No obligation.

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arkay LEADERS IN AUDIO, TV & HI-FI EQUIPMENT

120 CEDAR STREET NEW YORK 6

● **Tape Recording Components.** Viking of Minneapolis, 9600 Aldrich Ave., South, Minneapolis, Minn., now offers a complete line of components for tape recording, making it possible for the recordist to custom-tailor his system to his own needs. Model 85 (pictured) is the finest home-type deck in the line, and features flutter-



filter belt drive, two motors, dual rotary control, footage counter, and space for five heads, which may be full-track, half-track, or four-track models, with combinations for erasing, record/playback, or playback only. A complete line of amplifiers for both monophonic and stereo recording are also available so that any type of system may be set up. **H-42**

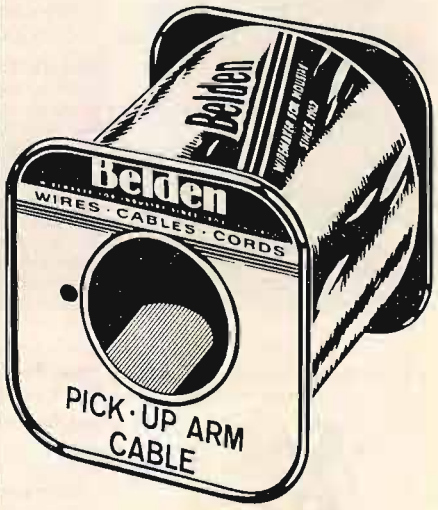
PHONO EQUIPMENT

● **Audax Stereo Pickup Arm Kit.** Serving the interest of economy as well as assuring top performance, the Audax arm has only two moving parts—the precision vertical and lateral pivots which assure the freedom of motion so necessary for play-



ing stereo records. A screwdriver is the only tool needed for assembly and time required is approximately 15 minutes. Wired to accommodate either stereo or monophonic cartridges, the Audak arm kit is available in both 12- and 16-in. models. Audax Division of Rek-O-Kut Company, Inc., 38-19 108th St., Corona 68, N.Y. **H-43**

● **Belden Stereo Tone Arm Cable.** Specifically designed for stereo systems, the new Belden No. 8430 cable has two 32-AWG copper conductors with 0.009-in. vinyl insulation, making it extremely



flexible, light weight, and small in diameter. Conductors are color-coded for easy identification. Available on 10-, 25-, and 250-ft. spools from all Belden distributors. Belden Manufacturing Company, Chicago 80, Ill. **H-44**

● **Garrard Model 4HF Deluxe Manual Record Player.** Fully wired for stereophonic and monophonic operation, this new Garrard model contains a 12-in. turntable complete with transcription-type tone-arm mounted on a single unit plate. Although modest in price, the 4HF affords most of the features usually expected in



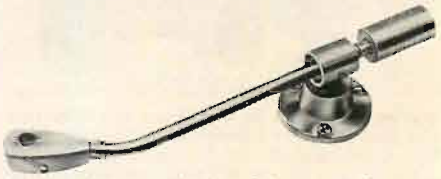
equipment considerably higher in cost. Variable speed adjustment is available on each of the four standard operating speeds. Automatic start-stop is built into the tone arm rest. A newly-designed center spindle housing is equipped with a pressure lubricating system. Handsome black, white and chrome styling. British Industries Corporation, Port Washington, N.Y. **H-45**

● **Pickering "Stereotable."** Engineered primarily to defeat the rumble problem in stereo record reproduction, the new Pickering Gyropoise 800 turn-table utilizes a form of magnetic suspension in place of conventional mechanical linkage. The



Stereotable is a single-speed machine—33⅓ rpm—and incorporates a built-in precision leveling adjustment. Vertical period of spring suspension is below 5 cps, and compound vertical rumble attenuation is 12 db/octave below resonance. Noise is 65 db below reference level, and speed accuracy is ± 2.0 per cent total variation. Pickering & Company, Inc., Plainview, N.Y. **H-46**

● **Rek-O-Kut Stereo-Monophonic Tone Arm.** Equipped with a die-cast aluminum cartridge shell designed to accommodate 3- and 4-terminal stereo cartridges, this new Rek-O-Kut arm incorporates a number of features which assure virtually



friction-free vertical and horizontal movement. Open-front design permits visual location of stylus in record groove. While mechanically a single unit, the arm is divided into two sections isolated acoustically from each other. Resonance varies from 12 to 15 cps, depending upon the cartridge employed. Rek-O-Kut Company, Inc., 38-19 108th St., Corona 68, N.Y. **H-47**

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NEW LITERATURE

• **Fairchild Recording Equipment Corporation,** 10-40 40th Ave., Long Island City 1, N. Y., has available a super-duper booklet titled "Stereo! . . . the easy way." Highly informative, the publication is entirely practical in nature and does a great deal to clear the air of confusion which exists on many aspects of the stereo field in general. Irrespective of your interest in stereo, you will find this booklet of definite value. Write for it. **H-1**

• **H. H. Scott, Inc.,** 111 Powdermill Road, Maynard, Mass., will mail free of charge a new brochure which gives full technical information on the Scott Stereo-Dapter, a device which updates a present component system for stereo records and tapes. With the Stereo-Dapter two separate amplifiers can be controlled from a central point. A master volume control permits adjusting the levels of both channels simultaneously. Requests for copies of the folder should be addressed to Dept. P. **H-2**

• **American Microphone Manufacturing Company,** 412 S. Wyman St., Rockford, Ill., has just issued a 16-page catalog which describes in detail the company's full product line. Included are microphones for tape recording, broadcast, public address, and general purposes, as well as handsets, phono cartridges and arms, mobile equipment, and accessories. The handsome two-color Catalog 58 is available free upon written request. **H-3**

• **Radio Products Sales, Inc.,** 1501 S. Hill St., Los Angeles, Calif., has just completed a new catalog for the high fidelity enthusiast and the commercal sound installer. Known as the "Sound Foyer Catalog," it contains 68 pages of detailed information about a wide range of hi-fi and commercial sound products. **H-4**

• **Pickering & Company, Inc.,** Sunnyside Blvd., Plainview, N. Y., has just published "It Takes Two to Stereo," a new booklet about the stereo record and how it works. Written by Walter O. Stanton, Pickering president, its twelve pages of interesting information tells the high-fidelity enthusiast what to expect and what to do to convert from monophonic music to stereo. Diagrams and drawings illustrate the differences between conventional and stereo records—how they are recorded and reproduecd. Offered free, your request for this excellent booklet should be directed to the attention of Dept. SB. **H-5**

• **Sylvania Electric Products Inc.,** 1740 Broadway, New York 19, N. Y., has recently published a new booklet entitled "Performance Tested Transistor Circuits." Intended primarily for hobbyists and students of electronics, the 60-page publication contains a variety of circuits plus information on how to build transistorized high-fidelity components, test equipment, light meters, and special equipment such as burglar alarms and metronomes. Copies of the booklet may be obtained by remitting 35 cents for each copy desired to Sylvania Electric Products Inc., 1100 Main St., Buffalo 9, N. Y.

• **S.O.S. Cinema Supply Corp.,** 602 W. 52nd St., New York 19, N. Y., has produced a 176-page illustrated catalog which covers practically all equipment for motion-picture and TV production. Designed as a reference for producers, TV stations, film laboratories, advertising agencies and all other users of professional motion-picture equipment, this 11th edition by S.O.S. is said to be the largest work of its kind ever attempted within the industry. Prices are plainly stated. This excellent reference work and buying guide is available free to members of the motion-picture and television industry. Requests for copies must be sent on company letterheads.



Weathers has done it again—with components engineered specifically for the finest reproduction of stereophonic sound. These components are the ultimate in quality, reliability, and economy.

2 Superb Stereo Cartridges*

The Weathers Ceramic Stereo Cartridge (shown) outperforms **any** magnetic cartridge. Tracks at 2 grams . . . shielded against hum . . . 25 db channel separation . . . 15 to 30,000 cps frequency response. Comes complete with leads and connectors to fit all standard mountings . . . with diamond stylus $17.50 . . . with sapphire stylus $9.75.

The Weathers FM Stereo Cartridge for the Weathers FM Pickup. Universally acknowledged to be the finest ever made. Gives you the ultimate in channel separation (up to 35 db) and 10 to 30,000 cps flat response. **Tracks at 1 gram** . . . never causes record wear. Prices on request.

*Play both monaural and stereophonic records without damage.

The Weathers Turntable and FM Pickup

The lightest, quietest, and smoothest turntable ever produced. Noise level is 25 db less than that recorded on today's finest records. Isolated against outside vibrations. Rumble and acoustic feedback are practically eliminated. Maintains constant speed regardless of variations in line voltage or load. The Weathers FM Pickup and Micro Touch Tonearm show absolutely no intermodulation or harmonic distortion and no resonances over the complete audio spectrum. Prices on request.

Compatible Speaker Systems

Shown above at left is the Weathers Decorator . . . at right the Fiesta . . . both ideal for stereo.

	Mahogany each	Blonde each
Decorator	$135.00	$139.00
Fiesta	$ 59.95	$ 62.50



See your dealer or write for booklet number 658A.

Weathers Industries, 66 E. Gloucester Pike, Barrington, N. J.
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★ Marantz Electronic Crossover, using two amplifiers, audibly improves most speaker systems. It adds the final touch of perfection to deluxe installations.

★ High fidelity systems at modest cost can be made to give high grade performance because of the inherent virtues of this mode of operation.



ELECTRONIC CROSSOVER $90
(Cabinet extra)
Prices slightly higher in West

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Circle 88A





irish
BRAND
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Available wherever quality tape is sold.
Circle 88B

STEREO RECORD RELEASES

WHILE THERE WAS some doubt in the minds of many whether or not there would be enough stereo records on the market to warrant converting the old monophonic system to stereo, it is now apparent that the dam is broken. We cannot guarantee this list to be complete, but within the realm of information we have been able to glean from the record manufacturers, the records listed below should be available now (a few September releases are also included). Not all companies are represented—after all, there are over 200 labels, and most of them will certainly enter the stereo field.

Stereo tapes have been around for so long by now that they have their own catalog, and sources are so well known that there doesn't seem to be much point in listing all of them —this would take pages.

But those who want to start a stereo record library now may count on these titles being available in record stores now, or certainly within a few weeks at most.

AUDIO FIDELITY

Mallet Magic	AFSD 1825
Johnny Puleo and His Harmonica Gang (Vol. 1)	AFSD 1830
Port Said Music of the Middle East	AFSD 1833
Bullring! La Fiesta Brava! (Vol. 4)	AFSD 1836
Railroad Sounds	AFSD 1843
Giant Wurlitzer (Vol. 3)	AFSD 1844
La Zambra Music of Spain	AFSD 1848
Lionel	AFSD 1849
Marching Along With the Phenomenal Dukes of Dixieland	AFSD 1851
Bagpipes and Drums	AFSD 1857
Music of the African Arab (*September*)	AFSD 1858
Johnny Puleo and His Harmonica Gang (Vol. 2) (*September*)	AFSD 1859
On Bourbon Street With the Phenomenal Dukes of Dixieland	AFSD 1860
Sutton Place South (*September*)	AFSD 1873
Al Hirt Swingin' Dixie	AFSD 1877
Molto Italiano! (*September*)	AFSD 1883

BEL CANTO

Plain Vanilla	SR-1001
Aloha To Jazz	SR-1002
Polka Time	SR-1003
More Bounce to the Ounce	SR-1004
Listening to Larry	SR-1005
Harry Marshard Plays Resort Favorites (45 rpm)	SR-1006
Almost Square, Little Bird	45-01
Bye Bye Blues, The Breeze	45-02
Plain Vanilla, Charleston Forever	45-03
Monkey Shines, Chicken Rag	45-04

COUNTERPOINT

Zabaleta	542
Smoky Mountain Ballads	545
Aldo Parisot plays Boccherini and Vivaldi Cello Concerti	555
Juanita Hall-Bloody Mary Sings the Blues	556
Sounds of Genius	558
Beethoven Octet	559
Follow the Drinking Gourd	560
Portrait of Pee Wee	562

DECCA

Mishel Piastro Conducts Great Piano Melodies	DL 78719
Band Masterpieces	DL 78633
Slaughter on Tenth Avenue	DL 78657
The Young Lions	DL 78719
Claude on a Cloud	DL 78722
Viva Flamenco!	DL 78736
Wayne King in Hi Fi	DL 78751
The Magic Islands	DL 79048
The Concert-Masters of New York	DL 79955
The Firebird Suite	DL 79978

ELEKTRA

Around the World in Stereo	SMP-4X
Tenderly	113-X
The New York Jazz Quartet Goes Native	118-X
The Jazz Messengers	120-X
The Original Trinidad Steel Band In Stereo	139-X
In The Glory Land	201-X
Gypsy Magic	202-X
Neue Deutschmeister Band	203-X

GRAND AWARD

The Roaring 20's	G.A. 201 S.D.
The Flirty 30's	G.A. 202 S.D.
Enoch Light & His Orchestra Play Waltzes for Dancing	G.A. 203 S.D.
Knuckles O'Toole and his Orchestra Play Honky Tonk Piano	G.A. 204 S.D.
Roman Spectacular	G.A. 205 S.D.
The All Star Alumni Orchestra (Tommy Dorsey Hits)	G.A. 206 S.D.
The All Star Alumni Orchestra (Glenn Miller Hits)	G.A. 207 S.D.
Paul Whiteman and his Orchestra Play Hawaiian Hits	G.A. 208 S.D.
Knuckles O'Toole Plays the Greatest All Time Ragtime Hits	G.A. 209 S.D.
Dancing Under The Stars	G.A. 210 S.D.
The Roaring 20's (Vol. 2)	G.A. 211 S.D.

HALLMARK

Peer Gynt Suite, Cappriccio Italiane	HLG-500
Symphony #5 in E Minor (Tchaikowsky)	HLG-501
Symphony #6 in B Minor (Tchaikowsky)	HLG-502
Symphony #2 (Beethoven)	HLG-503
Wagner Overtures	HLG-504
Mardi Gras and others	HLG-505
Schubert's Unfinished and Third Symphonies	HLG-506
Brahm's First Symphony	HLG-507
Tchaikowsky's Fourth Symphony	HLG-508
Slavic Moods	HLG-509
World Famous Overtures	HLG-510
Tone Poems, Etc.—	HLG-511

HIGH FIDELITY RECORDINGS

Genius of George Wright	R 713
My Fair Lady (George Wright)	R 715
Jazz 'n Razz Ma Tazz	R 805
Taboo	R 806

OMEGA

Champagne Music
Marx Makes Broadway
Destination Moon
Music For Heavenly Bodies

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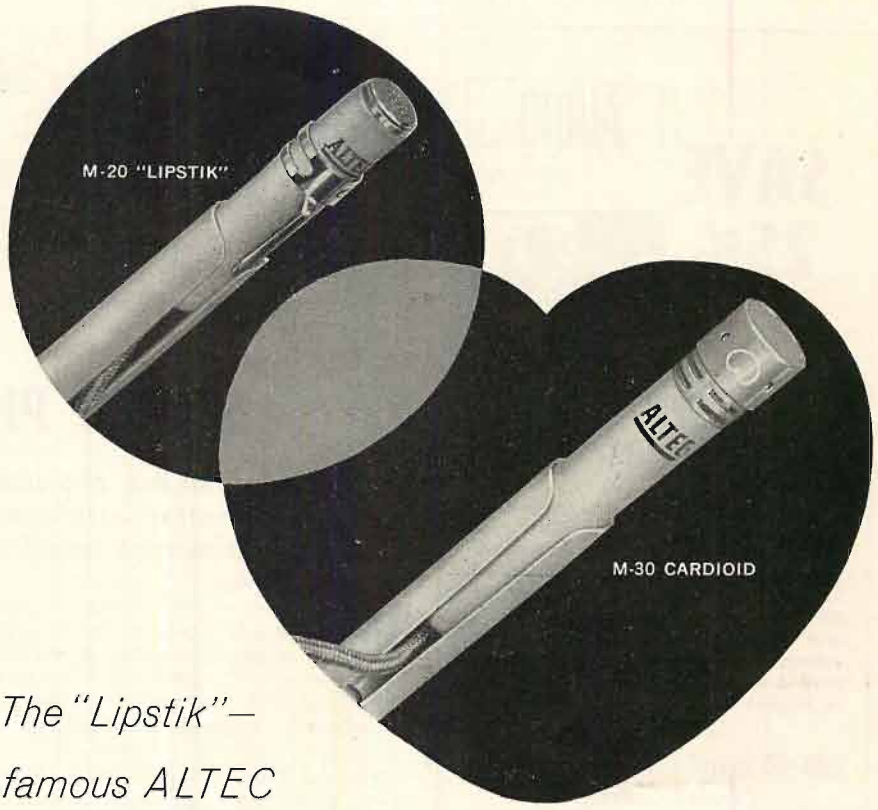
RCA VICTOR

Gaite Parisienne (Offenbach)	LSC-1817
Symphony No. 6 "Pathetique" (Tchaikowsky)	LSC-1901
Symphony No. 7 in A, Fidelio Overture, (Beethoven)	LSC-1991
The Nuteracker, Op. 71 (Excerpts) (Tchaikowsky)	LSC-2052
The Rite of Spring (Stravinsky)	LSC-2085
Hi-Fi Fiedler	LSC-2100
Serenade For Strings	LSC-2105
La Mer (Debussy)—Escales (Ibert)	LSC-2111
Vienna	LSC-2112
Violin Concerto in D, (Tchaikowsky)	LSC-2129
Symphony in D Minor (Franck)	LSC-2131
Lieutenant Kije, (Prokofieff) Song of The Nightingale (Stravinsky)	LSC-2150
The Sleeping Beauty (Excerpts) (Tchaikowsky)	LSC-2177
The Reiner Sound	LSC-2183
Billy The Kid—Rodeo (Copland)	LSC-2195
Pictures at an Exhibition (Moussorgsky-Ravel)	LSC-2201
Symphony No. 3, in F, (Brahms)	LSC-2209
Selections From The Desert Song	LSO-1000
Lena Horne At The Waldorf Astoria	LSO-1028
South Pacific	LSO-1032
Sketches By Skitch	LSP-1401
The Lass With The Delicate Air	LSP-1403
Party Night At Joe's	LSP-1476
Mucho Puente	LSP-1479
The Band Of The Coldstream Guards	LSP-1480
Sweet Seventeen	LSP-1487
Straight Down The Middle	LSP-1497
Around The World	LSP-1499
Lavalle In Hi-Fi	LSP-1516
The New Glenn Miller Orchestra In Hi-Fi	LSP-1522
Canadian Sunset	LSP-1529
The Things I Love In Hi-Fi	LSP-1543
Harry Belafonte Presents The Millard Thomas Group In Music And Songs Of The Caribbean	LSP-1551
Be Mine Tonight	LSP-1554
Ralph Flanagan In Hi-Fi	LSP-1555
Walter Schumann Presents The Voices	LSP-1558
A Touch Of The Blues	LSP-1566
Between 18th And 19th On Any Street	LSP-1567
On The Bandstand	LSP-1579
Coffee Break	LSP-1582
Have A Wonderful Weekend	LSP-1603
The Holy City	LSP-1637
Deep In A Drum	LSP-1645
From France With Music	LSP-1646
As Long As There's Music	LSP-1647
Let's Face The Music And Dance	LSP-1667
Cha Cha Pops	LSP-1671
Under Western Skies	LSP-1676
Something Old, New, Borrowed And Blue	LSP-1678
From My Heart	LSP-1679
Julie Andrews Sings	LSP-1681
Just You, Just Me	LSP-1682
Welcome To My Heart	LSP-1717
George Feyer Takes You To Rodgers And Hammerstein's "South Pacific" And "Oklahoma"	LSP-1731

VANGUARD

The Four Seasons (Vivaldi)	BGS-5001
Scheherazade (Rimsky-Korsakov)	SRV-103SD
"Eroica" Symphony (Beethoven)	VSD-2002

(Continued on page 99)



The "Lipstik"—

famous ALTEC

Condenser Microphone—has the perfect new mate

THE M-30 CARDIOID CONDENSER

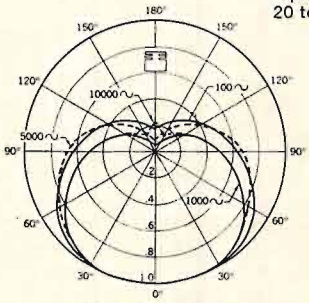
Now with the new ALTEC M-30, the smallest Cardioid Condenser microphone system in existence, you can fill both your directional and omnidirectional microphone needs with ALTEC "Lipstik" microphones.

The frequency range of the superb new M-30 Cardioid Condenser, mate to the famous M-20 "Lipstik," is from 20 to 20,000 cps with an outstanding smoothness typical of ALTEC condensers.

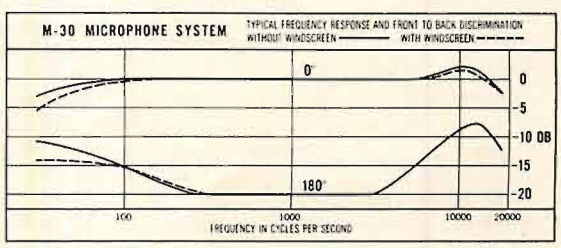
It has the same rugged construction, tiny size, and light weight of the famous "Lipstik." The Cardioid pattern of the new M-30 illustrates its high discrimination over a wide frequency range.

We invite critical judgment of both ALTEC'S M-20 "Lipstik" and M-30 Cardioid at your dealer's.

When you own both you have an unbeatable combination for all your omnidirectional and directional microphone needs.



POLAR CHARACTERISTIC
M-30 CARDIOID MICROPHONE



M-30 Cardioid Microphone System
ONLY $334.00 COMPLETE

Includes:

29A Microphone	$150.00
175A Base	$ 65.00
166A Stand Attachment	$ 7.00
169A Shock Mount	$ 12.00
525A Power Supply	$100.00

M-20 "Lipstik" Microphone System
ONLY $236.00 COMPLETE

M-30 SYSTEM SPECIFICATIONS:

29A Microphone
Type: Condenser
Directivity: Cardioid
Freq. Range: 20 to 20,000 cps
Hum: Not susceptible to magnetic fields
Capacitance: 50 mmf
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SYSTEM OUTPUT LEVEL FROM 525A POWER SUPPLY:

Unbalanced:
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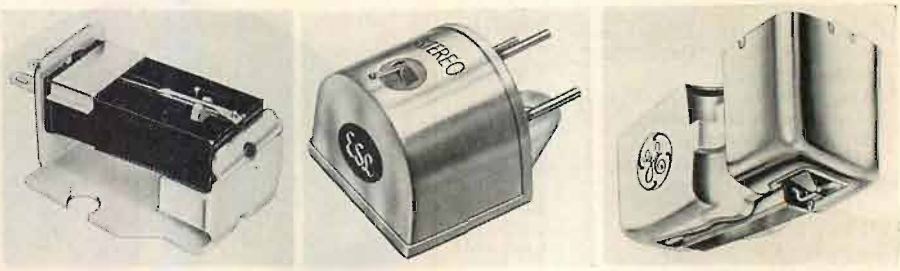
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Left to right: Electro-Voice 21-D, ESL C-100, General Electric, GC5.

STEREO PICKUP REVIEW

Description and characteristics of most of the stereo pickups so far introduced on the U.S. market, together with comparative output signals for a standard test record.

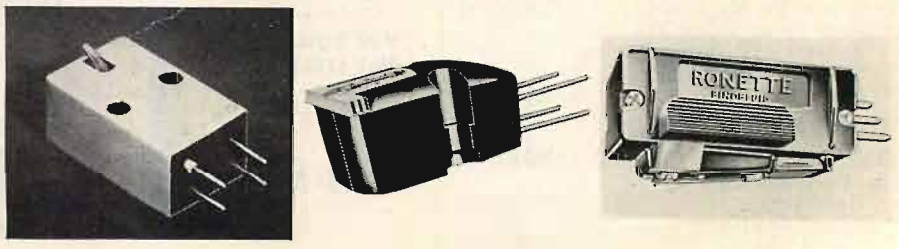
WITH MOST of the pickup manufacturers now ready to deliver stereo cartridges, a roundup of the characteristics may be of interest to the audiofan. Were the various units to be described in separate paragraphs, each separate description would sound almost like every other one. The chart on the opposite page gives most of the important information about the different models. Manufacturers' statements about frequency response are all reasonably similar, and channel separation at 1000 cps is usually stated as "over 20 db," except in the case of the ceramics in which channel separation is listed as being somewhat higher—usually in the range from 23 to 28 db, the latter figure being that of the Ronette.

All magnetic models—including variable reluctance, moving coil, and moving iron—are velocity sensitive, and consequently require the use of an equalized preamp for each channel, with equalization being that normally used with pickups of this type. The ceramic models have adequate output to work directly into the usual high-level inputs of an amplifier, although in most instances the impedance of the common high-level inputs is of the order of 500 K ohms, which is likely to attenuate low bass response. When working into stated load impedances, the ceramics should work into a flat amplifier, since they are so designed that the normal output *vs.* frequency curve is the complement of the RIAA curve. Thus a complete stereo amplifier need have no more than two high-gain stages.

Note that some cartridges have four terminals and others have only three. For all stereo uses, one side of each winding will be connected to ground, with the "hot" sides feeding the two channels. Thus, only three terminals are *required* for normal stereo operation, and for playing of monophonic records through a stereo system. The purist, however, may want to change the polarity of the coil connections and work the two coils in series for monophonic reproduction. With the two coils in series, either the vertical or the lateral component will cancel out, depending on the polarities of the coils. Thus a simple reversing switch on one of the coils will cause the pickup to reproduce either vertical or lateral records. For general use in the average home system, however, three terminals are adequate. When two completely separate amplifiers are used for the stereo system, the separate-coil connection may be some help in avoiding ground loops, as well as in phasing the two channels.

The inductance or capacitance of the generating elements is given, together with the resistance of the coils (where applicable), and the impedances given are calculated from the reactive and resistive components. The values given for compliance are those of the manufacturer, as are figures for dynamic mass, recommended stylus force, stylus radius, and recommended load resistance.

Values given for MEASURED OUTPUT are those actually measured from the outer groove (1000 cps, 78 rpm) of the Westrex 1A test record, which is modulated only on the left channel on one side, and only on the right channel on the other, with a stylus velocity of 5 cm/sec. We have not had an opportunity to make measurements on those pickups for which no output figures are given, but it is believed that those we have measured are more accurate for comparison purposes than published specifications, since all were measured under identical conditions and with the same record.



Left to right: Grado Stereo, Pickering 371, Ronette M3D.

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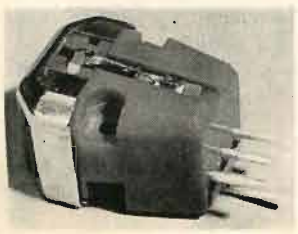
Left to right—Stereotwin 200, Shure M3D, Sonotone 8T4

PICKUP SPECIFICATION CHART

MAKE	Model	Type	Terms.	Ind/Cap	Res.	Imp. 1000~	Compliance	Dyn. Mass	Rec'd Sty. Force	Stylus radius	Rec'd Load Res.	Measured Output	Code
					ohms	ohms	cm/dyne	mg.	grams	mils	ohms		
ASTATIC	13TB [1]	ceramic	4	370 μμf		440 K	2×10^{-6}		5-7	0.7	2.0 meg		H-48
CBS	SC-1	ceramic	3	550 μμf		290 K	2×10^{-6}		5-7	0.8	1.2 meg [2]	0.43 V.	H-49
ESL	C-100 [3]	moving coil	3	app. 1 mh	21	25	5×10^{-6}	3	2-4	0.7	47,000	4.6 mv [4]	H-50
ELECTRO-VOICE	21-D [5]	ceramic	3	500 μμf		320 K	2×10^{-6}		6	0.7	5.0 meg	0.47 V.	H-51
FAIRCHILD	XP-4 [6]	moving coil	4	3.0 mh	600	600			4	0.7		2.9 mv	H-52
G.E.	GC-5 [7]	variable reluct.					4×10^{-6} L 2.5×10^{-6} V	2	2-4	0.5			H-53
GRADO	Stereo	moving coil	4			600	8×10^{-6} [8]	1.8	2	0.7	> 5000		H-54
PICKERING	371 [10]	variable reluct.	4	600 mh	3000	4800			3-6	0.7	27-47 K	4.0 mv	H-55
RONETTE	BF-40 [11]	ceramic	3 [11]				3.5×10^{-6}		4-8		2.0 meg	0.54 V.	H-56
SCOTT [12]						4000	3.5×10^{-6}	1	3.5	0.5	47,000		H-57
SHURE	M3D	moving magnet	4	350 mh	400	2150	4×10^{-6}		3-5	0.7	50,000	4.8 mv	H-58
SONOTONE	8T4 [13]	ceramic	4	590 μμf		270 K	2×10^{-6}		5-7	0.7	1-5 meg		H-59
STEREOTWIN	200	moving magnet	3	220 mh	600	1700	4×10^{-6}		4-6	0.7	47,000	8.0 mv	H-60
TANNOY	Vari-twin	variable reluct.							3-4	0.7			H-61
WEATHERS		ceramic							2	0.7			H-62

NOTES

[1] Several models available, some turnover types with .003-mil standard stylus.
[2] Recommended minimum load for normal low-frequency response.
[3] Professional model also available in integral arm mounting.
[4] Measured with transformer type TM-100.
[5] Several types available—turnover, Power point, and with diamond and sapphire styli.
[6] Experimental type; production model is 232.
[7] GC-7 is cartridge type intended for changer use; has 0.7-mil stylus.
[8] Compliance depends on stylus force.
[10] Model 196 also available integrated with Unipoise arm.
[11] Several models available—turnover, single, and with diamond or sapphire styli.
[12] Pickup and arm integral; intended for turntable use. Imported unit, built by London.
[13] Several models available—turnover, single, and with diamond or sapphire styli.



Left, Tannoy Varitwin

Right, Weathers ceramic.



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STEREO Q & A

(*from page 20*)

WQXR, as an illustration, is separated by 40,000 cps from the adjacent channel station on each side of it. There is the one prohibition in the F.C.C. rules—if interference to another station is caused, then the AM station may have to limit its modulating frequency to correct the interference.

3. Don't limiting amplifiers at your transmitters affect your stereo balance?

We have not found this to be the case. Practically all radio stations, both AM and FM, use limiting amplifiers in their chain of transmitting equipment. A limiting amplifier can be used as a protective device, or to lay down a stronger audio signal, or as a combination of both of these objects. Properly adjusted and used primarily as protective devices (to prevent overmodulation), the presence of limiting amplifiers in the circuit will not be detected.

4. Is WQXR-FM going to broadcast multiplex stereo?

The answer to this question is, "possibly." Every FM broadcaster today knows he is faced with making a decision on FM multiplex. Some FM stations primarily concerned with non-broadcast services are already engaged in multiplex transmission. This is being done under the F.C.C.'s Subsidiary Communications Authorization (SCA) which limits their subcarrier emission to non-broadcast functions. This automatically eliminates stereo broadcasting.

A petition was placed before the F.C.C. in April of this year to initiate rule making to permit stereo broadcasting using FM multiplex. If adopted, this proposal would permit stereo with one subcarrier using the sum-and-difference method. This system has a number of advantages. But all multiplexing has the one disadvantage of requiring a reduction in the audio level on the main carrier. This reduction ranges as high as 6 db (a 50 per cent reduction in audio level) which, to our way of thinking, is a degradation of existing FM service. It is quite possible that the advantage may outweigh the disadvantage.

These are the problems currently under consideration. Until they are resolved, WQXR plans to continue its AM-FM stereo.

5. What does the "multiplex" jack on my FM tuner mean?

This "multiplex" jack means that, if an FM station broadcasts on multiplex, and you attach to that jack an adaptor, along with a preamplifier, an amplifier, and a loudspeaker, you'll be able to receive the multiplex sub-carrier along with the main carrier of the FM station.

We think it is a shame that this "multiplex" jack, while perhaps not being misrepresented, is not being fully explained. Those we have seen so far do nothing more than tap the innards of the FM tuner (remember the "television" jack on the older radio sets?). Æ

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SUPPRESSION CONTROL

(*from page 23*)

must be short. In amplifiers with tape-monitor switches, there is generally a tape-recording output with cathode follower, in which case any audio cable will do, and length is not nearly as critical; take off from the tape output, and return to the monitor input. Leave the monitor switches on "monitor" position.

There is a temptation to use microphone cable with two wires inside a common shield in stereo work. At high impedances, this may cause channel leakage, and should be avoided.

Installation in Stereo Amps or Preamps

Those who are fortunate enough to own a good modern stereophonic amplifier or preamp will find all kinds of controls to facilitate stereo operation, but no VSSC. In one of our pet installations, we were able to modify the excellent Pilot SM-244 Stereo Control Amplifier without marring its appearance *or* jerry-rigging an outboard control, since the a.c. power switch is a separate knob without any other control included. We removed this switch, and replaced it with two ganged pots with an a.c. switch attached. With the power on, and the control in the minimum position, there is no stereo suppression. In the maximum clockwise position, the two stereo channels are completely fused for monaural record playing.

Other brands of stereo amps and preamps will lend themselves to this sort of modification with a little thought and ingenuity. At worst, it will be necessary to provide a control somewhere away from the panel; we found that as long as shielded line is used, it is not necessary to shield the control itself. Æ

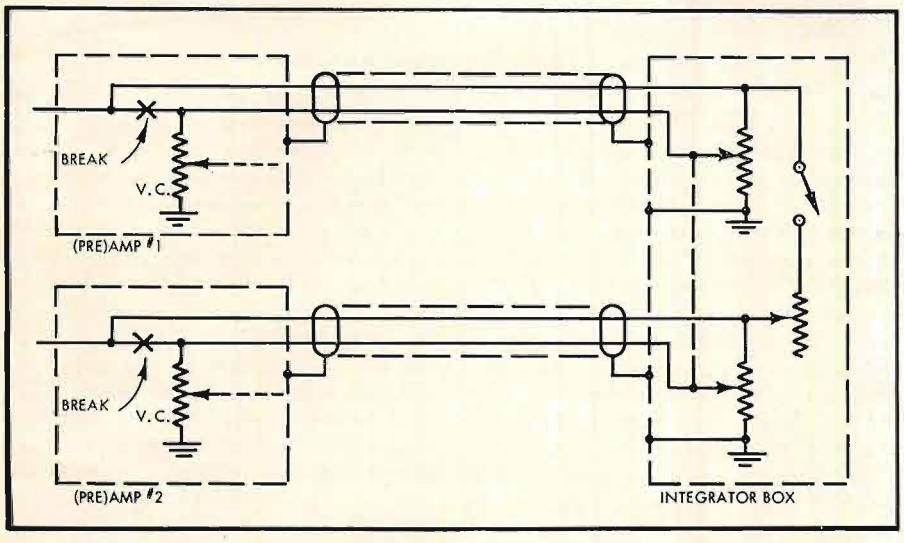


Fig. 4. Simple outboard integrator box, including two volume controls ganged together and a simple variable-stereo-suppression control. Although not shown here, a channel-switching system would be appropriate in this addition.

STEREO DISC PLAYBACK

(*from page 36*)

full potentialities the playback equipment should be designed using good engineering practices. Because the stereophonic pickups have an added degree of sensitivity they are likely to pick up about 3 db more rumble than the monophonic pickups; therefore high-quality turntables and changers should be specified. The vertical sensitivity of the pickup tends to accentuate the possibility of feedback, and therefore, the cabinet should be well constructed and the turntable and the pickup mount should be well isolated from the loudspeaker. Suppression of low-frequency vertical response is often a practical solution for stubborn rumble or feedback problems encountered with moderately priced equipment.

The stereophonic pickup should have a smooth, peak-free response—not an easy task when using 0.5- to 0.7-mil stylii—to avoid accentuating its natural tendency to reproduce 3 db more surface noise than a monophonic pickup. The loudspeaker should have an equally smooth response. The reward for these simple precautions will be an unsurpassed new experience in sound reproduction. Æ

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Although official tracking and recording stations have been set up at many points around the globe, there aren't enough of them to cover every point on each satellite's orbit. So, amateur recordings from widely scattered locations throughout the country could very well pick up information available from no other source.

With a few simple modifications, you can adapt your home FM receiver or communications receiver to bring in the signals from the Explorer and Vanguard satellites. What's more, by recording them at a high tape speed, you can actually understand much of what the satellites are saying!

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HIGH-QUALITY CARTRIDGE

(*from page 32*)

An example of interesting detail is the bend in the metal at the foot of the stylus arm, placing the stylus in proper playing position. This bend must be reinforced in some way since its unavoidable direction would otherwise result in a flexing of the stylus arm itself. This would be undesirable both because some stylus motion would be absorbed rather than transmitted, and because continuous flexing of this sort would cause failure of the piece, with the high accelerations involved. It would be possible to reinforce this by drawing (forming) to a complex shape, but fortunately modern materials make such complication as unnecessary as it is undesirable. A small drop of a special hard-setting epoxy cement is applied to the bend. The weight of this material is very small and its strength tremendous. Because of surface tension action a drop of the right size applied to this area will take a shape closely approximating the optimum strength-to-mass ratio and after it has set, the result is an extremely light and rigid piece.

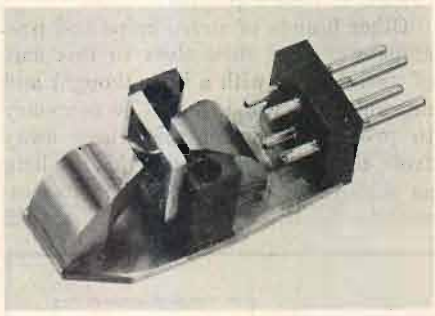


Fig. 7. Assembly of pickup to show magnet structure.

Another important part of such a cartridge is the magnetic structure. It is necessary to have the greatest possible field strength and uniformity, and yet size and weight must be kept down since it is not desirable to have the total cartridge weight too high if it is to operate satisfactorily in a majority of arms. The magnets are arranged as shown in *Figs.* 2 and 7, and it will be seen that the return path for the flux, or the "yoke" is actually the base of the cartridge. This construction was dictated by practical considerations, and the cartridge base is therefore made of a piece of Hyperco 35 magnetic alloy. The reluctance of this material and its saturation characteristics are such that full advantage can be taken of the magnetomotive force supplied by the magnets, which are of Alnico V.

To keep stray fields and reluctance to a minimum, the magnets are ground extremely flat for as perfect a fit to the flat plate as possible. They are then assembled in a jig which applies tremendous pressure, bringing them into intimate contact with the plate. This pressure forces the bonding cement out of the space between the magnet and the yoke except for whatever tiny depressions are left due to the graininess of the material, which thus becomes filled with cement instead of air. In this way, the greatest possible field is developed in the gap where the coil assembly is mounted.

After this assembly is complete it must be magnetized, which is done by means of a capacitor-discharge type of magnetizer. The assembly is placed between the poles of the magnetizer, with a brass piece separating the poles in such a way that the flux is required to travel through the proper path to energize the magnets. This flux density is so great that it would much more than saturate the yoke, or the base plate. Hence, while the charging is going on, the base plate is magnetically by-passed by putting a piece of soft iron in parallel with it, and in this way the magnets are given the greatest possible energization.

Final Assembly

After the coil assemblies and the bases have been completed—including the magnetic assembly and pin blocks for the terminals—final assembly can begin. The coil structure is mounted to the base and the lead wires are soldered to the pin terminals. The cartridge is then ready for final performance tests and inspection. It may be interesting to note that in stereo cartridges the phasing of the windings is important, and hence the coils are color coded when wound. They must be connected to the pins in proper sequence or the correct stereo relationship will not be preserved. Four terminals are used instead of three, for although two of these are ground terminals, four leads give additional flexibility, and in some circumstances it may be desirable to have the two input circuits electrically independent. This is especially so where two preamplifiers not specifically designed to be used together are used for stereo.

Final testing involves not only the usual tests for tracking ability, frequency response, wave shape and distortion, but also special checks on interchannel separation and other requirements peculiar to two-channel pickups. Frequent listening tests are also used, because this recording medium is so new that only by actual check of new releases can it be assured that the pickup will work in practice as it is known to work in laboratory tests.

Such are the problems associated with the design and manufacture of a quality phonograph pickup. There are many details of manufacture which space does not permit discussing, but the foregoing

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may give the reader a little better insight into the types of problems which must be solved and also, perhaps, what he is paying for when he buys phonograph pickups. As everyone knows, diamonds are expensive. The reader now knows that wire may be expensive also. But the most important commodity his money buys is neither diamonds nor wire, but rather a proportionate part of engineering skill and production experience for which there is no substitute if the ultimate in listening fidelity is to be obtained. Æ

TRANSLATOR

(*from page 25*)

position of the FUNCTION switch that provides a true sum—R + L—output to both output channels.

If the input is from an R – L source, matrixing will provide R + L in the left channel and FUNCTION switch position 2 will provide the desired mixture. If the input is from an S – D source, the S input may be fed straight through to both channels by setting the FUNCTION switch to position 7. The BALANCE control may be used to control mixing proportions when L and R inputs are used.

The true vertical component of a conventional lateral recording can be obtained by matrixing the output of a 45/45 pickup. FUNCTION switch position 2 will provide lateral output only with the LEFT CHANNEL PHASE switch in one position and vertical output only with the switch in the other position.

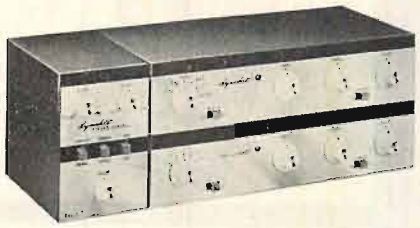
The full capability of the translator, working with various possible combinations of input signals, is summarized in Tables 1, 2, and 3.

Thus, in one easily built, compact unit, complete flexibility of stereo control is available. This equipment may be used for any matrixing operation in recording or playback operations. For example, the standard Western Electric 9A vertical/lateral reproducer[3] may be used for playback of 45/45 recordings; mid-side microphone outputs may be converted to left-right signals, and 0/90 recordings—such as described and demonstrated by London—may be played with a 45/45 pickup. The ability to make such conversions assures that any equipment bought today will remain useful, no matter what may develop in the progress of vertical/lateral *vs.* 45/45 recordings, even though the 45/45 is the accepted standard. Æ

[3] Henning, "Universal phonograph reproducer," AUDIO, March, 1958.

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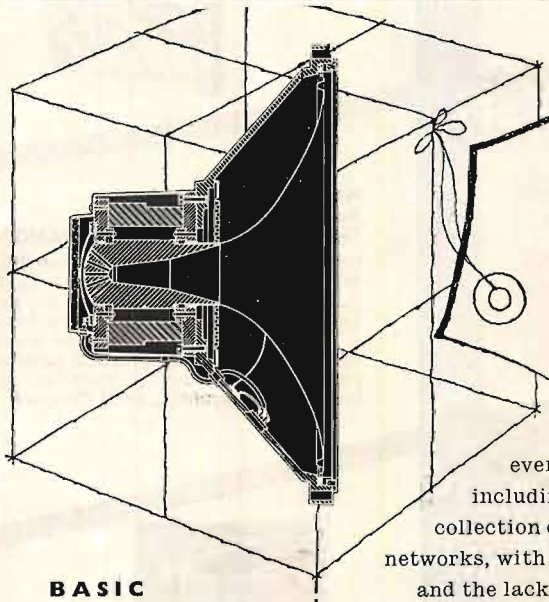
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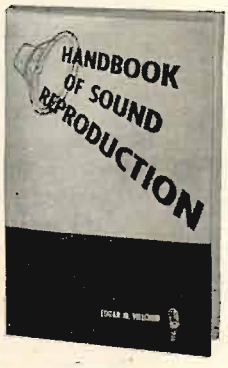
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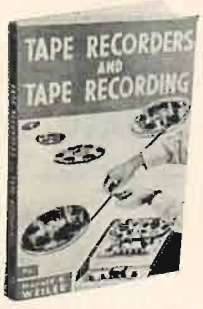
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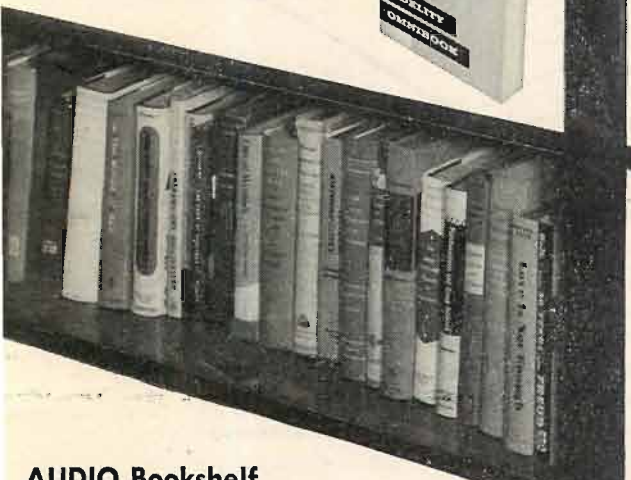
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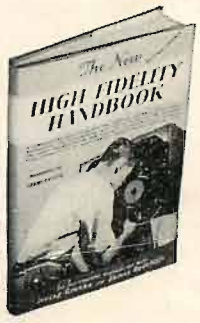
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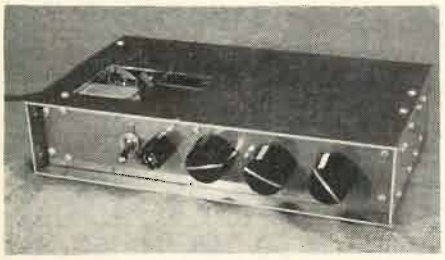
MULTIPLEX CONVERTER

(*from page 22*)

translator in areas where both very strong and weak signals are present.

Advantages of Multivibrator Detector

The use of the multivibrator as an FM detector has several advantages here. The automatic squelch or muting feature has already been mentioned. Since it is a triggered device it can be used with a single limiter to provide the advantages



"Prettied up" model of the experimental translator. The third knob is an input attenuator.

of several additional stages of limiting. Being coupled to the limiter by a circuit which strongly differentiates the "clipped" carrier, it responds only to zero-crossings of the signal. If some care is taken to provide symmetric limiting the multivibrator is an extremely linear detector. Any pulse-counting detector is linear but with its added limiter effect the multivibrator has the advantage. It is an extremely wide-band device and performs satisfactorily over the frequency range of 20 to 80 kc without need of changing time constants. Its output impedance is on the order of 10,000 ohms and resonable lengths of shielded cable can be used without seriously affecting the audio response. For this reason a cathode follower output has been omitted. The .001-μf capacitor shunting the output materially reduces the subcarrier component present in the output although it does not eliminate it completely. In most cases this residue ultrasonic signal has no effect since the audio amplifier either cannot respond to it or else removes it in the tone-control circuits. In one case an audio amplifier was encountered which, because of poor design, resonated at 35 kc. The residual subcarrier component was sufficient to cause noticeable distortion. The situation was remedied by the use of a two-section low-pass filter tuned to 15 kc to remove the last trace of the subcarrier in the output.

Operation at Low Subcarrier Frequencies

Two problems may arise in operating the translator at 34 kc which are not present for the other two subchannels and are due to its proximity to the audio range. In some cases, where the signal is very strong, the first triode will be over-driven by components of the main channel near 17 kc and the second harmonic falls into the 34-kc subchannel. This is easily remedied by increasing the value of the input resistor. The second difficulty is that as a result of striving for the high audio frequencies some hash may appear in the output due to some residual subcarrier which is not completely removed by the .001-μf capacitor shunting the output. The .001-μf value was chosen to allow widest frequency response and is satisfactory for 41 and 67 kc subcarriers. If a slight degradation of the highs can be tolerated, this capacitance can be replaced by one of .005 μf. The standards for broadcasting stereo have not yet been frozen so the pre-emphasis is not settled. In case 75 μsec. is chosen, a .003- or .004-μf capacitor should be used.

A word regarding fidelity is in order here. These circuits are designed with time constants commensurate with the highest frequency range the broadcasters



Translator used with typical small FM receiver.

plan to transmit in the future. However, very few of them are actually transmitting such high fidelity now. As a matter of fact some are inadvertently transmitting excess noise at the higher audio frequencies. For the time being, until the stations begin to do a better job on the highs, it is suggested that the high-frequency response of the audio output of the translator be limited by shunting it with the higher capacitance. The background music is usually limited to 6 or 7 kc and response to higher frequencies only detracts by unnecessarily introducing noise. In this case a .005- or .007-μf capacitor will reduce the noise without deteriorating the quality of the program material. For use with candle-

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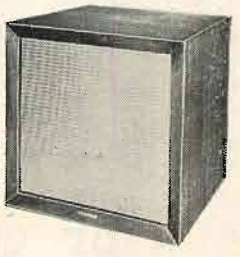


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light, one might even wish to go to .01 μf.

Performance Data

Several multiplex translators constructed by the author have been in use for two years in the New York area with very good results. One of these employed elaborate amplifiers of the band-pass type and many stages of amplitude limiting. It may have performed slightly better than the circuit shown here but the margin, when perceptible, was very small. It should also be pointed out that the FM receiver itself limits to some extent the over-all performance of the system. The newer receivers with broad-band detectors are decidely superior in this respect. Often the limitation on performance in the past has turned out to be at the transmitter. This situation is rapidly improving with the new transmitting equipment being noticeably better. At any rate, the circuit shown here has performed satisfactorily in all cases and is considerably easier to construct. The high- and low-pass filters which have been used provide the broad bands with sharp sides very easily while band-pass filters are necessarily elaborate and difficult to line up.

There have been many cases where listeners have complained that the multiplexed "canned-music" is getting into the main channel and interfering with the hi-fi program. It's true there were some cases in the beginning where the fault was at the station but in the majority of cases the difficulty has turned out to be at the receiver. The most likely cause is the improper alignment of the FM receiver itself. Any, but any, receiver can get out of alignment and some times it is a knock-down-drag-out battle to get the audiofan to even consider the possibility that his own $167.95 Jerkwood could be the culprit. Sometimes, as mentioned above, it even turns out to be the fault of the audio amplifier.

A complaint received by one station read "How do I keep that multiplex out of my soprano?" It will be interesting, after this article, to observe the reaction of the broadcasters when the listeners begin to ask them, "How do I keep that excited soprano out of my multiplex?"

Æ

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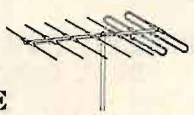
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Industry People...

John H. Cashman, founder and former president of The Radio Craftsmen, Inc., and pioneer electronics executive, died at his home in Chicago on July 10 after a heart seizure. Many of us remember him so well, and his passing saddens us all.

Maynard H. Patterson, Robert W. Mueller and **Lyle H. Fisher,** all officers of Minnesota Mining & Manufacturing Company, Inc., have been elevated to vice-presidencies. **Harold P. Larsen,** office manager since 1954, has been named assistant treasurer . . . **William P. Gallagher** succeeds **Hal Cook** as director of sales for Columbia Records, Inc. Mr. Cook has joined Warner Brothers Record Corporation as vice-president in charge of sales and marketing . . . **Marty Bettan** has been appointed manufacturer's rep by the Magnecord division of Midwestern Instruments, Inc., to cover New York and northern New Jersey.

John B. Anthony has been named general sales manager of R. T. Bozak Sales Company. Bozak also has appointed **Harry Miller** as sales rep to cover the Mid-Atlantic states . . . **Harold D. Weiler,** hi-fi author and New York manufacturers representative, planning to expand the latter activity to include Philadelphia, Baltimore, and Washington. Æ

STEREO RECORDS

(from page 89)

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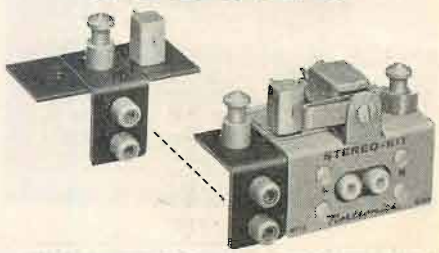
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STEP ONE

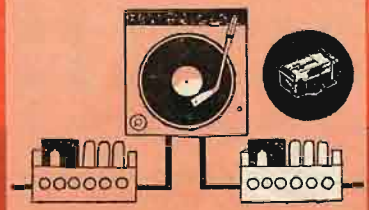
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MODEL 21MD—Stereo with .7-mil Diamond Stylus, Net $19.50

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STEP TWO



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smallest folded-horn corner enclosure for best musical balance and response range: phenomonal bass range; extended two full octaves. Matches the Coronet and other comparable speaker systems. With SP8B, Net **$74.50**, or BARONET III with SP8B and T35B VHF driver, Net **$111.50**

OR

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popular folded-horn corner enclosure . . . compact, economical . . . delivers most extended bass range for its size. With SP12B, Net **$107.00**; with 3-way 12TRXB, Net **$138**

OR

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OR



Add-on E-V EMPIRE*...
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OR

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Just 300 years ago, in 1658, Richard Frank penned in his memoirs . . ."Art imitates nature—and necessity is the mother of invention." Today, in 1958, this parable has become a reality, for art has truly imitated nature with the development of the remarkable stereophonic phonograph record . . . and Pickering & Company has, of *necessity* invented the "Gyropoise 800" *airborne* Stereotable, *specifically* for the stereo record.

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The Gyropoise is an exclusive invention of Pickering & Company, Inc. Patents are pending, and all rights are reserved.

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